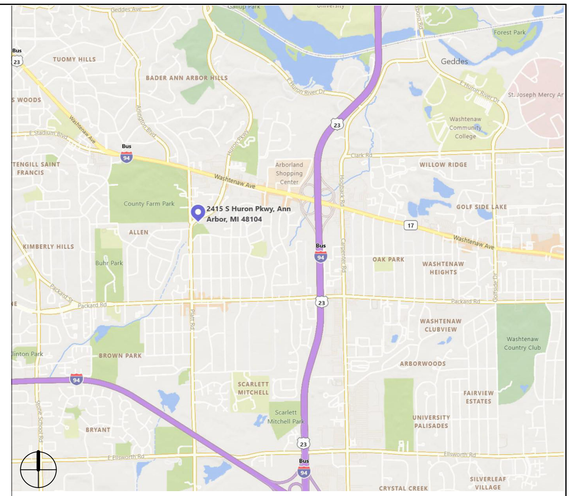
ANN ARBOR FIRE STATION #4

2415 S. Huron Pkwy, Ann Arbor, Michigan 48104



VICINITY MAP

City of Ann Arbor Fire Department

Owner
111 North Fifth Ave.
Ann Arbor, MI 48104-1405
Mike Kennedy - Fire Chief
mkennedy@ay2gov.org

PEA Group

Civil Engineer
7927 Nemco Way, Suite 115
Brightin, MI 48116
Jonathan Curry, PE
jcurry@peagroup.com

Silman

Structural Engineer
211 N. Fourth Ave, Suite 2A
Ann Arbor, MI 48104
Kristina Hensel, PE
kristina.hensel@silman.com

A3C Collaborative Architecture

Architect - Project Number: 21018
115 1/2 East Liberty St.
Ann Arbor, MI 48104
Don Barry
dbarry@a3c.com

InSite Design Studio, Inc

Landscape Architect
412 Longshore Dr.
Ann Arbor, MI 48105
Shannan Gibb-Randall
sgibb-randall@insite-studio.com

Peter Basso Associates

MEP Engineers
5145 Livernois, Suite 100
Troy, MI 48098
David Conrad, PE
dconrad@pbanet.com

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TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23
Design Development	05/26/23
Site Plan Approval	09/22/22

Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

TITLE SHEET

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet G0.01

DRAWING INDEX KEY:

ISSUED FOR REFERENCE ONLY ○
ISSUED FOR REVIEW ◑
ISSUED FOR BID/PERMIT ●

SHEET #	SHEET NAME	Site Plan Approval 09/22/22	Design Development 05/26/23	Bids/Permits 08/04/23	Bids/Permits 10/11/24
1. GENERAL					
G0.01	TITLE SHEET	◑	◑	●	●
G0.02	SHEET INDEX	◑	◑	●	●
G0.03	SUMMARY SHEET		◑	●	●
G0.04	WALL PARTITION TYPES			●	●
G0.10	CODE COMPLIANCE		◑	●	●
G0.11	CODE COMPLIANCE PLAN		◑	●	●
2. CIVIL					
C-1.0	TOPOGRAPHIC SURVEY	◑		●	●
C-1.1	TOPOGRAPHIC SURVEY	◑		●	●
C-1.2	TOPOGRAPHIC SURVEY	◑		●	●
C-1.3	ALTA/ASCM LAND TITLE SURVEY	◑		●	●
C-1.4	ALTA/ASCM LAND TITLE SURVEY	◑		●	●
C-1.5	SOIL BORING INFORMATION PLAN	◑		●	●
C-2.0	DEMOLITION PLAN	-		●	●
C-3.0	OVERALL DIMENSIONAL LAYOUT PLAN	◑		●	●
C-3.1	TURNING MOVEMENTS & SIGHT TRIANGLES	◑		●	●
C-4.0	GRADING PLAN	◑		●	●
C-5.0	SOIL EROSION & SEDIMENTATION CONTROL PLAN	◑		●	●
C-6.0	UTILITY PLAN	◑		●	●
C-6.1	SANITARY SEWER AND WATER MAIN PLAN & PROFILE	◑		●	●
C-6.2	STORM WATER PROFILES			●	
C-7.0	DRAINAGE PLAN	-		●	●
C-7.1	STORM WATER PROFILES	◑		●	●
C-7.2	STORM WATER DRAINAGE AREAS AND CALCULATIONS	◑		●	●
C-7.3	WCWRC WORKSHEET-FIRE STATION SIDE	◑		●	●
C-7.4	WCWRC WORKSEEETS - BASKETBALL COURT SIDE			●	●
C-7.5	STORM WATER DETENTION OUTLET CALCULATIONS			●	
C-8.0	NOTES	-		●	●
C-8.1	SESC NOTES & DETAILS	◑		●	●
C-8.2	DETAILS	◑		●	●
C-8.3	ADS DETENTION SYSTEM DETAILS	◑		●	●
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L.02	NATURAL FEATURES OVERLAY PLAN	◑		●	●
L.03	NATURAL FEATURES TREE INFORMATION	◑		●	●
L.04	OVERALL LANDSCAPE, TREE, SHRUB, AND SEEDING PLAN	◑		●	●
L.05	LANDSCAPE PLAN FIRE STATION AREA	◑		●	●
L.06	LANDSCAPE PLAN BASKETBALL AREA	◑		●	●
L.07	LANDSCAPE DETAILS			●	●
4. ARCHITECTURE					
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A2.12	SECOND LEVEL FLOOR PLAN	◑	◑	●	●
A2.13	ROOF PLAN		◑	●	●
A2.21	DOOR SCHEDULE, DOOR & FRAME TYPES		◑	●	●
A2.22	INTERIOR DOOR & WINDOW DETAILS			●	●
A2.41	INTERIOR FINISH SCHEDULE & KEY		◑	●	●
A2.42	FINISH PLANS				●
A3.11	EXTERIOR ELEVATIONS	-	◑	●	●
A3.12	EXTERIOR ELEVATIONS	◑	◑	●	●
A3.13	EXTERIOR ELEVATIONS	◑	◑	●	●
A3.21	BUILDING SECTIONS		◑	●	●
A3.22	BUILDING SECTIONS		◑	●	●
A3.23	BUILDING SECTIONS		◑	●	●
A3.31	WALL SECTIONS		◑	●	●
A3.32	WALL SECTIONS		◑	●	●
A3.33	WALL SECTIONS		◑	●	●
A3.34	WALL SECTIONS		◑	●	●
A3.35	WALL SECTIONS		◑	●	●
A3.36	WALL SECTIONS		◑	●	●
A3.37	WALL SECTIONS			●	●
A3.41	EXTERIOR DETAILS			●	●
A3.42	EXTERIOR DETAILS			●	●
A3.43	EXTERIOR DETAILS			●	●
A3.44	EXTERIOR DETAILS			●	●
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A4.11	ENLARGED PLANS		◑	●	●
A4.12	INTERIOR ELEVATIONS		◑	●	●
A4.13	INTERIOR ELEVATIONS		◑	●	●
A4.14	INTERIOR ELEVATIONS		◑	●	●
A4.15	INTERIOR ELEVATIONS		◑	●	●
A4.16	INTERIOR ELEVATIONS		◑	●	●
A4.17	INTERIOR ELEVATIONS		◑		
A4.18	INTERIOR ELEVATIONS		◑		
A5.11	ADA CODE SHEET		◑	●	●
A6.11	FIRST LEVEL REFLECTED CEILING PLAN		◑	●	●
A6.12	SECOND LEVEL REFLECTED CEILING PLAN		◑	●	●
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A7.11	ENLARGED STAIR & ELEVATOR PLANS		◑	●	●
A7.12	STAIR & ELEVATOR SECTIONS		◑	●	●
A7.13	STAIR & ELEVATOR DETAILS			●	●
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A8.12	INTERIOR FINISH DETAILS			●	●
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S0.02	LEGEND & ABBREVIATIONS		◑	●	●
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S1.02	SECOND LEVEL STRUCTURAL PLAN		◑	●	●
S1.03	ROOF STRUCTURAL PLAN		◑	●	●
S2.01	ELEVATIONS		◑	●	●
S2.02	ELEVATIONS		◑	●	●
S3.01	FOUNDATION SECTIONS		◑	●	●
S4.01	SUPERSTRUCTURE SECTIONS		◑	●	●
S4.02	SUPERSTRUCTURE SECTIONS			●	●
S5.01	TYPICAL DETAILS		◑	●	●
S5.02	TYPICAL DETAILS		◑	●	●
S5.03	TYPICAL DETAILS		◑	●	●
S5.04	TYPICAL DETAILS		◑	●	●
S5.05	TYPICAL DETAILS		◑	●	●
S5.06	TYPICAL DETAILS		◑	●	●
S6.01	SCHEDULES		◑	●	●
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M0.01	MECHANICAL STANDARDS AND DRAWING INDEX		◑	●	●
M0.02	MECHANICAL SITE PLAN		◑	●	●
M0.03	ENERGY MODELING INFORMATION				
M3.01	FIRST LEVEL HVAC PIPING PLAN		◑	●	●
M3.02	SECOND LEVEL HVAC PIPING PLAN		◑	●	●
M4.01	FIRST LEVEL SHEET METAL PLAN		◑	●	●
M4.02	SECOND LEVEL SHEET METAL PLAN		◑	●	●
M4.03	ROOF SHEET METAL PLAN		◑	●	●
M5.01	ENLARGED MECHANICAL PLANS		◑	●	●
M5.02	MECHANICAL SECTIONS		◑	●	●
M5.03	MECHANICAL SECTIONS		◑	●	●
M5.51	MECHANICAL ISOMETRIC VIEWS		◑	●	●
M6.01	MECHANICAL DETAILS		◑	●	●
M6.02	MECHANICAL DETAILS		◑	●	●
M6.03	MECHANICAL DETAILS		◑	●	●
M6.04	MECHANICAL DETAILS		◑	●	●
M7.01	MECHANICAL SCHEDULES		◑	●	●
M7.02	MECHANICAL SCHEDULES		◑	●	●
M7.11	MECHANICAL SCHEDULES		◑	●	●
M7.12	MECHANICAL SCHEDULES		◑	●	●
M8.01	TEMPERATURE CONTROL STANDARDS AND GENERAL NOTES		◑	●	●
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M8.03	TEMPERATURE CONTROLS			●	●
M8.04	TEMPERATURE CONTROLS			●	●
M8.05	TEMPERATURE CONTROLS			●	●
M8.06	TEMPERATURE CONTROLS			●	●
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P2.01	FIRST LEVEL PLUMBING PLAN		◑	●	●
P2.02	SECOND LEVEL PLUMBING PLAN		◑	●	●
P2.03	ROOF PLUMBING PLAN		◑	●	●
P5.01	ENLARGED PLUMBING PLANS		◑	●	●
P6.01	PLUMBING DETAILS		◑	●	●
P6.02	PLUMBING DETAILS		◑	●	●
P7.01	PLUMBING SCHEDULES		◑	●	●
P7.02	PLUMBING SCHEDULES		◑	●	●
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E0.01	ELECTRICAL STANDARDS AND DRAWING INDEX		◑	●	●
E0.02	ELECTRICAL STANDARD SCHEDULES		◑	●	●
E0.03	ELECTRICAL SITE PLAN		◑	●	●
E2.01	FIRST LEVEL LIGHTING PLAN		◑	●	●
E2.02	SECOND LEVEL LIGHTING PLAN		◑	●	●
E3.01	FIRST LEVEL POWER PLAN		◑	●	●
E3.02	SECOND FLOOR POWER PLAN		◑	●	●
E4.01	ROOF ELECTRICAL PLAN		◑	●	●
E5.01	ONE LINE DIAGRAM		◑	●	●
E5.02	PANEL SCHEDULES		◑	●	●
E7.01	ELECTRICAL DETAILS AND DIAGRAMS		◑	●	●
E7.02	ELECTRICAL DETAILS AND DIAGRAMS			●	●
E7.03	ELECTRICAL DETAILS AND DIAGRAMS			●	●
E7.04	ELECTRICAL DETAILS AND DIAGRAMS			●	●
9. FIRE PROTECTION					
FP1.01	FIRE PROTECTION PLANS		◑	●	●
FP6.01	FIRE PROTECTION DETAILS		◑	●	●

GENERAL PROJECT NOTES

1. CONSTRUCTION OF THIS PROJECT SHALL BE IN COMPLIANCE WITH ALL APPLICABLE CODES, ORDINANCES AND REGULATIONS.
2. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND EACH SUBCONTRACTOR TO REVIEW, UNDERSTAND AND COORDINATE WORK WITH APPLICABLE CODES, ORDINANCES, REGULATIONS, AND ALL CONTRACT DRAWINGS BEFORE THE INSTALLATION OF THEIR WORK. ANY DISCREPANCY BETWEEN DRAWINGS AND SPECIFICATIONS SHALL BE BROUGHT TO THE ARCHITECT'S ATTENTION FOR CLARIFICATION. ANY WORK INSTALLED IN CONFLICT WITH THE ARCHITECTURAL DOCUMENTS SHALL BE CORRECTED BY THE CONTRACTOR AT HIS OWN EXPENSE AND AT NO EXPENSE TO THE OWNER, ENGINEER OR ARCHITECT.
3. SCHEDULE AND RECEIVE APPROVAL FROM GOVERNING JURISDICTION AND THE ENGINEER FOR ALL UTILITY INTERRUPTIONS IN ADVANCE OF NEEDED DATE. CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE REQUIRED NOTIFICATION TIMES WITH EACH GOVERNING JURISDICTION AND/OR UTILITY.
4. CONTRACTOR SHALL VERIFY SIZES AND LOCATIONS OF ALL OPENINGS FOR MECHANICAL EQUIPMENT, ELECTRICAL EQUIPMENT, OWNER SUPPLIED EQUIPMENT, AND OTHER EQUIPMENT, AS WELL AS SHOP DRAWINGS AS REVIEWED BY ARCHITECT OR ENGINEER BEFORE PROCEEDING WITH WORK.
5. CONTRACTOR SHALL VERIFY/ADJUST SIZES AND LOCATIONS OF ALL EQUIPMENT PADS AND BASES, POWER, WATER AND DRAIN INSTALLATION BEFORE PROCEEDING WITH THE WORK. THIS SHALL OCCUR WITH NO ADDITIONAL COST TO OWNER.
6. PROVIDE BLOCKING BEHIND ALL WALL MOUNTED ACCESSORIES AND MILLWORK AS REQUIRED BY APPLICABLE MANUFACTURER RECOMMENDATIONS, AND AS INDICATED BY ARCHITECT DURING SUBMITTAL PROCESS.
7. ALL PENETRATIONS OF FIRE RESISTIVE WALLS SHALL BE PROTECTED BY MATERIALS AND INSTALLATION DETAILS THAT CONFORM TO UNDERWRITERS LABORATORIES' LISTINGS FOR THROUGH PENETRATION FIRE STOP SYSTEM.
8. CONTRACTOR SHALL CONTACT ARCHITECT PRIOR TO FINAL PLACEMENT OF LIGHT FIXTURES AND DIFFUSERS IN ALL CEILINGS AND WALLS. COORDINATE WITH ELECTRICAL PRIOR TO ACOUSTICAL CEILING GRID INSTALLATION.
9. ALL DIMENSIONS ARE FROM FACE OF CONCRETE MASONRY UNIT, BLOCK, STUD OR CENTERLINE OF COLUMNS, UNLESS NOTED OTHERWISE.
10. ALL EXTERIOR WALL & ROOF OPENINGS, FLASHING, COUNTER-FLASHING, EXPANSION JOINTS SHALL BE CONSTRUCTED IN SUCH A MANNER AS TO MAKE THEM WEATHERPROOF AND WATERTIGHT.
11. EACH INSTALLER SHALL BE RESPONSIBLE FOR VERIFICATION AND COORDINATION WITH OTHER INSTALLERS TO SECURE COMPLIANCE OF DRAWING AND SPECIFICATIONS CONCERNING THE ACCURATE LOCATION OF STRUCTURAL MEMBERS AND OPENINGS FOR MR MECHANICAL, ELECTRICAL AND MISCELLANEOUS EQUIPMENT.
12. DO NOT SCALE DRAWINGS. THE CONTRACTOR SHALL USE DIMENSIONS AS SHOWN AND ACTUAL FIELD MEASUREMENT. NOTIFY ARCHITECT OF ANY DISCREPANCIES.
13. RECYCLING- CONTRACTOR IS ENCOURAGED TO RECYCLE ALL MATERIALS POSSIBLE AND TO USE RECYCLED MATERIALS WHERE SUITABLE. CONTRACTOR SHOULD NOTIFY ARCHITECT OF POTENTIAL RECYCLED MATERIALS WHICH MAY BE APPROPRIATE FOR SUBSTITUTION.
14. THIS PROJECT HAS BIDDER DESIGNED AND INSTALLED FEATURES AS NOTED BELOW, TO BE SUBMITTED AS A DEFERRED SUBMITTAL BY THE CONTRACTOR. THE CONTRACTOR IS RESPONSIBLE FOR APPLYING FOR AND OBTAINING ALL REQUIRED PERMITS. THE CONTRACTOR IS RESPONSIBLE FOR INCLUDING ALL PREPARATION AND PERMIT REVIEW TIME IN THE PROJECT SCHEDULE. THE CONTRACTOR SHALL HIRE ENGINEERS FOR DELEGATED DESIGN AND PROVIDE REQUIRED STAMPED (BY MI STATE LICENSED ENGINEERS) DRAWINGS AND CALCULATIONS. BIDDER DESIGNED & INSTALLED ITEMS INCLUDE:
    - AUTO. SPRINKLER SYSTEM PER NFPA 13, MBC SECTION 903
    - FIRE ALARM SYSTEM PER SPECIFICATIONS AND REQUIREMENTS

DRAWING SYMBOLS

DETAIL REFERENCE — 1 / A101 SIM — DETAIL NUMBER / SHEET NUMBER

BUILDING SECTION — 1 / A#.# SIM — SECTION NUMBER / SHEET NUMBER

WALL SECTION — 1 / A#.# SIM — SECTION NUMBER / SHEET NUMBER

INTERIOR ELEVATIONS — 1 Ref; Ref A7.1 1 Ref — ELEVATION NUMBER / SHEET NUMBER

ROOM IDENTIFICATION — ROOM NAME / 101 — ROOM NUMBER

WINDOW/RELITE TAG — A — WINDOW TYPE REFERENCE

DOOR TAG — ### — DOOR TYPE REFERENCE

WALL TYPE TAG — # — ITEM REFERENCE

CEILING TAG — 10'-0" — CEILING HEIGHT

GRID NUMBER — 0 — GRID LINE REFERENCE

NORTH ARROW

ABBREVIATIONS

&	AND	C.I.	CAST IRON	E.A.	EXPOSED AGGREGATE	FURR.	FURRING	LAB.	LABORATORY	PERP.	PERPENDICULAR	SBC	SEATTLE BUILDING CODE	T.V.	TELEVISION
∠	ANGLE	C.I.P.	CAST IN PLACE	EA.	EACH	FUT.	FUTURE	LAM.	LAMINATE	PL.	PLATE	S.C.	SOLID CORE	T.O.W.	TOP OF WALL
@	AT	C.J.	CONSTRUCTION/CONTROL JOINT	E.J.	EXPANSION JOINT	F.V.	FIELD VERIFY	LAV.	LAVATORY	P-LAM, P. LAM.	PLASTIC LAMINATE	SCD	SEAT COVER DISPENSER	TYP.	TYPICAL
℄	CENTERLINE	C.L.	CENTERLINE	EL.	ELEVATION			LDRY.	LAUNDRY	PALST.	PLASTER	SCHED.	SCHEDULE		
∅	DIAMETER	CLG.	CEILING	ELEC.	ELECTRICAL	GA.	GAUGE	LKR.	LOCKER	PLYWD.	PLYWOOD	S.D.	SOAP DISPENSER	UNF.	UNFINISHED
#	POUND OR NUMBER	CLKG.	CAULKING	ELEV.	ELEVATOR (OR ELEVATION)	GALV.	GALVANIZED .	L.S. / LSCP	LANDSCAPING	PNL.	PANEL	S.DET. / SD	SMOKE DETECTOR	U.N.O.	UNLESS NOTED OTHERWISE
A.B.	ANCHOR BOLT	CLR.	CLEAR	EMER.	EMERGENCY	GB.	GRAB BAR	LT.	LIGHT	P.P.	POWER POLE	SECT.	SECTION	U.O.N.	UNLESS OTHERWISE NOTED
ACOUST.	ACOUSTICAL	CMU.	CONCRETE MASONRY UNIT	ENCL.	ENCLOSURE	G.F.I.	GROUND FAULT INTERRUPTER			PR.	PAIR	SF	SQUARE FOOT	UR.	URINAL
A.D.	AREA DRAIN	CNTR.	COUNTER	E.P.	ELECTRICAL PANEL	GL.	GLASS	MAX.	MAXIMUM	PRCST.	PRECAST	S.G.	SAFETY GLASS		
A.C.	ASPHALT CONCRETE	C.O.	CASED OPENING OR CLEANOUT	EQ.	EQUAL	GLAM	GLULAM	M.C.	MEDICINE CABINET	PSL	PARALLEL STRAND LUMBER	SH.	SHELF	VAC.	VACUUM
ADJ.	ADJACENT	COL.	COLUMN	EQPT. / EQUIP.	EQUIPMENT	GND.	GROUND	MECH.	MECHANICAL	P.T.	PRESSURE TREATED	SHT.	SHEET	V.B.	VAPOR BARRIER
ADJUST.	ADJUSTABLE	CONC.	CONCRETE	E.W.C.	ELECTRICAL WATER COOLER	GR.	GRADE	MEMB.	MEMBRANE	PT.	POINT	SHTHG/ SHT'G	SHEATHING	VCR	VINYL CARPET REDUCER
A.F.F.	ABOVE FINISH FLOOR	CONN.	CONNECTION	EX. / EXIST.	EXISTING	GLS.	GALVANIZED STEEL	MFR.	MANUFACTURE(R)	PTD	PAINTER	SHWR.	SHOWER	VERT.	VERTICAL
AGGR.	AGGREGATE	CONSTR.	CONSTRUCTION	EXPO.	EXPOSED	GWB	GYPSUM WALL BOARD	MH	MANHOLE	PTD	PAPER TOWEL DISPENSER	SIM.	SIMILAR	VEST.	VESTIBULE
AHJ	AUTHORITY HAVING JURISDICTION	CONT.	CONTINUOUS	EXP.	EXPANSION	GYP.	GYPSUM	MIN.	MINIMUM	PTD/R	COMBINATION PAPER TOWEL DISPENSER & RECEPTACLE	SLDS.	SOLID SURFACE	V.T.O.	VENT TO OUTSIDE
A.I.B.	AIR INFILTRATION BARRIER	CORR.	CORRIDOR	EXT.	EXTERIOR	MIR.	MIRROR					SND.	SANITARY NAPKIN DISPENSER		
AL / ALUM.	ALUMINUM	CPT.	CARPET			H.B.	HOSE BIBB	MISC.	MISCELLANEOUS	PTN.	PARTITION	SNR	SANITARY NAPKIN RECEPTACLE	W.	WEST
APC	ACOUSTICAL PANEL CEILING	CRB	CRUSHED ROCK BASE	F.A.	FIRE ALARM	H.C.	HOLLOW CORE	M.O.	MASONRY OPENING	P.T.A.	PAPER TOWEL RECEPTACLE	S.M.	SHEET METAL	W/	WITH
APPROX.	APPROXIMATE	CTR.	CENTER	F.B.	FLAT BAR	HD	HEAD	MTD.	MOUNTED METAL	PRE-FIN	PRE-FINISHED	S.O.G.	SLAB ON GRADE	W.A.B.	WEATHER AIR BARRIER (SAME AS WRB)
ARCH.	ARCHITECTURAL OR ARCHITECT	CTSK.	COUNTERSUNK	FCB	FIBER COMPOSITE BOARD	HDR.	HEADER	MTL. / MET.	METAL			SPEC.	SPECIFICATION	W.R.B.	WEATHERWATER RESISTIVE BARRIER
ASB.	ASBESTOS			F.D.	FLOOR DRAIN	HDWD.	HARDWOOD H	MTRL.	MATERIAL	Q.T.	QUARRY TILE	SQ.	SQUARE	W.C.	WATER CLOSET
ASPH.	ASPHALT	D.B.	DOORBELL	FDN.	FOUNDATION	HDWR.	HARDWARE	MUL.	MULLION	R.	RISER	S.S.	STAINLESS STEEL	WD.	WOOD
		DBL.	DOUBLE	F.E.	FIRE EXTINGUISHER	H.M.	HOLLOW METAL			RAD.	RADIUS	S.SK.	SERVICE SINK	WDW.	WINDOW
BD.	BOARD	DEPT.	DEPARTMENT	F.E.C.	FIRE EXTINGUISHER CABINET	HORIZ.	HORIZONTAL	N.	NORTH	R.D.	ROOF DRAIN	STA.	STATION	W.M.	WATER METER
BITUM.	BITUMINOUS	DEMO.	DEMOLISH, DEMOLITION	F.	FINISH FLOOR	HR.	COHOUR	N.I.C.	NOT IN CONTRACT	RECP.	RECEPTACLE	STD.	STANDARD	W/O	WITHOUT
BLDG.	BUILDING	D.F.	DRINKING FOUNTAIN	FG	FIBER GLASS	H.R.	HANDRAIL	NO.	NUMBER	RECEPT.	RECEPTION	STL.	STEEL	WP.	WATERPROOF
BLK.	BLOCK	DET./DTL.	DETAIL	F.H.	FIRE HYDRANT	HSS	HOLLOW STRUCTURAL SECTION	NOM.	NOMINAL	REF.	REFERENCE	STOR.	STORAGE	W.R.	WATER RESISTANT, WATER-RESISTIVE
BLKG.	BLOCKING	DIA.	DIAMETER	F.H.C.	FIRE HOSE CABINET	HT.	HEIGHT	N.T.S.	NOT TO SCALE	REFR.	REFRIGERATOR	STRL, STRUCT.	STRUCTURAL	WSCT.	WAINSCOT
BLW	BELOW	DIM.	DIMENSION	FIN.	FINISH					REINF.	REINFORCED	SUSP.	SUSPENDED	WT.	WEIGHT
BM.	BEAM	DISP.	DISPENSER	FL., FLR	FLOOR	I.B.C.	INTERNATIONAL BUILDING CODE	O.A.	OVERALL	REQ'D	REQUIRED	SYM.	SYMMETRICAL		
BMK.	BENCHMARK	DN.	DOWN	FLASH.	FLASHING	I.D.	INSIDE DIAMETER (DIM.)	O.H.	OVERHEAD	RESIL.	RESILIENT				
BOT.	BOTTOM	D.O.	DOOR OPENING	FLUOR.	FLUORESCENT	IN.	INCH	OBS.	OBSCURE	RESIST.	RESISTANT	T.B.S.	TO BE SELECTED		
BTWN.	BETWEEN	DP	DEEP	F.O.C.	FACE OF CONCRETE	INCL.	INCLUDE(D)	O.C.	ON CENTER OUTSIDE	RM.	ROOM	T.C.	TOP OF CURB		
		DR.	DOOR	F.O.F.	FACE OF FINISH	INSUL.	INSULATION	O.D.	DIAMETER (DIM.) O.D.	R.O.	ROUGH OPENING	TEL.	TELEPHONE		
CAB.	CABINET	D.S.	DOWNSPOUT	F.O.S.	FACE OF STUDS	INT.	INTERIOR	OF.	OVERFLOW O.F.	R. & S.	ROD & SHELF	TEMP	TEMPORARY		
C.B.	CATCH BASIN	D.S.P	DRY STANDPIPE	F.P.	FIREPLACE			OFCI	OWNER FURNISH/ CONTRACTOR INSTALL	RGSTR.	REGISTER	TER.	TERRAZZO		
CEM.	CEMENT	D.W.	DISHWASHER	FPRF.	FIREPROOF	JAN.	JANITOR			RSP	RIGID SHEET PANEL	T&G	TONGUE & GROOVE		
CER.	CERAMIC	DWG.	DRAWING	FRP	FIBERGLASS REINFORCED PANEL	JST.	JOIST	OFF.	OFFICE	WD.	REDWOOD	THK.	THICK		
C.F.M.	CUBIC FEET/MIN.	DWR.	DRAWER	F.S.	FULL SIZE	JT.	JOINT	OPNG.	OPENING	R.W.L.	RAIN WATER LEADER	T.O.	TOP OF		
C.G.	CORNER GUARD			FT.	FOOT OR FEET			OPP.	OPPOSITE			T.P.	TOP OF PAVEMENT		
CH.	CHALK	E.	EAST	FTG.	FOOTING	KIT.	KITCHEN	O/	OVER	S.	SOUTH	TPD	TOILET PAPER DISPENSER		
								OF/CI	OWNER FURNISHED/ CONTRACTOR INSTALLED			TRD. OR T	TREAD		

TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23
Design Development	05/26/23
Site Plan Approval	09/22/22

Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

SHEET INDEX

A3C
COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.o3c.com

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SUMMARY

DEVELOPMENT PROGRAM (LDR 1:3(1))

(A) LAND USE

THE PROJECT SITE IS LOCATED AT 2415 SOUTH HURON PARKWAY, ANN ARBOR, MI 48104, NEAR THE INTERSECTION OF PLATT ROAD. THIS IS THE LOCATION OF THE EXISTING FIRE STATION #4, WHICH WILL BE REPLACED BY THE PROPOSED PROJECT.

(B) SITE ANALYSIS

THE SITE WILL BE ACCESSED VIA TWO PROPOSED DRIVEWAYS ON SOUTH HURON PARKWAY. ALL SIDEWALKS PROPOSED SHALL MEET ALL REQUIREMENTS OF ADA STANDARDS FOR ACCESSIBLE DESIGN.

PUBLIC UTILITIES:

WATER LEADS (DOMESTIC AND FIRE PROTECTION) WILL BE EXTENDED TO THE BUILDING CONNECTING TO THE EXISTING MAIN AT SOUTH HURON PARKWAY AS SHOWN ON SHEET P-60. A SANITARY SEWER LEAD WILL CONNECT TO THE EXISTING SANITARY SEWER ON THE EAST SIDE OF THE PROPERTY.

THE SITE CURRENTLY RUNS UN-DETAINED VIA SHEET FLOW TO THE SOUTH HURON PARKWAY RIGHT-OF-WAY STORM SEWER SYSTEM AND TO MALLETTS CREEK. THE PROPOSED DEVELOPMENT INCLUDES A NEW BELOW GROUND DETENTION SYSTEM WITH A RAIN GARDEN STRUCTURES. A NEW ON-SITE ENCLOSED STORM SEWER SYSTEM DESIGNED PER THE WASHTENAW COUNTY WATER RESOURCES COMMISSIONER STANDARDS IS ALSO INCLUDED. THE DETENTION BASIN WILL CAPTURE STORM WATER RUNOFF FROM THE EXISTING ON-SITE TRIBUTARY DRAINAGE AREAS. THE DETENTION BASINS WILL DISCHARGE TO THE EXISTING STORM SEWER SYSTEM AND ULTIMATELY TO MALLETTS CREEK AT A LOWER PEAK FLOW RATE; THAT CURRENTLY EXISTS.

SITE LIGHTING WILL BE PROVIDED BY BUILDING AND POLE MOUNTED LIGHTS, AS SHOWN ON THE PHOTOMETRIC PLAM, SHEET G.03.

TRASH RECYCLING AND COMPOST WILL BE DEPOSITED IN CURB-SIDE CARTS THAT WILL BE BROUGHT TO THE ROAD SIDE BY THE OCCUPANTS OF THE BUILDING. NO DUMPSTERS ARE INCLUDED AS A PART OF THE PROJECT.

THE CONSTRUCTION COVERED BY THESE PLANS SHALL BE IN COMPLETE CONFORMANCE WITH THE CITY OF ANN ARBOR STANDARDS.

(C) SUSTAINABLE ELEMENTS

1) GENERAL PROJECT INFORMATION

THE ANN ARBOR FIRE STATION 4 PROJECT IS A 12,097 SQUARE FOOT, 2-STORY, FIRE STATION TO REPLACE THE EXISTING OUTDATED FACILITY. THE FIRE STATION 4 PROJECT WILL BE CONSTRUCTED THROUGH A DESIGN-BID-BUILD PROJECT DELIVERY METHOD

THE ANN ARBOR STATION4 PROJECT WILL BE DESIGNED TO ACHIEVE A NET ZERO ENERGY CONSUMPTION RATING CALCULATED ON A ANNUALIZED BASIS. UNDER THIS BASIS OF CALCULATION, THE GOAL IF THIS PROJECT IS THAT THE BUILDING WOULD SUPPLY MORE ENERGY THAN IT WOULD CONSUME WITHIN A GIVEN YEAR

2) BUILDING SPACE SUMMARY

THE BUILDING PROGRAM INCLUDES A MAIN APPARATUS BAY DESIGNED FOR COMMUNITY ENGAGEMENT AND VISIBILITY. THE STATION IMPLEMENTS CURRENT ADVANCEMENTS IN DESIGN THINKING FOR SAFETY AND INCLUSIVELY. IS IS THE PROGRAMMED AS A "HOT ZONE" DESIGN TO REDUCE FIREFIGHTER EXPOSURE TO CARCINOGENS. DECONTAMINATION ZONES AND GEAR STORAGE ARE SEPARATED FROM LIVING AREAS. DORMITORIES, RESTROOMS, AND LOCKER ROOMS ARE DESIGNED FOR GENDER NEUTRALITY.

3) ENERGY

BASED ON ENGERY MODELING, THE BUILDING'S ESTIMATED ANNUAL ENERGY USAGE IS 89,462 kWh OF 100% ELECTRICAL ENERGY, FOR A SITE ENERGY USAGE INTENSITY (EUI) FOR 25 kBTU/ft2/yr. THIS COMPARES FAVORABLY TO THE NATIONAL AVERAGE SITE EUI FOR FIRE STATIONS AT 63.5 kBTU/ft27yr, 1 AND TO THE EXISTING FIRE STATION #4 SITE EUI AT APPROXIMATELY 127 kBTU/ft2/yr, 2 THESE IMPROVEMENTS IN ENERGY USAGE WILL BE ACHIEVED THROUGH MULTIPLE FACTORS, INCLUDING THICKER INSULATION, TIGHTER AIR SEALING, MORE ENERGY EFFICIENT LIGHTS, AND MORE ENERGY EFFICIENT HVAC EQUIPMENT

4) WATER USAGE

THE BUILDING WILL MINIMIZE ITS WATER CONSUMPTION THROUGH USE OF LOW FLOW PLUMBING FIXTURES. IT IS EXPECTED THAT THIS WILL REDUCE DOMESTIC WATER CONSUMPTION BY A MINIMUM 30% OVER THE ENERGY POLICY ACT OF 1992 ALLOWABLE WATER CONSUMPTION.

5) MECHANICAL SYSTEMS

A CLOSED LOOP GROUND SOURCE GEOTHERMAL EXCHANGE FIELD CONSISTING OF APPROXIMATELY 20 BORES EXTENDING AT LEAST 300 FEET DEEP AND INTERCONNECTED INTO MULTIPLE COMMON PIPING HEADERS WILL BE PROVIDED. THE WELL FIELD WILL BE LOCATED UNDER THE PARKING LOT AND PARKLANDS TO THE WEST OF THE BUILDING. REFER TO SHEET M0.02 FOR SCHEMATIC BORE POSITIONS

THE VENTILATION AIR FOR THE BUILDING WILL BE PROVIDED BY TWO ENERGY RECOVERY VENTILATORS (ERVs) THE UNITS WILL RECOVER THE HEAT FROM EXHAUST AIR/RELIEF AIR AND TRANSFER THE HEAT TO THE OUTSIDE AIR STREAM TO PRE-COOL OR PRE-HEAT THE OUTSIDE AIR THAT WILL BE SUPPLIED TO EACH HEAT PUMP OR OCCUPIED SPACE.

6) ELECTRICAL SYSTEMS

A PHOTOVOLTAIC ARRAY ON THE ROOF OF THE BUILDING WILL GENERATE ELECTRICAL ENERGY AND THE EXCESS WOULD BE SUPPLIED TO THE ELECTRICAL GRID. THE BUILDING WILL BE FULLY ELECTRIFIED. ENERGY CONSUMPTION WILL BE REDUCED USING GROUND SOURCE HEAT PUMPS TIED TO GEOTHERMAL FIELD AND AN EFFICIENT BUILDING ENVELOPE

THE LIGHTING METHOD WILL BE 100% LED FIXTURES. LIGHTING CONTROLS WILL INCORPORATE DIMMERS, OCCUPANCY SENSORS, 0-10V DIMMING, PARTIAL AUTOMATIC ON/OFF FUNCTIONALITY, AND DAYLIGHT HARVESTING

(A) PHASING SCHEDULE & COST

THE PROJECTS DESIGN WAS STARTED ON APRIL 1ST, 2021 AND DESIGN COMPLETIONS IS ESTIMATED TO BE FEBRUARY 1, 2023. CONSTRUCTION WILL BEGIN APRIL 1, 2023 AND IS SCHEDULED TO BE COMPLETED MAY 1, 2024. THIS PROJECT WILL INCLUDE A FORMAL COMMISSIONING PROCESS AS PART OF THE NET ZERO VERIFICATION PROCESS.

COMMUNITY ANALYSIS (LDR 1:3(2))

(A) IMPACT OF THE PROPOSED DEVELOPMENT ON PUBLIC SCHOOLS

THE DEVELOPMENT IS NOT RESIDENTIAL AND WILL HAVE NO IMPACT ON THE NUMBER OF SCHOOL AGE CHILDREN OR THE PUBLIC SCHOOLS.

(B) RELATIONSHIP OF INTENDED USE TO NEIGHBORING USES

THE SITE IS BOUNDED BY COMMERCIAL OFFICE TO THE NORTH, PUD TO THE NORTHWEST, AND SCHEFFLER PARK TO THE SOUTH AND EAST. MALLETT'S CREEK FLOWS ALONG THE SOUTHEAST CORNER OF THE PROPERTY. THE PROPOSED BUILDING MAINTAINS A MINIMUM DISTANCE OF 25' FROM THE 100-YEAR FLOODPLAIN OF THE CREEK. THE PROJECT'S DESIGN AND SCALE ARE INTENDED TO BRIDGE THE SPACE BETWEEN ADJACENT COMMERCIAL AREAS AND THE PARK AND RESIDENTIAL AREAS SURROUNDING IT.

THE DESIGN OF THE SITE AND BUILDING WILL COMPLEMENT AND IMPROVE UPON THE RELATIONSHIP OF THE SITE TO MALLETT'S CREEK AND THE PARK. THE BUILDING WILL TAKE ADVANTAGE OF SIGHTLINES TO THE CREEK AND THE SITE IMPROVEMENTS WILL INCLUDE THE REMOVAL OF BUCKTHORN AND OTHER INVASIVE SPECIES ABUTTING THE CREEK.

(C) IMPACT OF ADJACENT USES ON THE PROPOSED DEVELOPMENT

THE SITE IS ADJACENT TO A LOW STRESS BIKE ROUTE. THIS ROUTE WILL BE MAINTAINED AND ENHANCED. BIKE PARKING WILL BE ADDED IN A LOCATION NEAR THE ROUTE WHICH WILL SERVE PARK VISITORS.

THE PROJECT IS LOCATED ON A CITY BUS LINE AND IS WITHIN MINUTES OF BLAKE TRANSIT CENTER. THE PROJECT LOCATION MAKES IT CONVENIENT FOR VISITORS TO ARRIVE BY FOOT, BIKE, OR BUS. PARKING IS PROVIDED ON THE SITE AND PREPARATIONS HAVE BEEN PLANNED FOR FUTURE EV CHARGING.

(D) IMPACT OF PROPOSED DEVELOPMENT ON AIR AND WATER QUALITY, AND ON EXISTING NATURAL FEATURES OF THE SITE AND NEIGHBORING SITES

GENERAL INFORMATION

AS PART OF THIS PROJECT, A PORTION OF THE EXISTING PARK LAND WILL BE UTILIZED. ALTERNATIVE DESIGNS WERE THOROUGHLY INVESTIGATED, AND THE CURRENT SITE PLAN LAYOUT WAS DEEMED TO BE THE MOST FEASIBLE SOLUTION DUE TO THE FOLLOWING FACTORS:

- DRIVE THROUGH BAYS WERE PREFERRED TO AVOID BACKING INTO THE BAYS FROM HURON PARKWAYS
- TRAFFIC AND PEDESTRIAN SAFETY ARE IMPROVED THROUGH CONTROLLING THE TRAFFIC SIGNAL AT THE INTERSECTION OF HURON PARKWAY AND PLATT ROAD
- PARK LAND USAGE ALLOWS FOR GEOTHERMAL WELL DISTRIBUTION
- STORM WATER MITIGATION IS IMPROVED

THE MOST SIGNIFICANT PARK FEATURE THAT IS AFFECTED BY THE PROJECT IS A SMALL BASKETBALL AREA ON THE WEST SIDE OF MALLETT'S CREEK. THIS AREA WILL BE REPLACED BY A FULL-SIZED BASKETBALL COURT ON THE EASTERN PORTION OF THE PARK AT THE LOCATION OF AN EXISTING DILAPIDATED ROLLER HOCKEY COURT, AS PART OF THIS PROJECT

THE ANN ARBOR PARKS ADVISORY COMMISSION HAS APPROVED THIS PLAN AND THE PROPOSED MITIGATION OF THE BASKETBALL COURT REMOVAL. COMMUNITY ENGAGEMENT FOR THIS PROPOSAL HAS BEEN COMPLETED AND THE PROPOSED MITIGATION WAS DEEMED TO BE THE MOST SATISFACTORY SOLUTION.

AIR AND WATER QUALITY

TEMPORARY SOIL EROSION AND SEDIMENTATION CONTROLS WILL BE IMPLEMENTED DURING CONSTRUCTION TO MINIMIZE CONTAMINATED RUNOFF FROM LEAVING THE SITE. ANY NEGATIVE IMPACT TO AIR QUALITY WOULD OCCUR DURING CONSTRUCTION AND WOULD BE MINIMAL AND TEMPORARY.

THE SITE WILL UTILIZE AN INFILTRATION-BASED RAIN GARDEN SYSTEM. PLANTS NATIVE TO SOUTHEAST MICHIGAN WILL BE USED THROUGHOUT THE LANDSCAPE DESIGN.

NATURAL FEATURES

THERE IS NO ENDANGERED SPECIES HABITAT ON THE SITE. MALLETT'S CREEK FLOWS ALONG THE SOUTHEAST SIDE OF THE SITE. THE PROJECT AREA IS MORE THAN 25' FROM THE 100-YEAR FLOODPLAIN OF THE CREEK. TREES WHICH WILL NOT BE REMOVED WILL BE PROTECTED DURING CONSTRUCTION.

NATURAL FEATURES STATEMENT OF IMPACT (LDR 1:4(21) AND CHAPTER 37 3:126)

PLEASE REFER TO PLANS AND THE EXISTING TREE INVENTORY ON SHEET P-1.3 - TREE SURVEY FOR LOCATION OF EXISTING NATURAL FEATURES WHICH INCLUDES LANDMARK TREES AFFECTED BY THE PROJECT AS WELL AS THOSE WITHIN FIFTY (50) FEET OF THE LIMITS OF DISTURBANCE OF THE PROJECT.

MITIGATION

REFER TO THE LANDSCAPE PLANS AND SCHEDULES, SHEETS L-1 THROUGH L-6 FOR LOCATIONS, SIZES, AND SPECIES OF TREES PROVIDED FOR MITIGATION.

(E) TRAFFIC IMPACT (ATTACHMENT D OF LDR)

TRAFFIC VOLUMES WILL NOT BE IMPACTED BY THE PROPOSED PROJECT. TRAFFIC SIGNAL CONTROL AT THE INTERSECTION OF HURON PARKWAY AND PLATT ROAD WILL IMPROVE TRAFFIC SAFETY. TRAFFIC WOULD BE STOPPED IN ALL DIRECTIONS UPON TRIGGERING OF THE STATION ALARM, ALLOWING ENGINES TO EXIT IN A CONTROLLED MANNER. IN ADDITION, SIGHTLINES FOR EXITING VEHICLES WOULD BE IMPROVED BY SHIFTING TRAFFIC TO THE INTERSECTION.

SW AERIAL RENDERING

NE RENDERING

SW RENDERING

COMPARISON CHART

ZONING	PL	PL
Lot area	No Minimum	31,154 SF
Building Footprint		8,770 SF
Useable Floor Area		9,650 SF
Fire Area		12,097 SF
FAR (Max.)	None	128%
Height	None	29'-0' to top of highest parapet
(From average grade		26'-0" to top of roof structure
within 20' of site)		19'-0" to top of parapet (low bay)
		14'-0" to top of roof (low Bay)
Max. Buidling Coverage	None	28%
Min. Open Space	None	72%
Building Frontage		
Set backs		
Front	None	19.6'
Side	None	10.8'
Parking		
Off-Street Parking	0	8
Delivery Space		1
Bicycle Parking	None	4 Class C

SITE PLAN INFOMATION

BUILDING HEIGHT. THE VERTICAL DISTANCE OF A BUILDING IS MEASURED FROM THE AVERAGE ELEVATION OF THE FINISHED GRADE WITHIN 20 FEET OF THE BUILDING TO THE HIGHEST POINT OF THE ROOF FOR A FLAT ROOF, TO THE DECK LINE OF A MANSARD ROOF, OR TO THE MIDPOINT ELEVATION BETWEEN EAVES AND RIDGE FOR A GABLE, HIP OR GAMBREL ROOF OF A BUILDING.

OPEN SPACE. THE PORTION OF A LOT WHICH IS DEVOTED TO OUTDOOR RECREATION SPACE, GREENERY, AND SPACE FOR HOUSEHOLD ACTIVITIES. OPEN SPACE AREA MAY INCLUDE, BUT SHALL NOT BE LIMITED TO, LAWNS, LANDSCAPING AND GARDENS, WOODED AREAS, SIDEWALKS AND WALKWAYS, ACTIVE AND PASSIVE RECREATIONAL AREAS, UNENCLOSED ACCESSORY STRUCTURES USED FOR RECREATIONAL PURPOSES, PERMANENT OR SEASONAL WATER SURFACES AND PROTECTED NATURAL AREAS. IT SHALL NOT INCLUDE AREA COVERED BY PARKING LOTS, DRIVEWAYS, REFUSE FACILITIES, OR ENCLOSED ACCESSORY STRUCTURES.

OPEN SPACE, ACTIVE. THE PORTION OF OPEN SPACE DEVOTED TO AND SUITABLE FOR OUTDOOR RECREATION AND HOUSEHOLD ACTIVITIES MEASURING AT LEAST 6 FEET BY 10 FEET IF INTENDED FOR COMMON OR SHARED USE BY ALL HOUSEHOLDS AND AT LEAST 4 FEET BY 10 FEET IF INTENDED FOR PRIVATE OR INDIVIDUAL HOUSEHOLD USE. COMMON OR SHARED ACTIVE OPEN SPACE MAY INCLUDE, BUT SHALL NOT BE LIMITED TO, LAWNS, SIDEWALKS AND PATHWAYS, PLAYGROUNDS, FIELDS (BASEBALL, SOCCER, ETC.), COURTS (BASKETBALL, TENNIS, ETC.), AND SWIMMING POOLS. PRIVATE OR INDIVIDUAL ACTIVE OPEN SPACE MAY INCLUDE, BUT SHALL NOT BE LIMITED TO, PORCHES, DECKS, BALCONIES, PATIOS, AND ACCESSIBLE PORTIONS OF ROOFS. ACTIVE OPEN SPACE SHALL NOT INCLUDE WOODLANDS, STORM WATER MANAGEMENT BASINS, WETLANDS, NATURAL FEATURES OPEN SPACE, CONFLICTING LAND USE BUFFERS, VEHICULAR USE AREA INTERIOR LANDSCAPE ISLANDS OR SCREENING.

USABLE FLOOR AREA, NONRESIDENTIAL. USABLE FLOOR AREA FOR NONRESIDENTIAL USES SHALL BE MEASURED TO THE EXTERIOR FACE OF THE EXTERIOR WALLS FOR ALL FLOOR AREAS THAT ARE ACCESSIBLE BY A FIXED STAIRWAY, RAMP, ESCALATOR OR ELEVATOR, WHICH MAY BE MADE FIT FOR OCCUPANCY. THE MEASUREMENT SHALL INCLUDE THE FLOOR AREA OF ANY ACCESSORY BUILDINGS AND ABOVE-GRADE PARKING STRUCTURES, EXCEPT THOSE PORTIONS OF A PARKING STRUCTURE USED FOR REQUIRED PREMIUM OR PUD PARKING. BELOW-GRADE PARKING CELLAR AREAS SHALL NOT BE COUNTED AS USABLE FLOOR AREA. FOR THE PURPOSE OF THIS SUBSECTION, THE DEFINITIONS OF CELLAR AND GRADE CONTAINED IN CHAPTER 98 OF THIS CODE SHALL APPLY.

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STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

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Issue	Date
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Drawn: KJ Checked: FEA

City of Ann Arbor
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2415 S HURON PKWY
ANN ARBOR, MI 48104

SUMMARY SHEET

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
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T: (734) 663 - 1910
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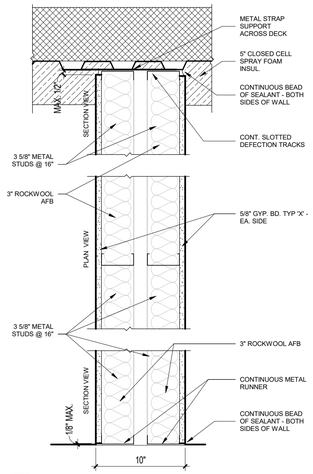
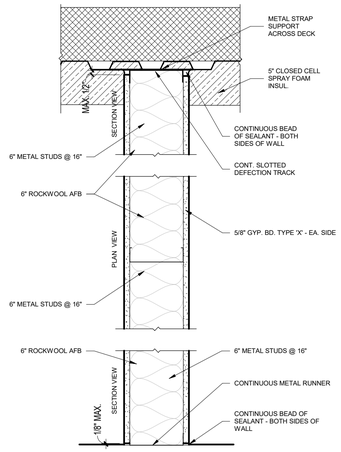
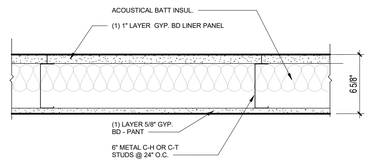
WALL TYPE NOTES
1. WALL TYPES ARE KEYED ON SHEETS A2.11, A2.12, A4.11 AND A7.11
2. MOISTURE RESISTANT GYPSUM BOARD AT TOILET ROOMS, ALCOVES AND DECON
3. SEE FINISH SCHEDULE FOR ADDITIONAL GYPSUM BOARD INFORMATION
4. SEE WALL SECTIONS FOR EXTERIOR WALL TYPES



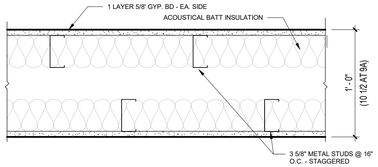
12 1/2 HOUR FIRE PARTITION - TO UNDERSIDE OF METAL DECK ABOVE
UL ASSEMBLY NO. U419 (SIMILAR), STC RATING OF 52 (ASSEMBLY NO. ISS-25)



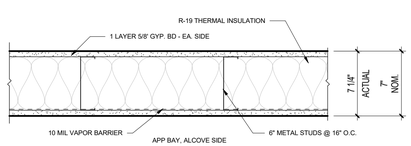
11 1/2 HOUR FIRE PARTITION - TO UNDERSIDE OF METAL DECK ABOVE
UL ASSEMBLY NO. U419 (SIMILAR), STC RATING OF 52 (ASSEMBLY NO. ISS-25)



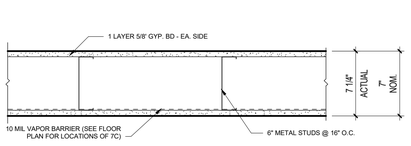
10 1-HOUR FIRE-RATED SHAFT WALL CONSTRUCTION- (1) LAYER TYPE 'X', 5/8" GYP. BOARD OVER C-H STUDS AT 24" O.C. WITH 1" THICK GYP. BOARD LINER PANEL (TYPE "SLX"). ACOUSTIC BATT INSULATION FULL HEIGHT. PARTITION EXTENDS FROM FLOOR TO UNDERSIDE OF METAL DECK ABOVE. UL ASSEMBLY NO. U415, SYSTEM "A"



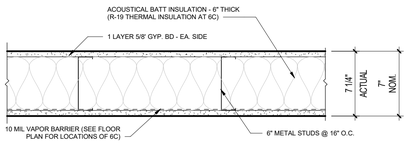
9 TO UNDERSIDE OF DECK OR STRUCTURE
9A TO 6" ABOVE FINISHED CEILING



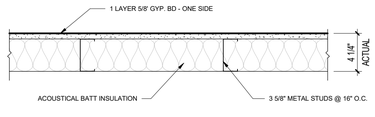
8 TO UNDERSIDE OF DECK
8A TO UNDERSIDE OF DECK (GYP. BD. ONE SIDE)



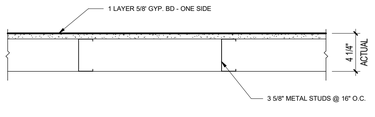
7 TO UNDERSIDE OF DECK OR STRUCTURE (NO VAPOR BARRIER)
7A TO 6" ABOVE FINISHED CEILING (NO VAPOR BARRIER)
7C TO UNDERSIDE OF DECK OR STRUCTURE WITH VAPOR BARRIER



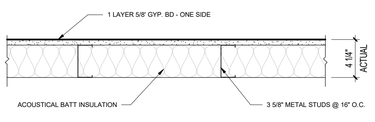
6 TO UNDERSIDE OF DECK OR STRUCTURE (AT COLUMN LINE 2 SEE WALL SECTION FOR EXTENT OF WALL) (NO VAPOR BARRIER)
6A TO 6" ABOVE FINISHED CEILING (NO VAPOR BARRIER)
6C TO UNDERSIDE OF DECK OR STRUCTURE WITH VAPOR BARRIER TO HALL SIDE



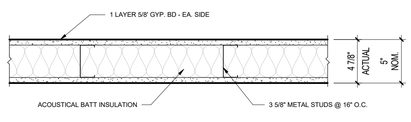
5 TO UNDERSIDE OF DECK OR STRUCTURE
5A TO 6" ABOVE FINISHED CEILING



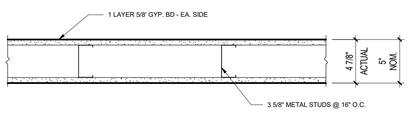
4 TO UNDERSIDE OF DECK OR STRUCTURE
4A TO 6" ABOVE FINISHED CEILING



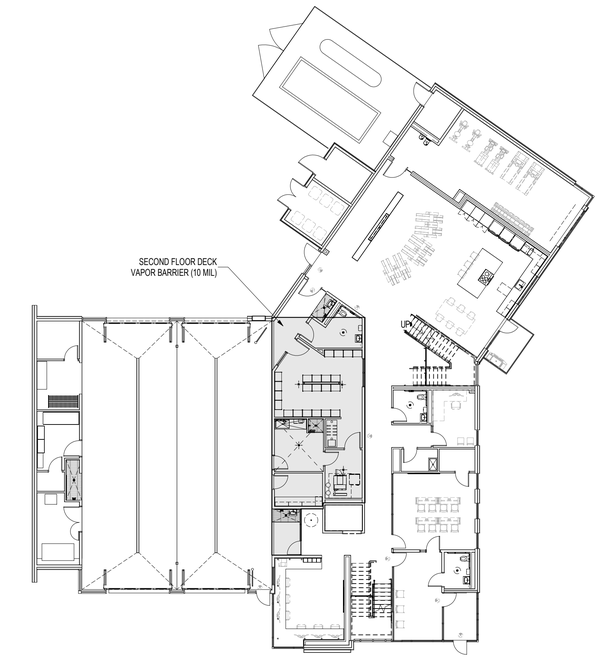
3 TO UNDERSIDE OF DECK OR STRUCTURE
3A TO 6" ABOVE FINISHED CEILING



2 TO UNDERSIDE OF DECK OR STRUCTURE
2A TO 6" ABOVE FINISHED CEILING



1 TO UNDERSIDE OF DECK OR STRUCTURE
1A TO 6" ABOVE FINISHED CEILING



1 FIRST FLOOR PLAN
Scale: 1/16" = 1'-0"

0 1/2' 1' 1 1/2'
1 1/2" = 1'

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STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23

Drawn: KJ Checked: FEA

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

WALL PARTITION TYPES

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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Sheet G0.04

BUILDING CODE SUMMARY

2015 Michigan Building Code (MBC 2015)

2021 Michigan Plumbing Code (MPC 2021)

2021 Michigan Mechanical Code (MMC 2021)

2023 National Electrical Code (NEC 2023) with part 8 State amendments

ICC / ANSI A117.1 – 2009 & Michigan Barrier Free Design Law of Public Act 1 of 1966 as amended

2015 International Energy Conservation Code Part 10 with ANSI / ASHRAE /

IESNA Standard 90.1-2013 (Project voluntarily designed to more stringent ASHRAE 90.1-2019)

2015 International Fire code

2013 NFPA 13, 13D & 13R

2019 NFPA 72 Fire Alarm Code

MICHIGAN ENERGY CODE 2015 - ASHRAE STD. 90.1

(GOVERNING ENGERY CODE IS BASED ON ASHRAE 90.1-2013. THIS PROJECT VOLUNTARILY DESIGNED TO MORE STRINGIENT ASHRAE 90.1-2019 FOR NON-RESIDENTIAL UNLESS NOTED)

THE BELOW ARE MINIMUM CODE PERFORMANCES.
REFER TO SPECIFICATIONS AND DRAWINGS FOR REQUIRED PRODUCT VALUES - EQUAL OR HIGHER PERFORMANCE REQUIRED

BUILDING DESIGNATED AS NON=RESIDENTIAL.
CLIMATE ZONE 5A. BUILDING ENVELOPE REQUIREMENTS PER TABLE 5.5-5 (OF ASHRAE STD. 90.1-2019)

BUILDING ELEMENT	MIN. R-VALUE OF INSULATIION AND/OR ASSEMBLY MAX U-VALUE	MAX. SHGC
ROOF	R-30 c.i., U-0.032 (SEE DRAWINGS FOR R-60 ROOF)	
MASS WALLS STEEL-FRAMED	R-13 + R-10 c.i., U-0.055 (SEE DRAWINGS FOR R-43 WALLS)	
SLAB ON GRADE FLOORS - UNHEATED	R-15 FOR 24IN.	
OPAQUE DOORS - SWING	U-0.370	
- NONSWINING	U-0.310	
FENESTRATION - FIXED	U-0.36	SHGC - 0.38
- OPERABLE	U-0.45	SHGC - 0.33
- ENTRANCE DOOR	U-0.63	SHGC - 0.33

GENERAL NOTES

1. PROVIDE CONTINUOUS AIR BARRIER (SEE DRAWINGS AND SPECIFICATIONS FOR AIR/VAPOR BARRIER).
2. AIR LEAKAGE RATE OF THE BUILDING ENVELOPE SHALL NOT EXCEED 0.40 CFM/FT2 UNDER PRESSURE DIFFERENTIAL OF 0.3 IN. OF WATER.
3. PROVIDE ALL TESTING AND REPORTS FOR BUILDING ENVELOPE REQUIRMENTS.

CHAPTER 3 - USE & OCCUPANCY

Building Occupancy: B - Business Areas (Offices, Day Room, Exercise, Meeting Room, Kitchen, 2nd Floor areas other than sleeping, etc.)
R-3 - Residential Areas (2nd Floor Sleeping Rooms)
S-1 - Moderate-Hazard Storage (Apparatus Bay Support Areas, Mechanical Room)
S-2 - Low Hazard Storage (Apparatus Bay)

CHAPTER 4 - SPECIAL DETAILED REQUIREMENTS BASED ON USE & OCCUPANCY

Section 406.3.4 Separation (MBC 2015)

Section 420.2 Separation Walls (MBC 2015) — Fire Partitions (1/2 hour) are required to separate R-3 sleeping units from other occupancies in accordance with section 708 and 708.3 - exception 2 fire resistance rating of not less than 1/2 hour in VB building and equipped throughout with an automatic sprinkler system

Section 420.3 Horizontal Separtion (MBC 2015) — Horizontal assemblies (1/2 hour) are required to separate R-3 sleeping units from other occupancies in accordance with section 711 and 711.2.4.3 - exception fire resistance rating of not less than 1/2 hour in a VB building and equipped throughout with an automatic sprinkler system

CHAPTER 5 - BUILDING HIEGHTS & AREAS

Maximum allowable height and area:
Section 508.3 Nonseparated occupancies (MBC 2015)
(Based on V-B construction type with automatic sprinkler system throughout and use groups B, R-3, S-1 and S-2. The building area & height based on most restrictive allowances for the occupancy group)

Table 504.3, 504.4 & 506.2 (MBC 2015)

	Building	Allowed
Building Height	2 Story / 29'-0"	2 Story (S-1) / 40'-0" (B)
Building Area	8,715 SF First Floor	27,000 SF (B)
	3,326 SF Second Floor	
	12,041 SF Total	

Required Separation of Occupancies
Section 508.4 Table (MBC 2015) — Separation required per section 420.2 and 420.3 above.

CHAPTER 6 - TYPES OF CONSTRUCTION

Construction Classification
Section 602.5 (MBC 2015)
Type V-B, Sprinklered

Fire-Resistance Rating for Building Elements
Table 602 (MBC 2015)

Table 601 (MBC 2015)

Structural Frame	0 hours
Bearing Walls – Interior	0 hours
Bearing Walls – Exterior	0 hours
Nonbearing Walls – Interior	0 hours
Floor Construction	0 hours
Roof Construction	0 hours

Fire-Resistance Rating for Exterior Walls
Table 602 (MBC 2015)

Fire Separation Distance 10 < X < 30 Group B – 0 hours

CHAPTER 7 - FIRE & SMOKE PROTECTION

Fire Barriers
Section 707 & Section 713.4 (MBC 2015) — 1 Hour Fire Barrier at Elevator Shaft Enclosure

Fire Partitions
Section 708 (MBC 2015) — See Section 420.2 for separation requirements.

Floor Assemblies
Section 711 (MBC 2015) — See Section 420.3 for separation requirements.

Doors
Table 716.5 (MBC 2015) — 1 Hour Rated in 1 Hour Fire Barrier
1/3 Hour (20 min.) rated in 1/2 Hour Rated Fire Partition

CHAPTER 8 - INTERIOR FINISHES

Interior finishes shall be classified in one of the following groups:

Class A: Flame spread index 0-25: smoke-developed index 0-450
Class B: Flame spread index 25-75: smoke-developed index 0-450
Class C: Flame spread index 76-200: smoke-developed index 0-450

Interior wall and ceiling finish requirements
Table 803.11 (MBC 2015)

OCC GROUP	EXIT PASSAGEWAYS	CORRIDORS & ENCLOSURE FOR EXIT ACCESS	ROOMS & ENCLOSED SPACES
R-3	C	C	C
S	C	C	C
B	B	C	C

CHAPTER 9 - FIRE PROTECTION SYSTEMS

Automatic Sprinkler Systems
Section 903
The building will have an automatic sprinkler system throughout, unless otherwise noted.

Fire Alarm and Detection Systems
Section 907

The building will have automatic fire alarm system.

CHAPTER 10 - MEANS OF EGRESS

Ceiling Height
Section 1003.2 — Means of egress paths shall have a minimum height of 7'-6".

Occupant Load
Table 1004.1.2

OCCUPANT LOAD				
OCCUPANCY TYPE	FUNCTION OF SPACE	AREA	FLOOR AREA - SF PER	OCCUPANTS
LEVEL 1				
BUSINESS (B)	EXERCISE	699	50	13.98
BUSINESS (B)	BUSINESS AREAS	3,798	100	37.98
STORAGE (S-1)	ACC. STORAGE	1,389	300	4.63
STORAGE (S-2)	PARKING GARAGES	2,829	200	14.15
TOTAL - LEVEL 1		8,715		71
LEVEL 2				
BUSINESS (B)	BUSINESS AREAS	1,622	100	16.22
STORAGE (S-1)	ACC. STOR. / MECH / ELEC	872	300	2.90
RESIDENTIAL (R-3)	RESIDENTIAL	832	200	4.16
TOTAL - LEVEL 2		3,326		24
TOTAL - LEVEL 1 & 2		12,041		95

Required egress capacity based on occupant load (doors)
Section 1005.3.2

.2 x 95 Occupants = 19" Required
96" Provided

Common path of egress travel and exit access travel distance with automatic sprinkler system
Table 1006.2.1 and 1017.2 — Refer to floor plan plans on sheet G0.11 for distances within buidling

Common path of egress (MBC 1006.2.1
Occupancy Group B 100 FT
Occupancy Group R-3 125 FT
Occupancy Group S-1 & S-2 100 FT

Exist access travel distance (MBC 1017.2)
Occupancy Group R-3 250 FT
Occupancy Group S-1 250 FT
Occupancy Group B 300 FT
Occupancy Group S-2 400 FT

CHAPTER 29 - PLUMBING SYSTEMS

Plumbing systems and equipment shall be designed and installed per the Michigan Plumbing Code 2018 (MPC 2018)

Required fixtures
Table 403.1

Business Use Group (B) — Occupant Load = 13.98+37.98+16.22=68.18 (69)
35 Male and 35 Female

	Required
Water closets (1 per 25 required for first 50 and 1 per 50 For the remainder exceeding 50)	1.4 (Men) 1.4 (Women)
Lavatories (1 per 40 required for first 80 and 1 per 80 For the remainder exceeding 80)	.875 (Men) .875 (Women

Storage Use Group (S-1 & S-2) — Occupant Load = 4.63+14.15+2.90=21.68 (22)
11 Male and 11 Female

Water closets (1 per 100)	.11 (Men) .11 (Women)
Lavatories (1 per 100)	.11 (Men) .11 (Women)

Residential (R-3) — Occupant Load = 4.16 (use 6 for 6 beds)
3 Male and 3 Female

Water closets (1 per 10)	.3 (Men) .3 (Women)
Lavatories (1 per 10)	.3 (Men) .3 (Women)
Showers (1 per 8)	.375 (Men) .375 (Women)

	Required	Provided
Total Water Closets	2.8+.22+.6=4 (M & W)	6 (Unisex-individual)
Total Lavatories	1.75+.22+.6=3 (M & W)	6 (Unisex-individual)
Total Showers	.75=1 (M & W)	3 (Unisex-individual)
Total Drinking Fountains (1 per 100)	95/100=1	1
Service Sinks (1 required)		2

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NEW FIRE STATION 4
2415 S HURON PKWY
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CODE COMPLIANCE

Sheet G0.10

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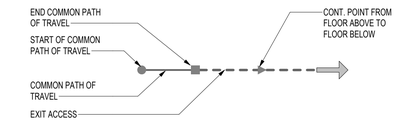
EGRESS TRAVEL

SPRINKLERED BUILDING - TABLES 1016.2 & 1014.3

PATH NUMBER	USE GROUP	LENGTH OF COMMON PATH TRAVEL	MAX. DISTANCE COMMON PATH OF TRAVEL	TOTAL LENGTH OF EXIT TRAVEL	MAX. EXIT TRAVEL DISTANCE WITH SPRINKLER SYSTEM
1	S-1	56' - 0"	100'	104' - 6"	250'
2	R-3	15' - 0"	100'	111' - 5"	250'
3	B	54' - 0"	125'	160' - 2"	300'
4	S-1	22' - 3"	100'	125' - 9"	250'

LEGEND



S-1 — OCCUPANCY GROUP

1/2 HR WALL

1 HR WALL

FE — WALL MOUNTED FIRE EXTINGUISHER

FEC — FIRE EXTINGUISHER CABINET

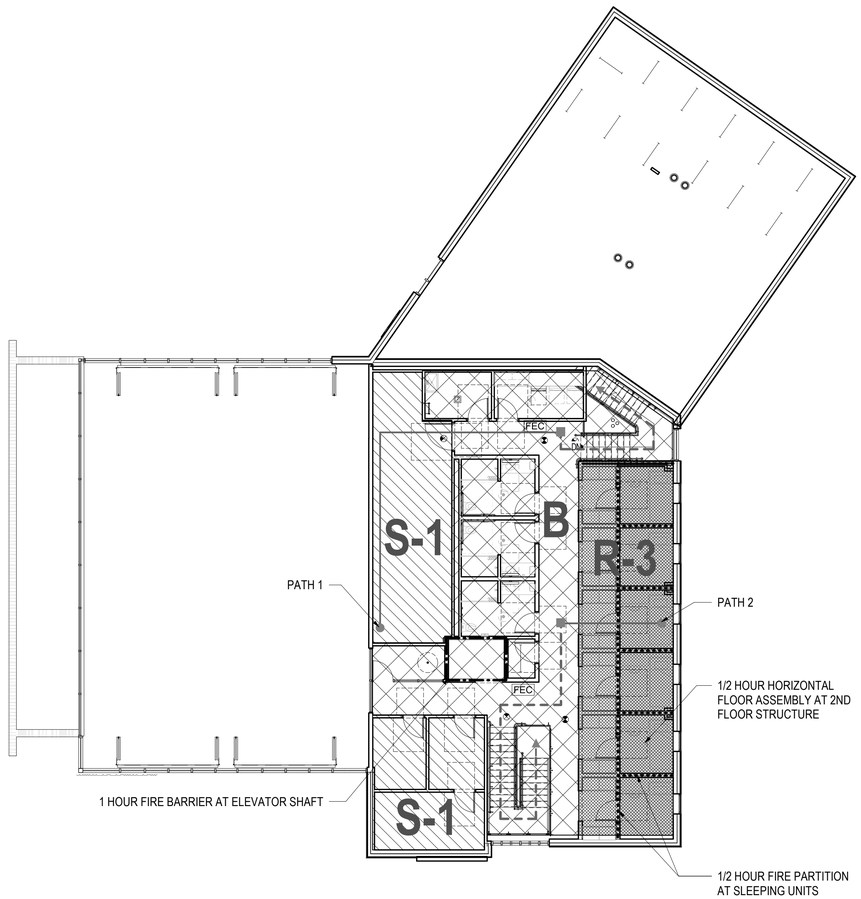
1/2 HOUR HORIZONTAL FLOOR ASSEMBLY SEPARATION

B

S-1

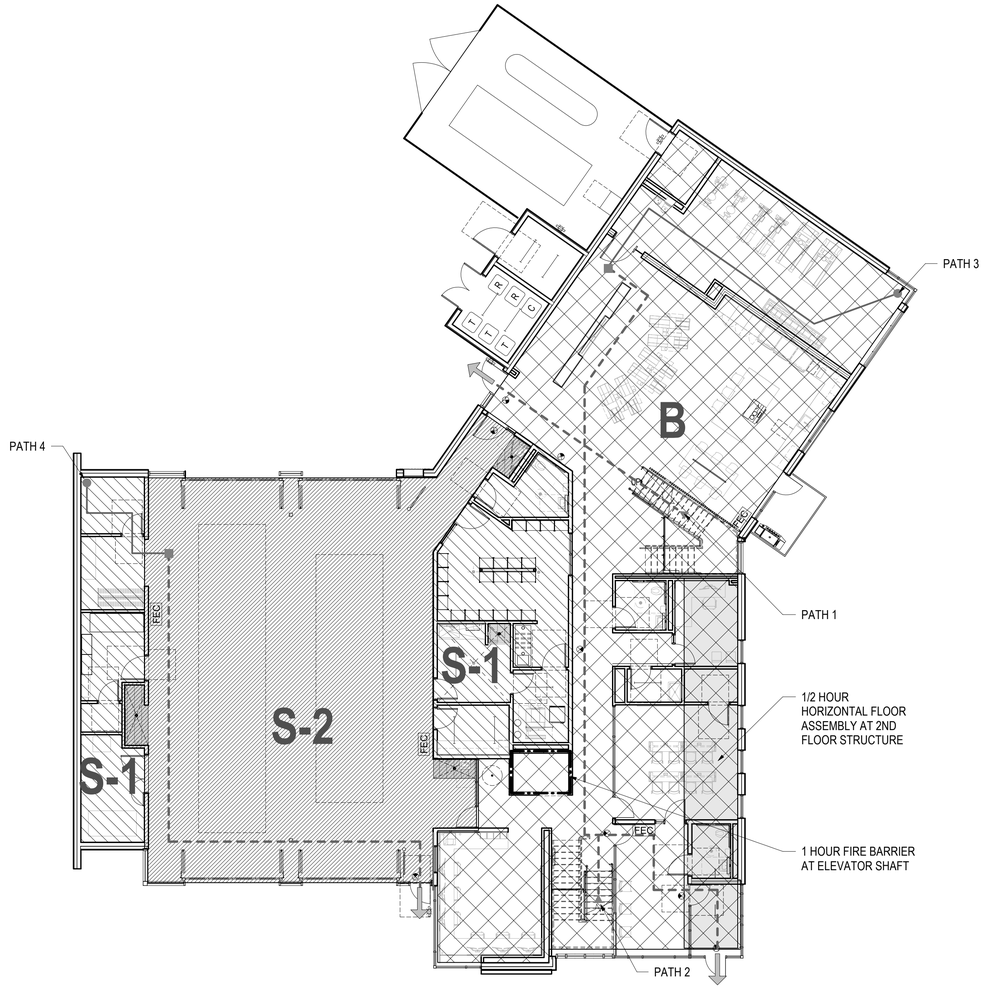
R-3

S-2



2 LEVEL 2 OCCUPANCY & EGRESS ROUTE

Scale: 3/32" = 1'-0"



1 LEVEL 1 OCCUPANCY & EGRESS ROUTE

Scale: 3/32" = 1'-0"

0 10' 20'

35° TRUE

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Sheet G0.11

FLOODPLAIN

BY GRAPHICAL PLOTTING, THE SITE IS WITHIN SEVERAL FLOOD ZONES PER FLOOD INSURANCE RATE MAP NUMBER 2616C0264E DATED APRIL 3, 2012.

- THE 1% ANNUAL CHANCE FLOODWAY IS SHOWN GRAPHICALLY AS MAPPED BY FEMA ON THE ABOVE REFERENCED MAP
- THE 0.2% AND 1% ANNUAL CHANCE FLOODPLAINS ARE SHOWN AS DETERMINED BY THE ELEVATION AND THE EXISTING CONTOURS.

CITY OF ANN ARBOR GEODETIC REFERENCE SYSTEM (AAGRS)

THE PROJECT IS DERIVED FROM THE AAGRS (MI STATE PLANE) COORDINATE SYSTEM: GEOID 12B

BENCHMARKS

(GPS DERIVED – NAVD88)

BM #300
BOLT ON THE SOUTH SIDE OF A SIGNAL POLE LOCATED ON THE EAST SIDE OF S. HURON PWKY AT THE INTERSECTION OF PLATT ROAD & S. HURON PKWY.
ELEV. – 793.38

BM #301
BOLT ON THE SOUTH SIDE OF A LIGHT POLE LOCATED ON THE SOUTH WIDE OF S. HURON PKWY, IN FRONT OF THE ANN ARBOR FIRE STATION #4.
ELEV. – 794.11

LEGAL DESCRIPTION

(Per City of Ann Arbor Assessing)

PARCEL ID 09-12-02-209-017

Land in the City of Ann Arbor, Washtenaw County, Michigan, described as follows:

COM W 1/4 COR TH N 88 DEG 50 MIN E 86.28 FT FOR POB TH NELY 300 FT ALG ARC NON-TANGENT CIR CURVE CONCAVE SE R=463.03 FT CHORD N 46 DEG 17 MIN 40 SEC E 294.78 FT TH S 14 DEG 37 MIN 30 SEC E 204.93 FT TH S 88 DEG 50 MIN W 264.91 FT TO POB PRT NW 1/4 SEC 2 T3S R6E

PARCEL ID 09-12-02-300-044

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REFERENCE DRAWINGS

WATER MAIN	UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED 6/2/2021
SANITARY SEWER	UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED 6/2/2021
STORM SEWER	UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED06/2/2021
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GAS	DTE GAS COMPANY MAP DATED 6/4/2021

LEGEND

- IRON FOUND
- IRON SET
- NAIL FOUND
- NAIL & CAP SET
- BRASS PLUG SET
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- MONUMENT SET
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- M MEASURED
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EXISTING

- ELEC., PHONE OR CABLE TV O.H. LINE, POLE & GUY WIRE
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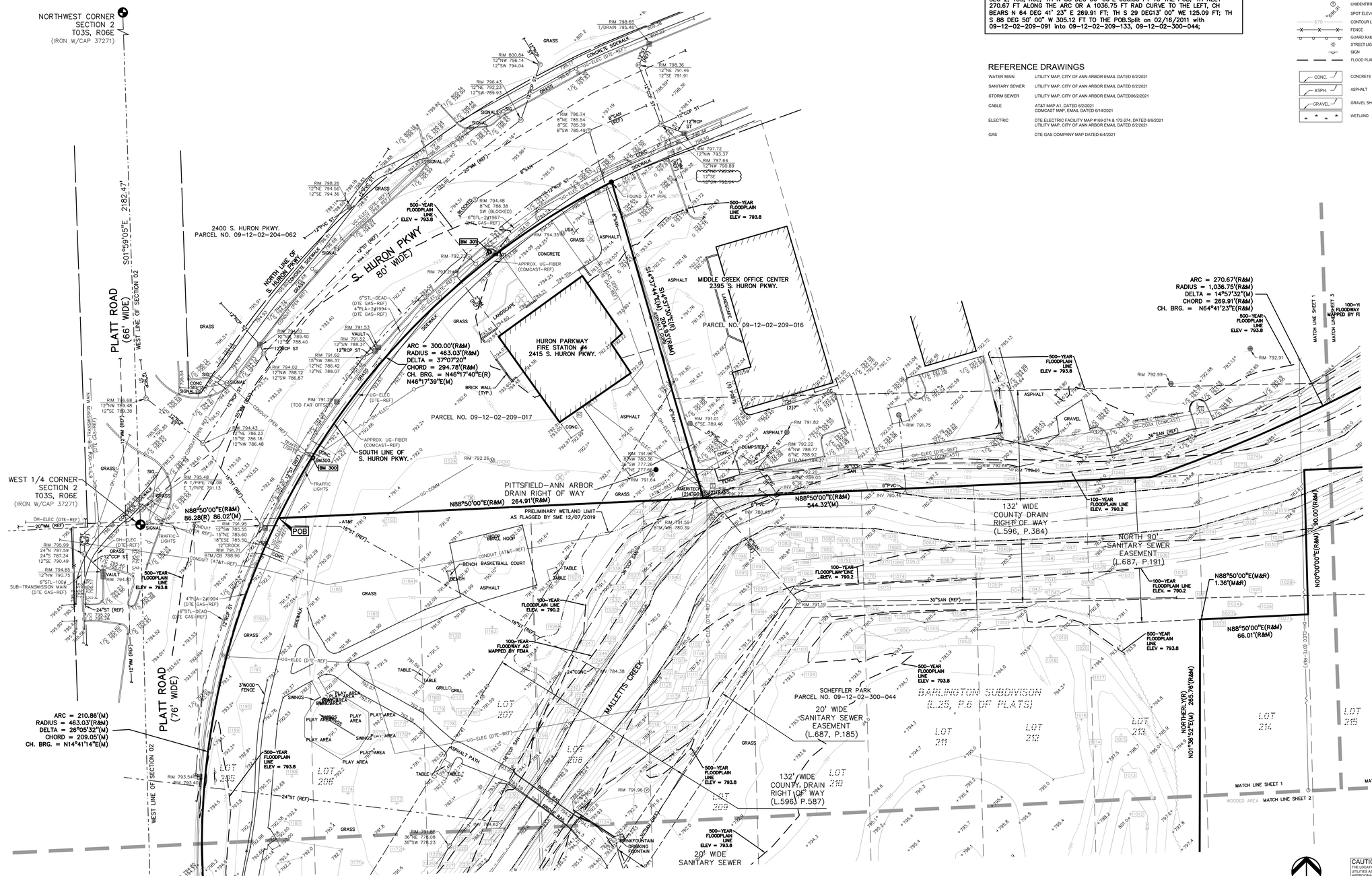

NORTH

SCALE: 1" = 30'

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811 Know what's below. Call before you dig.

S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\TOPOBASE-210184.dwg,09.03.05 4:41 PM

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STATE OF MICHIGAN
JOSEPH B WYWROT
ENGINEER
No. 6201046874
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
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PROJECT NUMBER	21018

ISSUE		
	Bids/Permits	10.11.24
	Site Plan-Engineering	08.21.24
	Final Site Plan-Rev	11.08.23
	Final Site Plan	09.08.23
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	WCWRC Resubmittal	01.13.23
	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

TOPOGRAPHIC SURVEY

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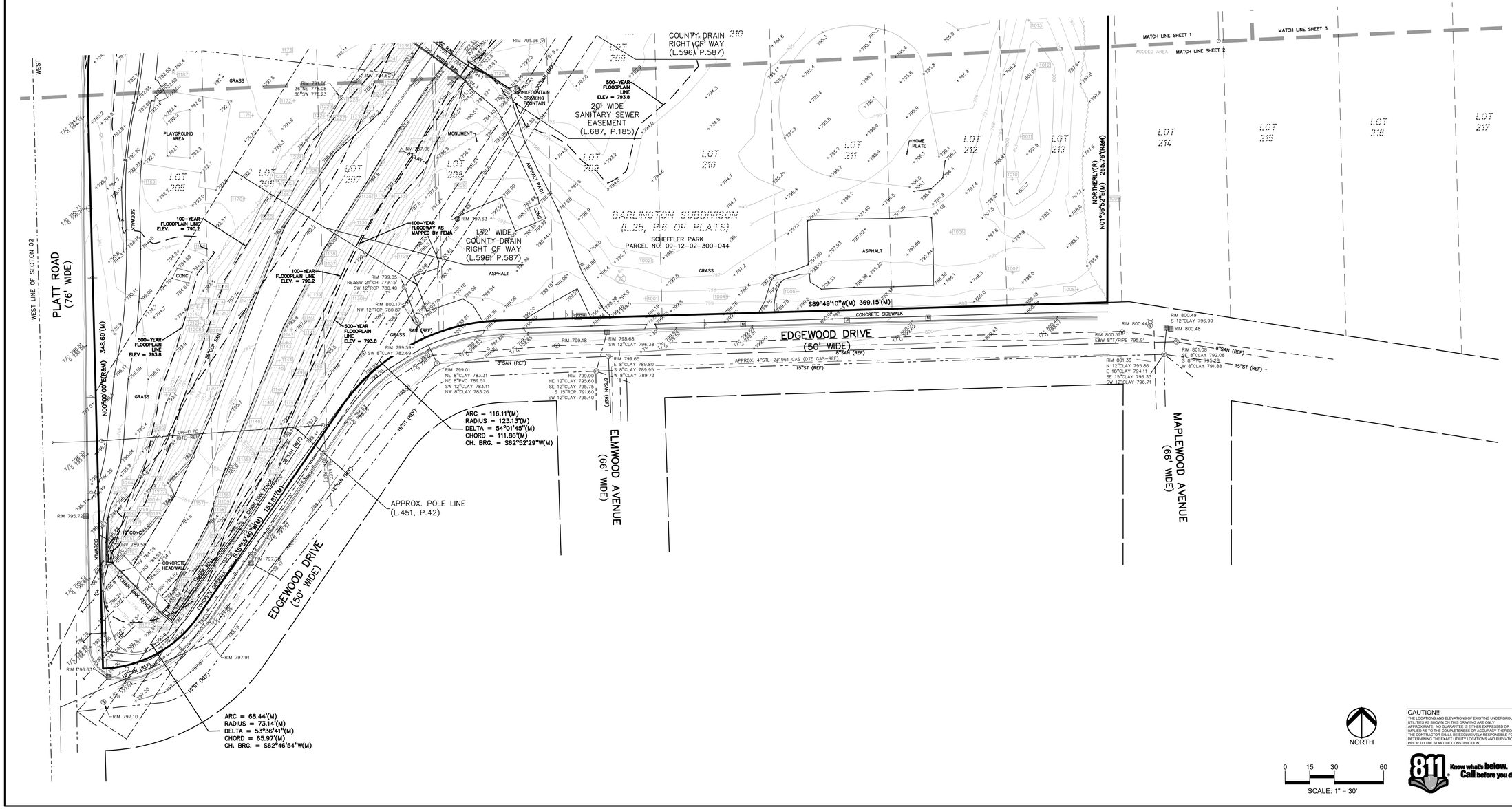

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	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

TOPOGRAPHIC SURVEY

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

SHEET C-1.1

S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\TOPOBASE-210184.dwg,09.03.05 4:41 PM

FLOODPLAIN

BY GRAPHICAL PLOTTING, THE SITE IS WITHIN SEVERAL FLOOD ZONES PER FLOOD INSURANCE RATE MAP NUMBER 2616C0264E DATED APRIL 3, 2012.

- THE 1% ANNUAL CHANCE FLOODWAY IS SHOWN GRAPHICALLY AS MAPPED BY FEMA ON THE ABOVE REFERENCED MAP
- THE 0.2% AND 1% ANNUAL CHANCE FLOODPLAINS ARE SHOWN AS DETERMINED BY THE ELEVATION AND THE EXISTING CONTOURS.

CITY OF ANN ARBOR GEODETIC REFERENCE SYSTEM (AAGRS)

THE PROJECT IS DERIVED FROM THE AAGRS (MI STATE PLANE) COORDINATE SYSTEM: GEOID 12B

BENCHMARKS

(GPS DERIVED – NAVD88)

BM #300
BOLT ON THE SOUTH SIDE OF A SIGNAL POLE LOCATED ON THE EAST SIDE OF S. HURON PWKY AT THE INTERSECTION OF PLATT ROAD & S. HURON PKWY.
ELEV. – 793.38

BM #301
BOLT ON THE SOUTH SIDE OF A LIGHT POLE LOCATED ON THE SOUTH WIDE OF S. HURON PKWY, IN FRONT OF THE ANN ARBOR FIRE STATION #4.
ELEV. – 794.11

LEGAL DESCRIPTION

(Per City of Ann Arbor Assessing)

PARCEL ID 09-12-02-209-017

Land in the City of Ann Arbor, Washtenaw County, Michigan, described as follows:

COM W 1/4 COR TH N 88 DEG 50 MIN E 86.28 FT FOR POB TH NELY 300 FT ALG ARC NON-TANGENT CIR CURVE CONCAVE SE R=463.03 FT CHORD N 46 DEG 17 MIN 40 SEC E 294.78 FT TH S 14 DEG 37 MIN 30 SEC E 204.93 FT TH S 88 DEG 50 MIN W 264.91 FT TO POB PRT NW 1/4 SEC 2 T3S R6E

PARCEL ID 09-12-02-300-044

Land in the City of Ann Arbor, Washtenaw County, Michigan, described as follows:

LOT 214 TH WLY 8 FT TH NELY 265.76 FT TO A PT WHICH IS S 88 DEG 50 MIN W 1.36 FT FROM WL LOT 214 TH N88 DEG 50 MIN E 1.36 FT TH SLY 265.68 FT TO POB ALSO N 90 FT LOT 214 DARLINGTON ALSO COM AT THE W 1/4 COR OF SEC 2, T3S, R6E; TH N 88 DEG 50' 00"E 630.33 FT TO THE POB; TH NELY 270.67 FT ALONG THE ARC OR A 1036.75 FT RAD CURVE TO THE LEFT, CH BEARS N 64 DEG 41' 23" E 269.91 FT; TH S 29 DEG13' 00" WE 125.09 FT; TH S 88 DEG 50' 00" W 305.12 FT TO THE POB.Split on 02/16/2011 with 09-12-02-209-091 into 09-12-02-209-133, 09-12-02-300-044;

REFERENCE DRAWINGS

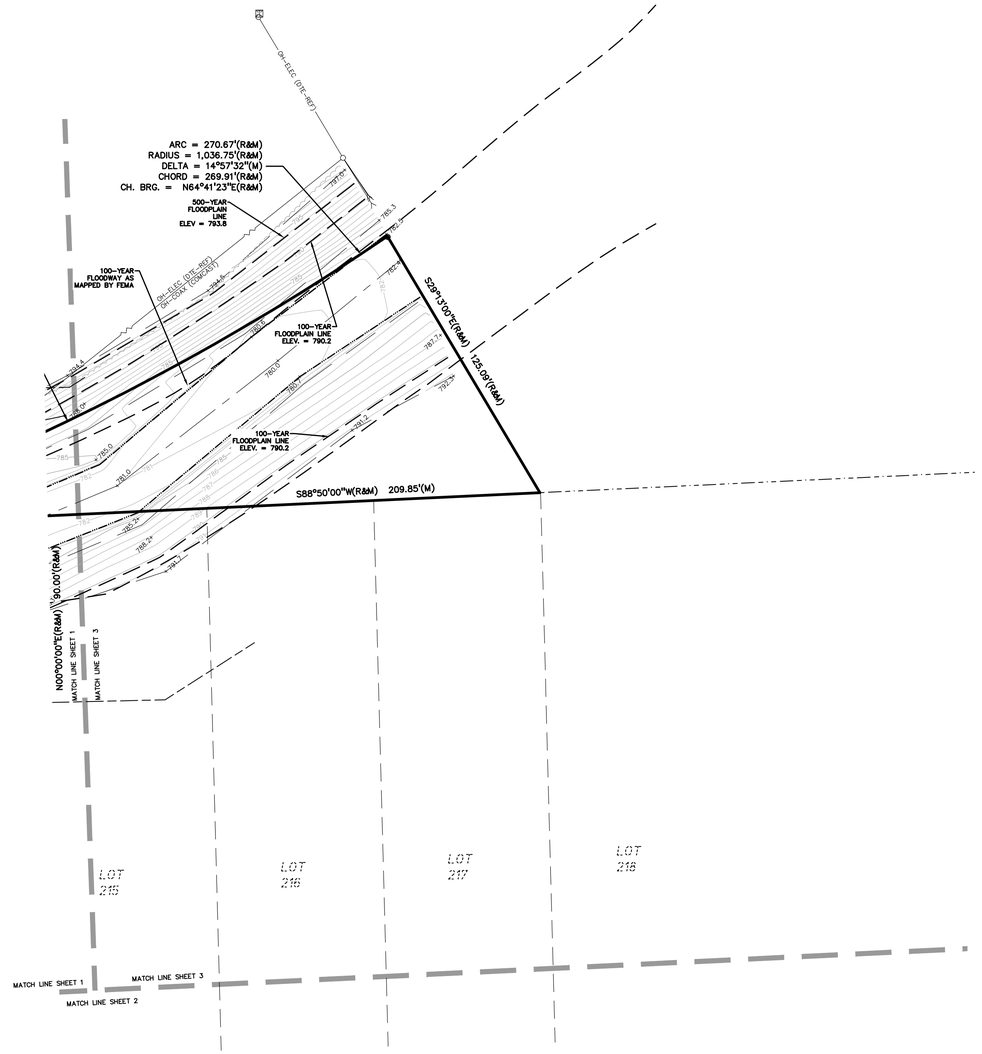
WATER MAIN	UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED 6/2/2021
SANITARY SEWER	UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED 6/2/2021
STORM SEWER	UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED06/2/2021
CABLE	AT&T MAP A1, DATED 6/2/2021 COMCAST MAP, EMAIL DATED 6/14/2021
ELECTRIC	DTE ELECTRIC FACILITY MAP #169-274 & 172-274, DATED 6/9/2021 UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED 6/2/2021
GAS	DTE GAS COMPANY MAP DATED 6/4/2021

LEGEND

IRON FOUND · IRON SET · NAIL FOUND · NAIL & CAP SET · BRASS PLUG SET · MONUMENT FOUND · MONUMENT SET · SEC. CORNER FOUND · R RECORDED · M MEASURED · C CALCULATED

EXISTING

- ELEC., PHONE OR CABLE TV O.H. LINE, POLE & GUY WIRE
- UNDERGROUND CABLE TV, CATV PEDESTAL
- TELEPHONE U.G. CABLE, PEDESTAL & MANHOLE
- ELECTRIC U.G. CABLE, MANHOLE, METER & HANDHOLE
- GAS MAIN, VALVE & GAS LINE MARKER
- WATERMAIN, HYD., GATE VALVE, TAPPING SLEEVE & VALVE
- SANITARY SEWER, CLEANOUT & MANHOLE
- STORM SEWER, CLEANOUT & MANHOLE
- COMBINED SEWER & MANHOLE
- SQUARE, ROUND & BEEHIVE CATCH BASIN, YARD DRAIN
- POST INDICATOR VALVE
- WATER VALVE BOX/HYDRANT VALVE BOX, SERVICE SHUTOFF
- MAILBOX, TRANSFORMER, IRRIGATION CONTROL VALVE
- UNIDENTIFIED STRUCTURE
- SPOT ELEVATION
- CONTOUR LINE
- FENCE
- GUARD RAIL
- STREET LIGHT
- SIGN
- FLOOD PLAN LINE
- CONCRETE
- ASPHALT
- GRAVEL SHOULDER
- WETLAND



NORTH

SCALE: 1" = 30'

0 15 30 60

CAUTION!!
THE LOCATIONS AND ELEVATIONS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THIS DRAWING ARE ONLY APPROXIMATE. NO GUARANTEE IS EITHER EXPRESSED OR IMPLIED AS TO THE COMPLETENESS OR ACCURACY THEREOF. THE CONTRACTOR SHALL BE EXCLUSIVELY RESPONSIBLE FOR DETERMINING THE EXACT UTILITY LOCATIONS AND ELEVATIONS PRIOR TO THE START OF CONSTRUCTION.

811 Know what's below. Call before you dig.

S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\TOPOBASE-210184.dwg,09.03.05 4:41 PM

TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
JOSEPH B WYWROT
ENGINEER
No. 6201040674
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

PROJECT NUMBER 21018

ISSUE		
	Bids/Permits	10.11.24
	Site Plan-Engineering	08.21.24
	Final Site Plan-Rev	11.08.23
	Final Site Plan	09.08.23
	Bids/Permits	08.04.23
	WCWRC Resubmittal	01.13.23
	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

TOPOGRAPHIC SURVEY

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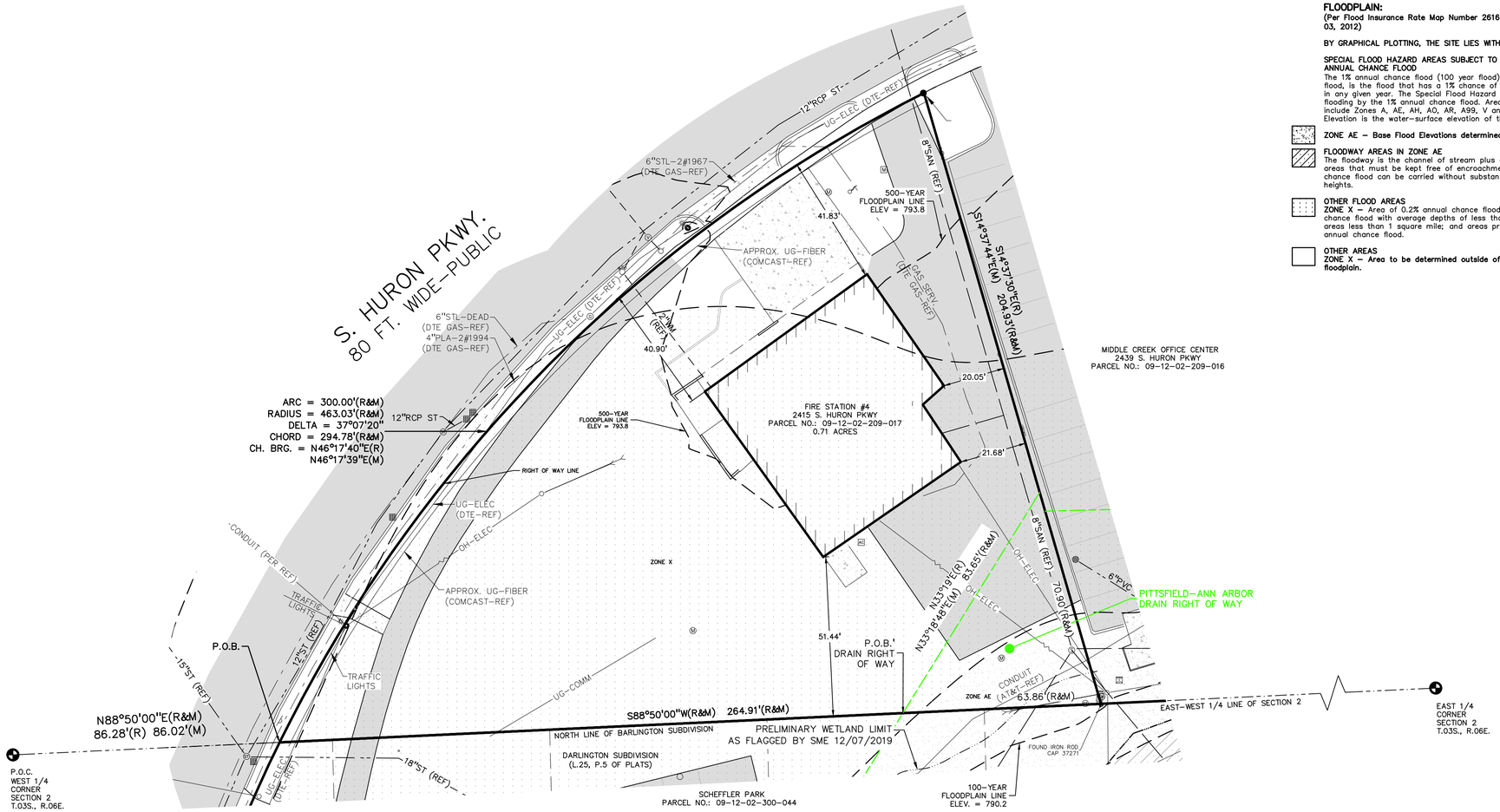
SHEET C-1.2



FLOODPLAIN:
(Per Flood Insurance Rate Map Number 26161C0264E. effective APRIL 03, 2012)

BY GRAPHICAL PLOTTING, THE SITE LIES WITHIN:

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100 year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE AE – Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE
The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS
ZONE X – Area of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS
ZONE X – Area to be determined outside of the 0.2% annual chance floodplain.

LEGEND:

- EX. OH. ELEC, POLE & GUY WIRE
- EX. U.G. CABLE TV & PEDESTAL
- EX. U.G. COMMUNICATION LINE, PEDESTAL & MANHOLE
- EX. U.G. ELEC,MANHOLE, METER & HANDHOLE
- EX. GAS LINE
- EX. GAS VALVE & GAS LINE MARKER
- EX. TRANSFORMER & IRRIGATION VALVE
- EX. WATER MAIN
- EX. HYDRANT, GATE VALVE & POST INDICATOR VALVE
- EX. WATER VALVE BOX & SHUTOFF
- EX. SANITARY SEWER
- EX. SANITARY CLEANOUT & MANHOLE
- EX. COMBINED SEWER MANHOLE
- EX. STORM SEWER
- EX. CLEANOUT & MANHOLE
- EX. SQUARE, ROUND, & BEEHIVE CATCH BASIN
- EX. YARD DRAIN & ROOF DRAIN
- EX. UNIDENTIFIED STRUCTURE
- EX. MAILBOX, SIGN & LIGHTPOLE
- EX. FENCE
- EX. GUARD RAIL
- EX. SPOT ELEVATION
- EX. CONTOUR
- EX. WETLAND
- IRON FOUND / SET
- NAIL FOUND / NAIL & CAP SET
- BRASS PLUG SET
- MONUMENT FOUND / SET
- SECTION CORNER FOUND
- RECORDED / MEASURED / CALCULATED
- CONCRETE
- ASPHALT
- TITLE EXCEPTION

REFERENCE DRAWINGS

TICKET NO.: B11523462-008

WATER MAIN	UTILITY MAP, CITY OF ANN ARBOR EMAIL, DATED 6/2/2021
SANITARY SEWER	UTILITY MAP, CITY OF ANN ARBOR EMAIL, DATED 6/2/2021
STORM SEWER	UTILITY MAP, CITY OF ANN ARBOR EMAIL, DATED06/2/2021
CABLE	AT&T MAP A1, DATED 6/2/2021 COMCAST MAP, EMAIL DATED 6/14/2021
ELECTRIC	DTE ELECTRIC FACILITY MAP #169-274 & 172-274, DATED 6/9/2021 UTILITY MAP, CITY OF ANN ARBOR EMAIL, DATED 6/2/2021
GAS	DTE GAS COMPANY MAP DATED 6/4/2021

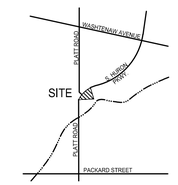
PEA GROUP
t: 844.813.2949
www.peagroup.com

NORTH

0 10 20 40
SCALE: 1" = 20'

811 Know what's below. Call before you dig.

CAUTION!!
THE LOCATIONS AND ELEVATIONS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THIS DRAWING ARE APPROXIMATE ONLY AND ARE BASED ON THE RECORDS PROCESSED OR IMPLIED AS TO THE COMPLETENESS OR ACCURACY THEREOF. THE CONTRACTOR SHALL BE EXCLUSIVELY RESPONSIBLE FOR DETERMINING THE EXACT UTILITY LOCATIONS AND ELEVATIONS PRIOR TO THE START OF CONSTRUCTION.



CLIENT
A3C
115 E. LIBERTY STREET
ANN ARBOR, MICHIGAN 48104

PROJECT TITLE
ANN ARBOR FIRE STATION #4
2415 S. HURON PARKWAY
ANN ARBOR, MICHIGAN 48104

NOTES CORRESPONDING TO SCHEDULE B

Issuing office file No.: Old Republic National Title Insurance Company
Commitment No.: LIB177111
Property Address: 2415 S Huron Pkwy, Ann Arbor, MI 48104-5129
Commitment Date: August 25, 2022

Items 1 through 11 are standard title exceptions

12. Pole Line Permit in favor of The Detroit Edison Company, as recorded in Liber 451, page 43, Washtenaw County Records. **[NOT LOCATED ON SURVEY PROPERTY AND IS NOT SHOWN ON THE SURVEY MAP.]**

SCHEDULE C PROPERTY DESCRIPTION

Issuing office file No.: Old Republic National Title Insurance Company
Commitment No.: LIB177111
Property Address: 2415 S Huron Pkwy, Ann Arbor, MI 48104-5129
Commitment Date: August 25, 2022

The land referred to in this Commitment is located in the City of Ann Arbor, County of Washtenaw, State of Michigan, and described as follows:

Commencing at the West 1/4 corner of Section 2, Town 3 South, Range 6 East, City of Ann Arbor, Washtenaw County, Michigan; thence along the East and West 1/4 line of said section, North 88 degrees 50' East 86.28 feet for a PLACE OF BEGINNING; thence Northeasterly along the Southeasterly line of the Huron Parkway 300.0 feet along the arc of a non tangential circular curve concave to the Southeast with a radius of 463.03 feet subtended by a chord which bears North 46 degrees 17' 40" East 294.78 feet; thence South 14 degrees 37' 30" East 204.93 feet; thence along the East and West 1/4 line of said section, South 88 degrees 50' West 264.91 feet to the PLACE OF BEGINNING, being a part of the Northwest 1/4 of said Section 2, Town 3 South, Range 6 East, City of Ann Arbor.

SUBJECT TO the right of way for the Pittsfield-Ann Arbor Drain over that part described as follows: Commencing at the West 1/4 corner of Section 2, Town 3 South, Range 6 East, City of Ann Arbor, Washtenaw County, Michigan; thence along the East and West 1/4 line of said section, North 88 degrees 50' East 287.33 feet for a PLACE OF BEGINNING; thence North 33 degrees 19' East 83.65 feet; thence South 14 degrees 37' 30" East 70.90 feet; thence along the East and West 1/4 line of said section, South 88 degrees 50' West 63.86 feet to the PLACE OF BEGINNING.

SURVEYOR'S NOTES

A) No table A Items requested.

B) Bearings were established by holding East-West 1/4 line of Section 2, T.03S., R.06E. at recorded baring N88°50E.

C) The surveyed property covers approximately 0.71 acres of land (31,152 square feet)

ALTA/NSPS LAND TITLE SURVEY CERTIFICATE

To: XXX

This is to certify that this map or plat and the survey on which it is based were made in accordance with the 2021 Minimum Standard Detail Requirements for ALTA/NSPS Land Title Surveys, jointly established and adopted by ALTA and NSPS. The field work was completed on August 25, 2022.

Christopher T. Beland, P.S.
Michigan Professional Surveyor No. 4001049106
Agent for PEA Group

September 20, 2022
Date

STATE OF MICHIGAN
CHRISTOPHER T. BELAND
PROFESSIONAL SURVEYOR NO. 4001049106
LICENSED PROFESSIONAL SURVEYOR

REVISIONS
- -

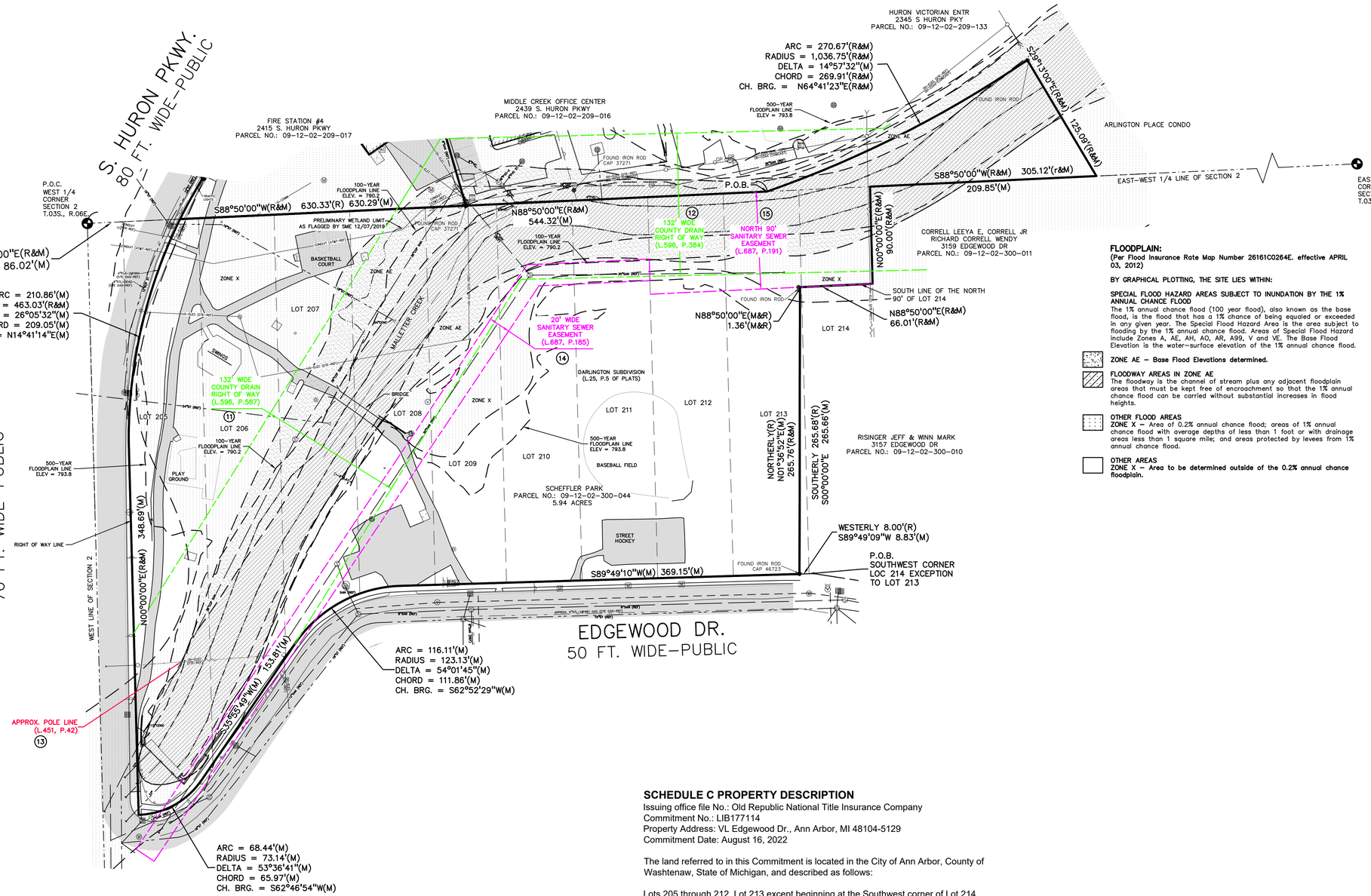
ORIGINAL ISSUE DATE:
September 20, 2022

DRAWING TITLE
ALTA/NSPS LAND TITLE SURVEY

PEA JOB NO.	2021-0184
P.M.	CB
DN.	JSH
DES.	-

DRAWING NUMBER:
C-1.3

\\peainc\pea\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\SURVEY-DEPT\2018ALTA\2018ALTA.dwg



FLOODPLAIN:
(Per Flood Insurance Rate Map Number 26161C0264E. effective APRIL 03, 2012)

BY GRAPHICAL PLOTTING, THE SITE LIES WITHIN:

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100 year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE AE – Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE
The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS
ZONE X – Area of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS
ZONE X – Area to be determined outside of the 0.2% annual chance floodplain.

LEGEND:

- EX. OH, ELEC, POLE & GUY WIRE
- EX. U.G. CABLE TV & PEDESTAL
- EX. U.G. COMMUNICATION LINE, PEDESTAL & MANHOLE
- EX. U.G. ELEC,MANHOLE, METER & HANDHOLE
- EX. GAS LINE
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- EX. WATER MAIN
- EX. HYDRANT, GATE VALVE & POST INDICATOR VALVE
- EX. WATER VALVE BOX & SHUTOFF
- EX. SANITARY SEWER
- EX. SANITARY CLEANOUT & MANHOLE
- EX. COMBINED SEWER MANHOLE
- EX. STORM SEWER
- EX. CLEANOUT & MANHOLE
- EX. SQUARE, ROUND, & BEEHIVE CATCH BASIN
- EX. YARD DRAIN & ROOF DRAIN
- EX. UNIDENTIFIED STRUCTURE
- EX. MAILBOX, SIGN & LIGHTPOLE
- EX. FENCE
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REFERENCE DRAWINGS

TICKET NO.: B11523462-008

WATER MAIN	UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED 6/2/2021
SANITARY SEWER	UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED 6/2/2021
STORM SEWER	UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED06/2/2021
CABLE	AT&T MAP A1, DATED 6/2/2021 COMCAST MAP, EMAIL DATED 6/14/2021
ELECTRIC	DTE ELECTRIC FACILITY MAP #169-274 & 172-274, DATED 6/9/2021 UTILITY MAP, CITY OF ANN ARBOR EMAIL DATED 6/2/2021
GAS	DTE GAS COMPANY MAP DATED 6/4/2021

NOTES CORRESPONDING TO SCHEDULE B

Issuing office file No.: Old Republic National Title Insurance Company
Commitment No.: LIB177114
Property Address: VL Edgewood Dr., Ann Arbor, MI 48104-5129
Commitment Date: August 16, 2022

Items 1 through 10 are standard title exceptions

11. Release of Right of Way in favor of County Drain Commissioner to the County of Washtenaw, as recorded in Liber 596, page 587, Washtenaw County Records. **[SHOWN ON THE SURVEY MAP.]**
12. Release of Right of Way in favor of County Drain Commissioner to the County of Washtenaw, as recorded in Liber 596, page 384, Washtenaw County Records. **[SHOWN ON THE SURVEY MAP.]**
13. Pole Line Permit in favor of The Detroit Edison Company, as recorded in Liber 451, page 42, Washtenaw County Records. **[SHOWN ON THE SURVEY MAP.]**
14. Easement in favor of City of Ann Arbor for Sanitary Sewer, as recorded in Liber 687, page 185, Washtenaw County Records. **[SHOWN ON THE SURVEY MAP.]**
15. Easement in favor of City of Ann Arbor for Sanitary Sewer, as recorded in Liber 687, page 191, Washtenaw County Records. **[SHOWN ON THE SURVEY MAP.]**
16. Release of Right of Way in favor of County Drain Commissioner to the County of Washtenaw, as recorded in Liber 535, page 18, Washtenaw County Records. **[NOT LOCATED ON SURVEY PROPERTY AND IS NOT SHOWN ON THE SURVEY MAP.]**

SCHEDULE C PROPERTY DESCRIPTION

Issuing office file No.: Old Republic National Title Insurance Company
Commitment No.: LIB177114
Property Address: VL Edgewood Dr., Ann Arbor, MI 48104-5129
Commitment Date: August 16, 2022

The land referred to in this Commitment is located in the City of Ann Arbor, County of Washtenaw, State of Michigan, and described as follows:

Lots 205 through 212, Lot 213 except beginning at the Southwest corner of Lot 214 thence Westerly 8 feet; thence Northeastly 265.76 feet to a point which is South 88 degrees 50 minutes West 1.36 feet from Westerly lline of Lot 214; thence North 88 degrees 50 minutes East 1.36 feet; thence Southerly 265.68 feet to point of beginning, also The North 90 feet of lot 214, all in Darlington Subdivision, as recorded in Libert 5 of Plats, page 5, Washtenaw County Records; Also com at the West 1/4 cor of Section 2, T3S, R6E; thence North 88 degrees 50 minutes 00 seconds Esat 630.33 feet along the East-West 1/4 line of said Section2 to the point of beginning; thence Northeasterly 270.67 feet in the arc of a curve to the left, radius 1036.75 feet, central angle 14 degrees 57 minutes 31 seconds and chord bearing North 64 degrees 41 minutes 23 seconds Est 125.09 feet; thence South 88 degrees 50 minutes 00 seconds West 305.12 feet along said East-West 1/4 line to the point of beginning, being a part of Section 2, T2S, R6E, Washtenaw County, Michigan.

* Schedule C contains typos and missing information legal below per County Tax recorded.

Land in the City of Ann Arbor, Washtenaw County, Michigan, described as follows:

LOTS 205 THRU 212 LOT 213 EXC BEG SW COR LOT 214 TH WLY 8 FT TH NELY 265.76 FT TO A PT WHICH IS S 88 DEG 50 MIN W 1.36 FT FROM WL LOT 214 TH N 88 DEG 50 MIN E 1.36 FT TH SLY 265.68 FT TO POB ALSO N 90 FT LOT 214 DARLINGTON ALSO COM AT THE W 1/4 COR OF SEC 2, T3S, R6E; TH N 88 DEG 50' 00" E 630.33 FT TO THE POB; TH NELY 270.67 FT ALONG THE ARC OR A 1036.75 FT RAD CURVE TO THE LEFT, CH BEARS N 64 DEG 41' 23" E 269.91 FT; TH S 29 DEG 13' 00" WE 125.09 FT; TH S 88 DEG 50' 00" W 305.12 FT TO THE POB.
PARCEL NO.: 09-12-02-300-044

SURVEYOR'S NOTES

A) No table A Items requested.

B) Bearings were established by holding East-West 1/4 line of Section 2, T.03S., R.06E. at recorded bearing N88°50E Darlington Subdivision as recorded in Liber 25, Page 6 of plats Washtenaw County records.

C) The surveyed property covers approximately 5.94 acres of land (258,771 square feet)

ALTA/NSPS LAND TITLE SURVEY CERTIFICATE

To: XXX

This is to certify that this map or plat and the survey on which it is based were made in accordance with the 2021 Minimum Standard Detail Requirements for ALTA/NSPS Land Title Surveys, jointly established and adopted by ALTA and NSPS. The field work was completed on August 25, 2022.

Christopher T. Beland, P.S.
Michigan Professional Surveyor No. 4001049106
Agent for PEA Group

September 20, 2022
Date

STATE OF MICHIGAN
CHRISTOPHER T. BELAND
PROFESSIONAL SURVEYOR NO. 4001049106
LICENSED PROFESSIONAL SURVEYOR

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NORTH
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SCALE: 1" = 50'

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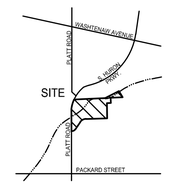

CLIENT
A3C
115 E. LIBERTY STREET
ANN ARBOR, MICHIGAN 48104

PROJECT TITLE
SCHEFFLER PARK
VL EDGEWOOD DR.
ANN ARBOR, MICHIGAN 48104

REVISIONS
- -

ORIGINAL ISSUE DATE:
September 20, 2022

DRAWING TITLE
ALTA/NSPS LAND TITLE SURVEY

PEA JOB NO.	2021-0184
P.M.	CB
DN.	JSH
DES.	-

DRAWING NUMBER:
C-1.4

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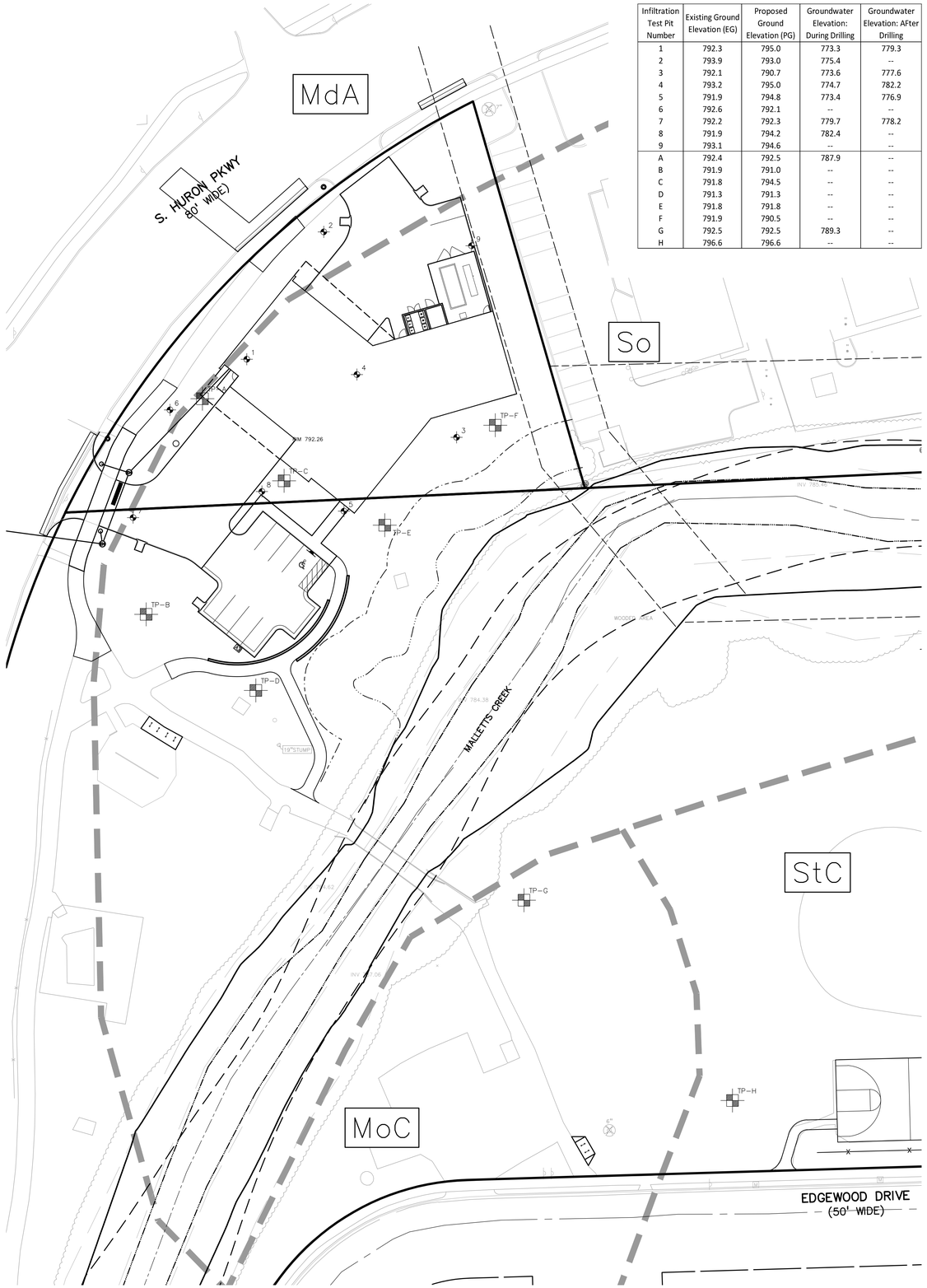
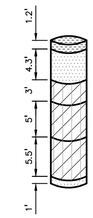


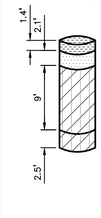
Infiltration Test Pit Number	Existing Ground Elevation (EG)	Proposed Ground Elevation (PG)	Groundwater Elevation: During Drilling	Groundwater Elevation: AFter Drilling
1	792.3	795.0	773.3	779.3
2	793.9	793.0	775.4	--
3	792.1	790.7	773.6	777.6
4	793.2	795.0	774.7	782.2
5	791.9	794.8	773.4	776.9
6	792.6	792.1	--	--
7	792.2	792.3	779.7	778.2
8	791.9	794.2	782.4	--
9	793.1	794.6	--	--
A	792.4	792.5	787.9	--
B	791.9	791.0	--	--
C	791.8	794.5	--	--
D	791.3	791.3	--	--
E	791.8	791.8	--	--
F	791.9	790.5	--	--
G	792.5	792.5	789.3	--
H	796.6	796.6	--	--

TEST BORING #1
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JUNE 18, 2021



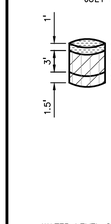
WATER LEVEL OBSERVATIONS:
DURING DRILLING: 19'
AFTER DRILLING: 13'

TEST BORING #6
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JUNE 18, 2021



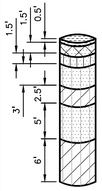
WATER LEVEL OBSERVATIONS:
DURING DRILLING: NONE
AFTER DRILLING: DRY

TEST PIT B
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JULY 14, 2022



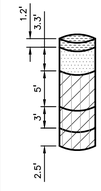
WATER LEVEL OBSERVATIONS:
DURING EXCAVATION: NONE
NO INFILTRATION TESTING PERFORMED

TEST BORING #2
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JUNE 18, 2021



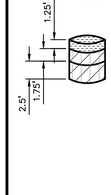
WATER LEVEL OBSERVATIONS:
DURING DRILLING: 18.5'
AFTER DRILLING: DRY

TEST BORING #7
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JUNE 18, 2021



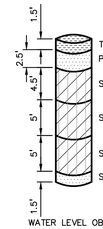
WATER LEVEL OBSERVATIONS:
DURING DRILLING: 12.5'
AFTER DRILLING: 14'

TEST PIT C
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JULY 14, 2022



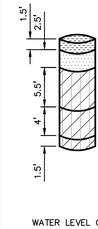
WATER LEVEL OBSERVATIONS:
DURING EXCAVATION: NONE
NO INFILTRATION TESTING PERFORMED

TEST BORING #3
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JUNE 18, 2021



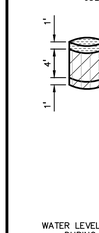
WATER LEVEL OBSERVATIONS:
DURING DRILLING: 18.5'
AFTER DRILLING: 14.5'

TEST BORING #8
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JUNE 18, 2021



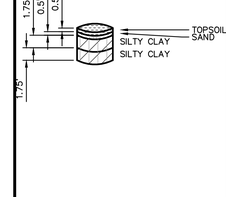
WATER LEVEL OBSERVATIONS:
DURING DRILLING: 9.5'
AFTER DRILLING: DRY

TEST PIT D
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JULY 14, 2022



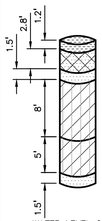
WATER LEVEL OBSERVATIONS:
DURING EXCAVATION: NONE
NO INFILTRATION TESTING PERFORMED

TEST PIT G
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JULY 14, 2022



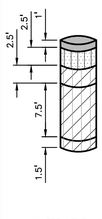
WATER LEVEL OBSERVATIONS:
DURING EXCAVATION: 3.25'
NO INFILTRATION TESTING PERFORMED

TEST BORING #4
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JUNE 18, 2021



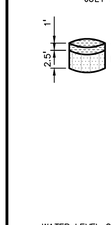
WATER LEVEL OBSERVATIONS:
DURING DRILLING: 18.5'
AFTER DRILLING: 11'

TEST BORING #9
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JUNE 18, 2021



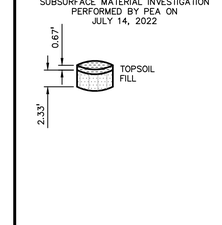
WATER LEVEL OBSERVATIONS:
DURING DRILLING: NONE
AFTER DRILLING: DRY

TEST PIT E
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JULY 14, 2022



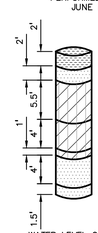
WATER LEVEL OBSERVATIONS:
DURING EXCAVATION: NONE
NO INFILTRATION TESTING PERFORMED

TEST PIT H
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JULY 14, 2022



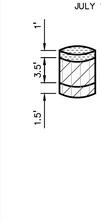
WATER LEVEL OBSERVATIONS:
DURING EXCAVATION: NONE
NO INFILTRATION TESTING PERFORMED

TEST BORING #5
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JUNE 18, 2021



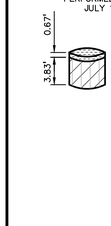
WATER LEVEL OBSERVATIONS:
DURING DRILLING: 18.5'
AFTER DRILLING: 15'

TEST PIT A
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JULY 14, 2022



WATER LEVEL OBSERVATIONS:
DURING EXCAVATION: 4.5'
NO INFILTRATION TESTING PERFORMED

TEST PIT F
SUBSURFACE MATERIAL INVESTIGATION PERFORMED BY PEA ON JULY 14, 2022



WATER LEVEL OBSERVATIONS:
DURING EXCAVATION: NONE
NO INFILTRATION TESTING PERFORMED

LEGAL DESCRIPTION
(Per City of Ann Arbor Assessing)

PARCEL ID 09-12-02-209-017

Land in the City of Ann Arbor, Washtenaw County, Michigan, described as follows:

COM W 1/4 COR TH N 88 DEG 50 MIN E 86.28 FT FOR POB TH NELY 300 FT ALG ARC NON-TANGENT CIR CURVE CONCAVE SE R=463.03 FT CHORD N 46 DEG 17 MIN 40 SEC E 294.78 FT TH S 14 DEG 37 MIN 30 SEC E 204.93 FT TH S 88 DEG 50 MIN W 264.91 FT TO POB PRT NW 1/4 SEC 2 T3S R6E

BENCHMARKS
(GPS DERIVED - NAVD88)

BM #300
BOLT ON THE SOUTH SIDE OF A SIGNAL POLE LOCATED ON THE EAST SIDE OF S. HURON PWKY AT THE INTERSECTION OF PLATT ROAD & S. HURON PKWY.
ELEV. = 793.38

BM #301
BOLT ON THE SOUTH SIDE OF A LIGHT POLE LOCATED ON THE SOUTH WIDE OF S. HURON PKWY, IN FRONT OF THE ANN ARBOR FIRE STATION #4.
ELEV. = 794.11

FLOODPLAIN NOTE:
BY GRAPHICAL PLOTTING, SITE IS WITHIN SEVERAL FLOOD ZONES PER FLOOD INSURANCE RATE MAP NUMBER 26161C0264E DATED APRIL 3, 2012. SEE SHEET P-1.0, TOPOGRAPHICAL SURVEY FOR MORE DETAILED INFORMATION.

SOIL INVESTIGATION

PER THE US DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE SOILS MAP FOR WASHTENAW COUNTY, SITE SOILS CONSIST OF:

MdA - MATHERTON SANDY LOAM, 0 TO 4 PERCENT SLOPES; HYDROLOGIC SOIL GROUP B/D

MoC - MORLEY LOAM, 6 TO 12 PERCENT SLOPES; HYDROLOGIC SOIL GROUP C

So - SLOAN SILT LOAM, 0 T 1 PERCENT SLOPES; FREQUENTLY FLOODED; HYDROLOGIC SOIL GROUP B/D

StC - ST. CLAIR CLAY LOAM, 6 TO 12 PERCENT SLOPES; HYDROLOGIC SOIL GROUP D

SOIL INVESTIGATION LEGEND:

SOIL BORING LOCATION

PROPOSED TEST PIT LOCATION

NOTE: A GEOTECHNICAL INVESTIGATION, DATED JULY 21, 2021, WAS COMPLETED BY PEA GROUP FOR THE PROJECT AND IS AVAILABLE UPON REQUEST. ADDITIONAL INFORMATION ON THE SOIL BORINGS CAN BE FOUND IN THIS REPORT.

NORTH

0 15 30 60

SCALE: 1" = 30'

CAUTION!!
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TCA ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
JOSEPH B. WYWROT
ENGINEER
No. 6201040674
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

PROJECT NUMBER 21018

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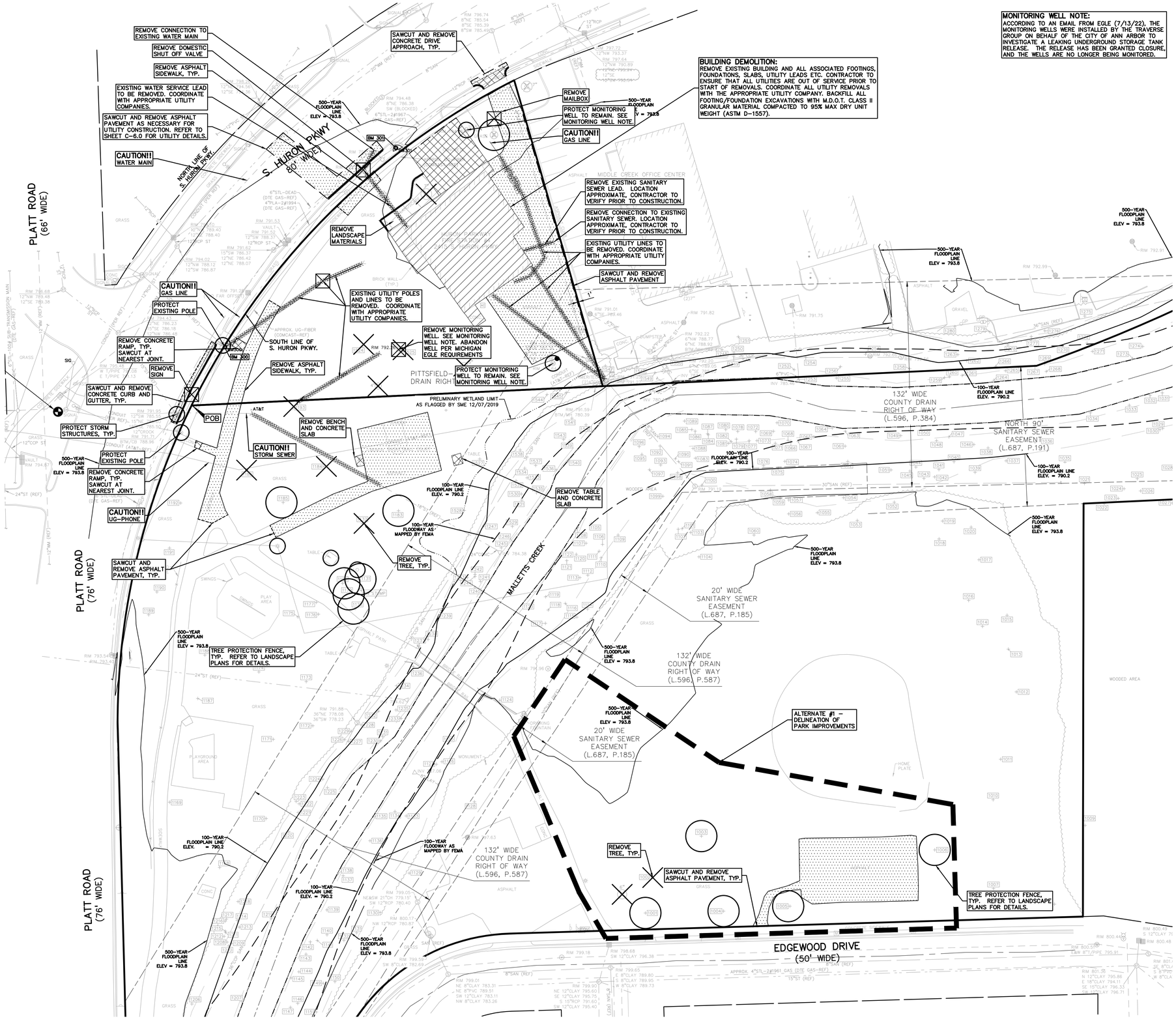
	Bids/Permits	08.04.23
	WCWRC Resubmittal	01.13.23
	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

SOIL BORING INFORMATION PLAN

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

SHEET C-1.5



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GENERAL DEMOLITION NOTES:

THESE NOTES APPLY TO ALL CONSTRUCTION ACTIVITIES ON THIS PROJECT:

1. ALL MATERIAL TO BE REMOVED, WHETHER SPECIFICALLY NOTED IN THE PLANS OR NOT, SHALL BE REMOVED FROM THE SITE BY THE CONTRACTOR AND DISPOSED OF OFF-SITE IN A LEGAL MANNER. NO ON-SITE BURY OR BURN PITS SHALL BE ALLOWED.
2. ALL DEMOLITION WORK SHALL CONFORM TO ALL LOCAL CODES AND ORDINANCES.
3. STAGING/PHASING OF DEMOLITION AND CONSTRUCTION IS TO BE COORDINATED WITH THE OWNER AND THE CONTRACTOR PRIOR TO CONSTRUCTION.
4. SPECIFIC DEMOLITION ITEMS HAVE BEEN INDICATED ON THE PLANS AS A GUIDE TO THE GENERAL SCOPE OF THE WORK. IT IS THE INTENT THAT THESE ITEMS SHALL BE COMPLETELY REMOVED BY THE CONTRACTOR ABOVE AND BELOW GROUND, UNLESS SPECIFICALLY NOTED OTHERWISE, AND THAT DEMOLITION WILL INCLUDE BUT WILL NOT NECESSARILY BE LIMITED TO THESE ITEMS. CONTRACTOR SHALL VISIT SITE TO VERIFY EXISTING CONDITIONS AND EXTENTS OF THE DEMOLITION THAT WILL BE REQUIRED PRIOR TO SUBMITTING A BID.
5. REMOVE ALL STRUCTURES DESIGNATED FOR REMOVAL ACCORDING TO THE DEMOLITION PLAN. THIS INCLUDES FOUNDATIONS, FOOTINGS, FOUNDATION WALLS, FLOOR SLABS, UNDERGROUND UTILITIES, CONCRETE, ASPHALT, TREES, ETC.
6. REFER TO LANDSCAPE DRAWINGS FOR TREE PROTECTION DETAILS.
7. THE CONTRACTOR SHALL, AS A MINIMUM, PROVIDE TREE PROTECTION FENCING AROUND EXISTING TREES TO BE SAVED THAT ARE WITHIN 15 FEET OF CONSTRUCTION ACTIVITIES AND AS INDICATED IN THE PLANS OR PER LOCAL AGENCY REQUIREMENTS.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CLEAN UP, NOISE, DUST CONTROL, STREET SWEEPING AND HOURS OF OPERATION IN ACCORDANCE WITH THE LOCAL CODES.
9. THE CONTRACTOR SHALL PROVIDE ALL NECESSARY BARRICADES, SIGNAGE, MARKINGS, LIGHTS AND OTHER TRAFFIC CONTROL DEVICES TO PROTECT THE WORK ZONE AND SAFELY MAINTAIN TRAFFIC PER AGENCY REQUIREMENTS AND IN ACCORDANCE WITH THE LATEST EDITION OF THE STATE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
10. THE CONTRACTOR SHALL CONTACT THE APPROPRIATE UTILITY COMPANIES TO CONFIRM THAT UTILITY LEADS HAVE BEEN TAKEN OUT OF SERVICE PRIOR TO DEMOLITION.
11. ALL BUILDING GAS LEADS, METERS AND ASSOCIATED EQUIPMENT SHALL BE REMOVED AS SHOWN ON THE PLANS. COORDINATE ALL ASSOCIATED WORK WITH THE APPROPRIATE UTILITY COMPANY.
12. REMOVE ALL OVERHEAD AND UNDERGROUND ELECTRICAL LINES WITHIN THE AREA OF CONSTRUCTION AS SHOWN ON THE PLANS. COORDINATE SHUTDOWNS AND REMOVALS WITH ELECTRICAL SERVICE PROVIDER OR THE APPROPRIATE UTILITY COMPANY. (NOTE: PHONE AND CABLE T.V. SERVICES MAY ALSO BE LOCATED ON OVERHEAD LINES.)
13. THE CONTRACTOR IS RESPONSIBLE FOR THE REMOVAL AND REPLACEMENT OF SIGNS AND SUPPORTS WITHIN THE WORK AREA, AS NECESSARY TO FACILITATE CONSTRUCTION. SIGNS SHALL BE PROTECTED OR STOCKPILED FOR REUSE AS SPECIFIED IN THE PLANS OR AS REQUIRED BY THE AGENCY OF JURISDICTION. THE CONTRACTOR SHALL REPLACE ANY DAMAGED SIGNS AND SUPPORTS AT NO ADDITIONAL COST TO THE OWNER.
14. THE CONTRACTOR SHALL NOTIFY THE APPROPRIATE 811/ONE CALL UTILITY LOCATING CENTER, THE CITY ENGINEER AND/OR THE AUTHORITY HAVING JURISDICTION 3 BUSINESS DAYS PRIOR TO THE BEGINNING OF CONSTRUCTION.

DEMOLITION LEGEND:

- ITEM TO BE PROTECTED
- ITEM TO BE REMOVED
- CURB/FENCE REMOVAL
- CONCRETE PAVEMENT AND SIDEWALK REMOVAL
- AREA OR ITEMS TO BE REMOVED
- UTILITY REMOVAL
- ABANDON UTILITY
- ASPHALT REMOVAL
- TREE REMOVAL
- SAWCUT LINE

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JOSEPH B. WYWROT
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t: 844.813.2949
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	Site Plan Approval	09.22.22

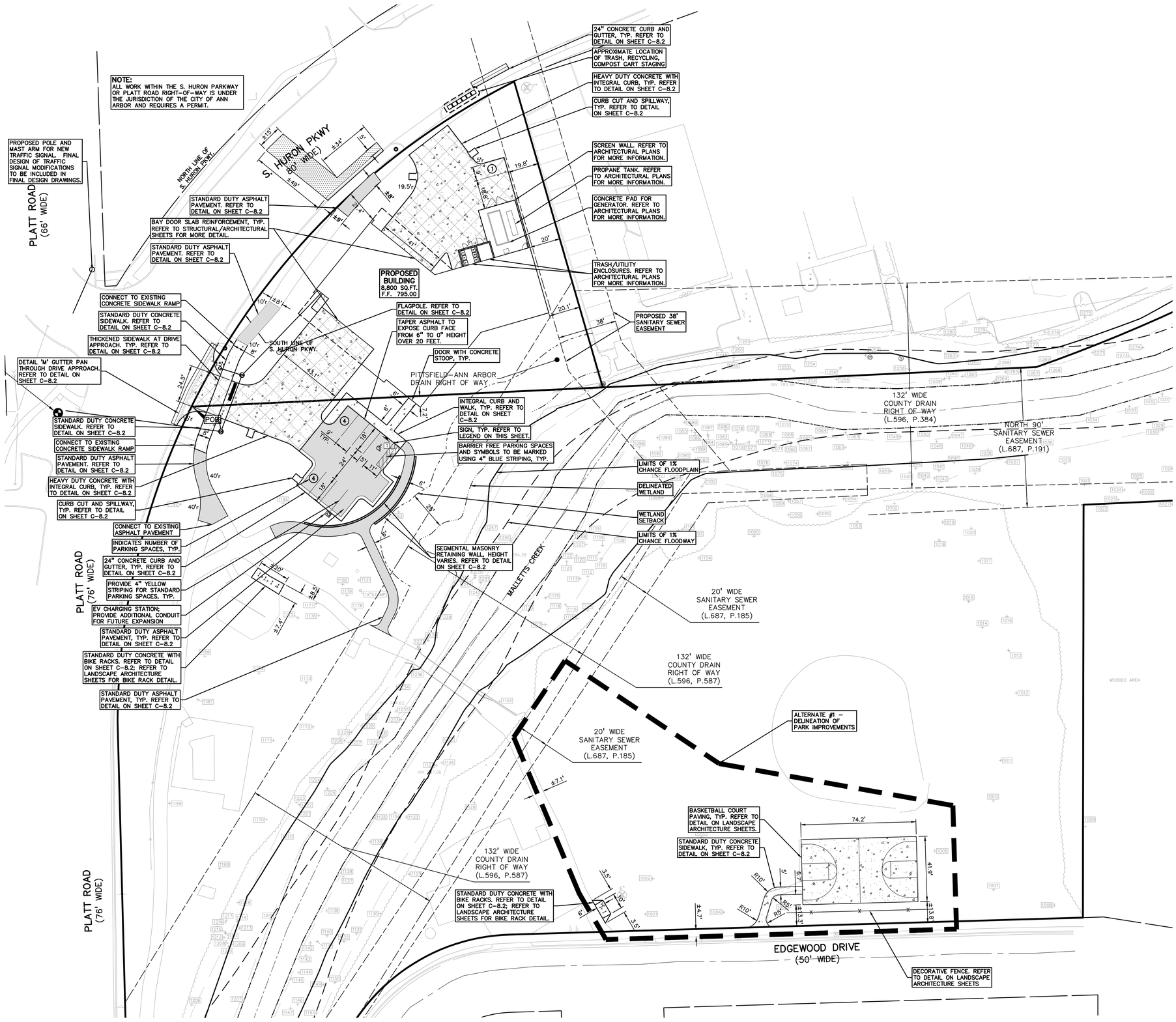
DRN: JW CHK'D: JC

DEMOLITION PLAN

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

SHEET C-2.0

S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\CONSTRUCTION\(C-2.0) DEMO-210184.dwg,09.03.05 4:41 PM



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GENERAL NOTES:

THESE NOTES APPLY TO ALL CONSTRUCTION ACTIVITIES ON THIS PROJECT.

1. ALL DIMENSIONS SHOWN ARE TO BACK OF CURB, FACE OF SIDEWALK, OUTSIDE FACE OF BUILDING, PROPERTY LINE, CENTER OF MANHOLE/CATCH BASIN OR CENTERLINE OF PIPE UNLESS OTHERWISE NOTED.
2. REFER TO NOTES & DETAILS SHEET FOR ON-SITE PAVING DETAILS.
3. REFER TO NOTES & DETAILS SHEET FOR ON-SITE SIDEWALK RAMP DETAILS.
4. ALL SIDEWALKS SHALL BE KEPT AND MAINTAINED IN GOOD REPAIR BY THE OWNER OF THE LAND ADJACENT TO AND ABUTTING THE SAME. PRIOR TO THE ISSUANCE OF THE FINAL CERTIFICATE OF OCCUPANCY FOR THIS SITE, ALL EXISTING SIDEWALKS IN NEED OF REPAIR MUST BE REPAIRED IN ACCORDANCE WITH CITY STANDARDS.

LEGEND:

- CONCRETE PAVEMENT (STD DUTY / HEAVY DUTY / R.O.W. ONLY)
- ASPHALT PAVEMENT (STD DUTY / HEAVY DUTY / DEEP STRENGTH)
- GRAVEL
- WETLAND
- CONCRETE CURB AND GUTTER
- REVERSE GUTTER PAN
- SETBACK LINE
- SIGN
- LIGHTPOLE
- FENCE
- GUARD RAIL

SIGN LEGEND:

'BARRIER FREE PARKING' SIGN [1]
'VAN ACCESSIBLE' SIGN [2]
REFER TO DETAIL SHEET FOR SIGN DETAILS

TCA
ARCHITECTURE + PLANNING + DESIGN

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OVERALL DIMENSIONAL LAYOUT PLAN

A3C
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
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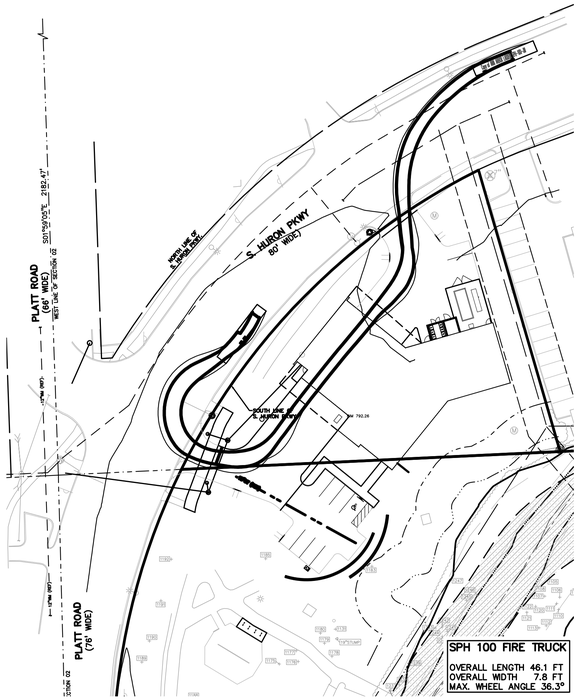
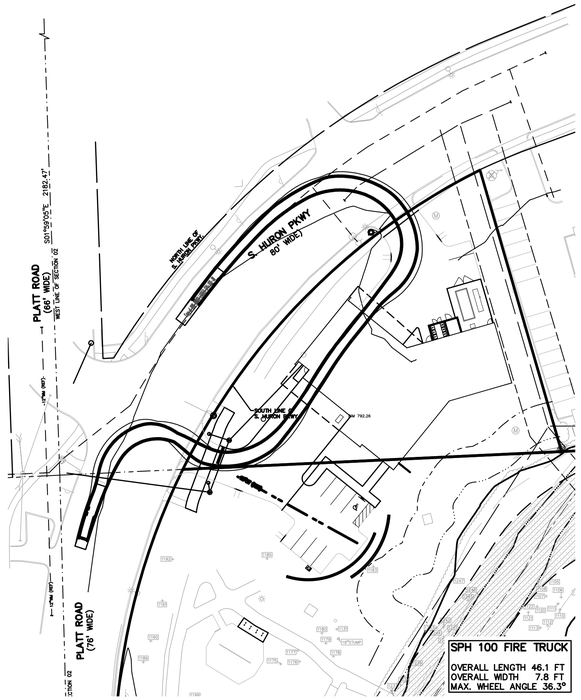
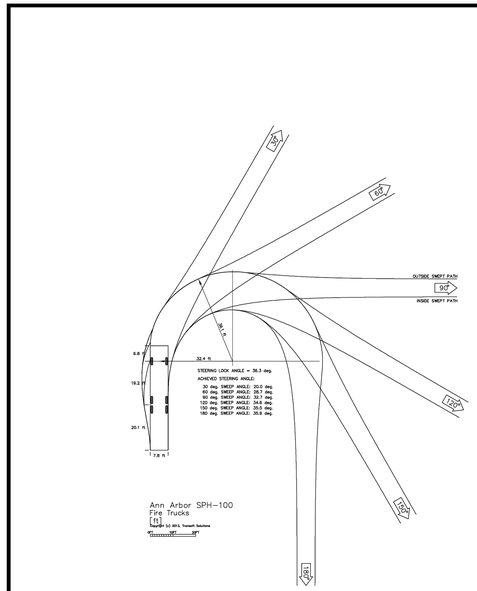
SHEET C-3.0

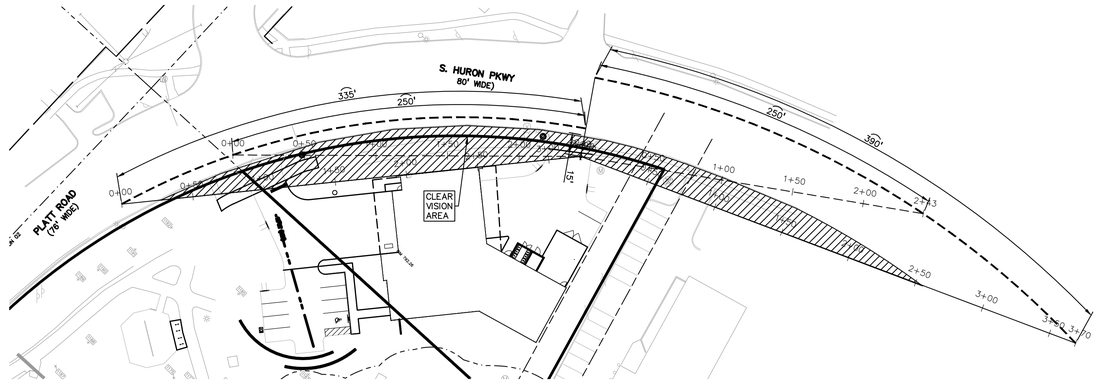


AERIAL FIRE TRUCK TURNING MOVEMENT
SCALE: 1" = 50'

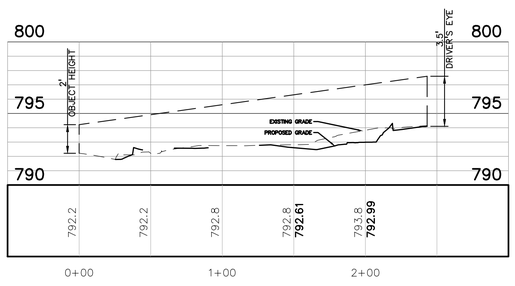


AERIAL FIRE TRUCK TURNING MOVEMENT
SCALE: 1" = 50'

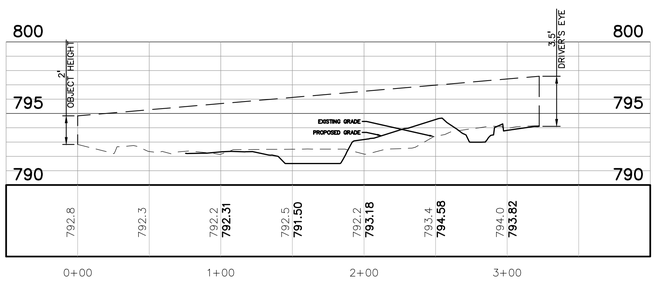




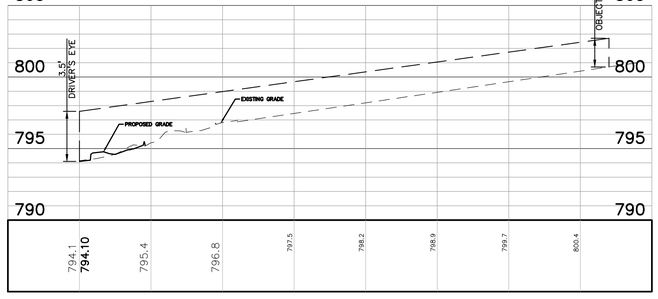
SIGHT TRIANGLES
SCALE: 1" = 30'



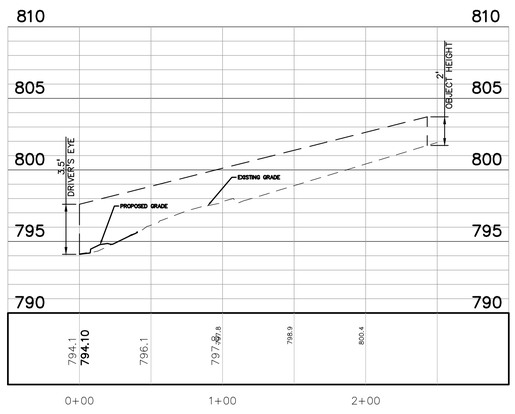
STOPPING SIGHT – WEST PROFILE



RIGHT–TURN SIGHT TRIANGLE PROFILE



LEFT–TURN SIGHT TRIANGLE PROFILE



STOPPING SIGHT – EAST PROFILE

LEGAL DESCRIPTION
(Per City of Ann Arbor Assessing)

PARCEL ID 09-12-02-209-017

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BENCHMARKS
(GPS DERIVED – NAVD88)

BM #300
BOLT ON THE SOUTH SIDE OF A SIGNAL POLE LOCATED ON THE EAST SIDE OF S. HURON PWKY AT THE INTERSECTION OF PLATT ROAD & S. HURON PKWY.
ELEV. – 793.38

BM #301
BOLT ON THE SOUTH SIDE OF A LIGHT POLE LOCATED ON THE SOUTH WIDE OF S. HURON PKWY, IN FRONT OF THE ANN ARBOR FIRE STATION #4.
ELEV. – 794.11

FLOODPLAIN NOTE:
BY GRAPHICAL PLOTTING, SITE IS WITHIN SEVERAL FLOOD ZONES PER FLOOD INSURANCE RATE MAP NUMBER 26161C0264E DATED APRIL 3, 2012. SEE SHEET P-1.0, TOPOGRAPHICAL SURVEY FOR MORE DETAILED INFORMATION.

SIGHT DISTANCE TRIANGLE NOTES:

THE SIGHT DISTANCE TRIANGLES FOR THE NORTH UN-SIGNALIZED DRIVEWAY INTERSECTION HAVE BEEN DRAWN USING INFORMATION PROVIDED BY THE CITY OF ANN ARBOR TRAFFIC REVIEW.

- SIGHT DISTANCE
  - ** 390 FT FOR LEFT-TURN MOVEMENT
  - ** 335 FT FOR RIGHT-TURN MOVEMENT
- * MINIMUM STOPPING SIGHT DISTANCE FOR 35 MPH IS 250 FT.

Figure 1 – Measuring Sight Distance for Entering the Public Road

NORTH

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0 15 30 60
SCALE: 1" = 30'

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JOSEPH R. WYWROT
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DRN: JW CHK'D: JC

TURNING MOVEMENTS & SIGHT TRIANGLES

A3C COLLABORATIVE ARCHITECTURE
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ANN ARBOR, MI 48104
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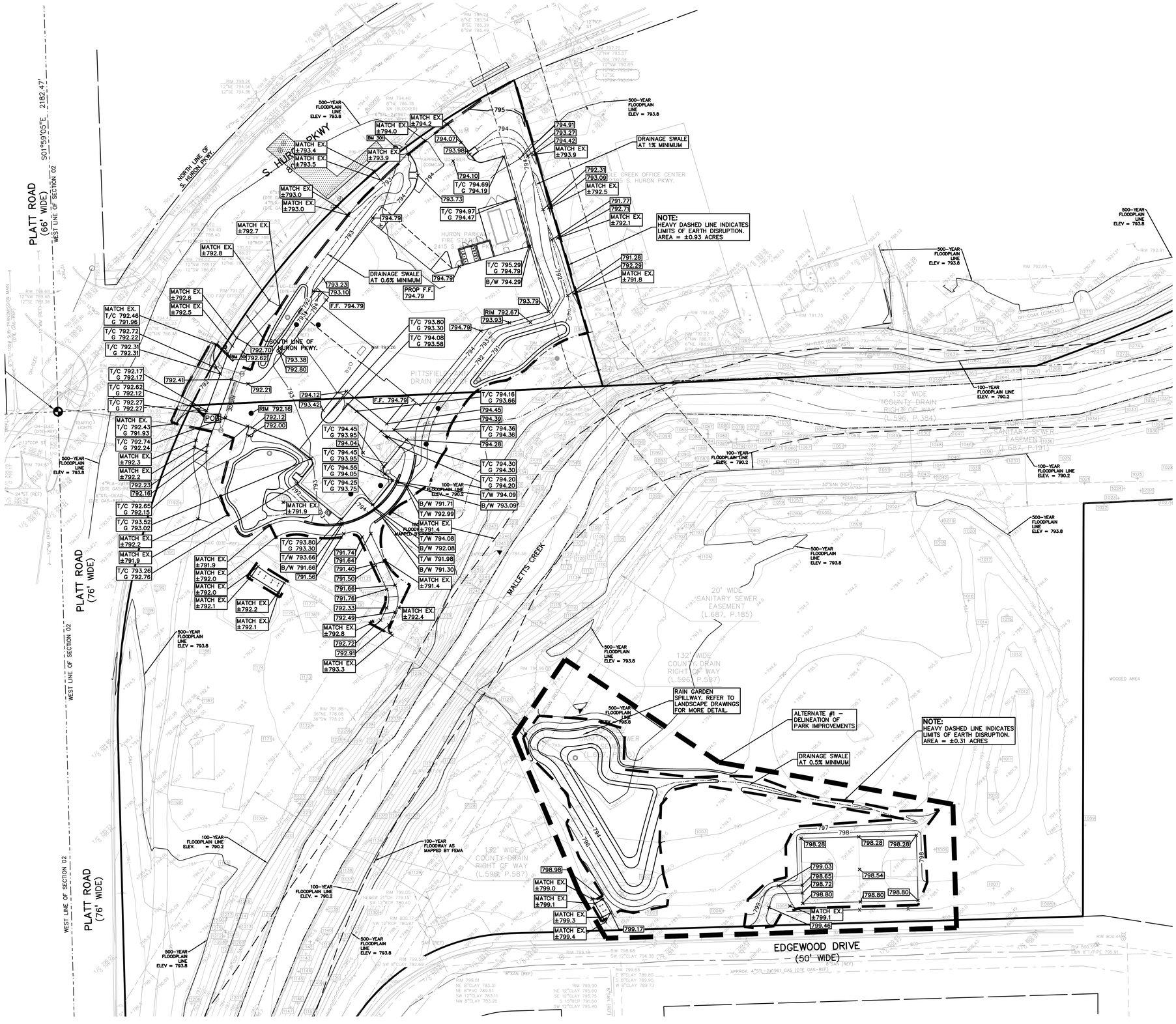
F: (866) 732 - 2168
www.a3c.com

SHEET C-3.1

S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\CONSTRUCTION\(C-3.1) TURN-210184.dwg,09.03.05 4:41 PM



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GRADING LEGEND:

- EXISTING SPOT ELEVATION
- PROPOSED SPOT ELEVATION: TYPICALLY TOP OF PAVEMENT IN PAVED AREAS, GUTTER GRADE IN CURB LINES.
- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPOSED REVERSE GUTTER PAN
- PROPOSED RIDGE LINE
- PROPOSED SWALE/DITCH

ABBREVIATIONS

T/C = TOP OF CURB	G = GUTTER GRADE
T/P = TOP OF PAVEMENT	F.G. = FINISH GRADE
T/S = TOP OF SIDEWALK	RIM = RIM ELEVATION
T/W = TOP OF WALL	B/W = BOTTOM OF WALL

REFER TO GRADING NOTES ON SHEET C-8.0

RETAINING WALL NOTE:
TOP OF WALL (T/W) AND BOTTOM OF WALL (B/W) GRADES ARE THE FINISH GRADE AT THE TOP AND BOTTOM OF THE RETAINING WALL, NOT ACTUAL TOP AND BOTTOM OF THE WALL STRUCTURE.

EARTHWORK BALANCING NOTE:
THE CONTRACTOR SHALL BE RESPONSIBLE FOR IMPORTING OR EXPORTING ALL MATERIALS AS REQUIRED TO PROPERLY GRADE THIS PROJECT TO THE FINISHED ELEVATIONS SHOWN ON THE APPROVED PLANS. THE CONTRACTOR SHALL MAKE THEIR OWN DETERMINATION OF CUT AND FILL QUANTITIES AND ALLOW FOR REMOVAL OF EXCESS OR IMPORTATION OF ADDITIONAL MATERIAL AT NO ADDITIONAL COST TO THE OWNER.

NORTH

0 15 30 60
SCALE: 1" = 30'

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DRN: JW CHK'D: JC

GRADING PLAN

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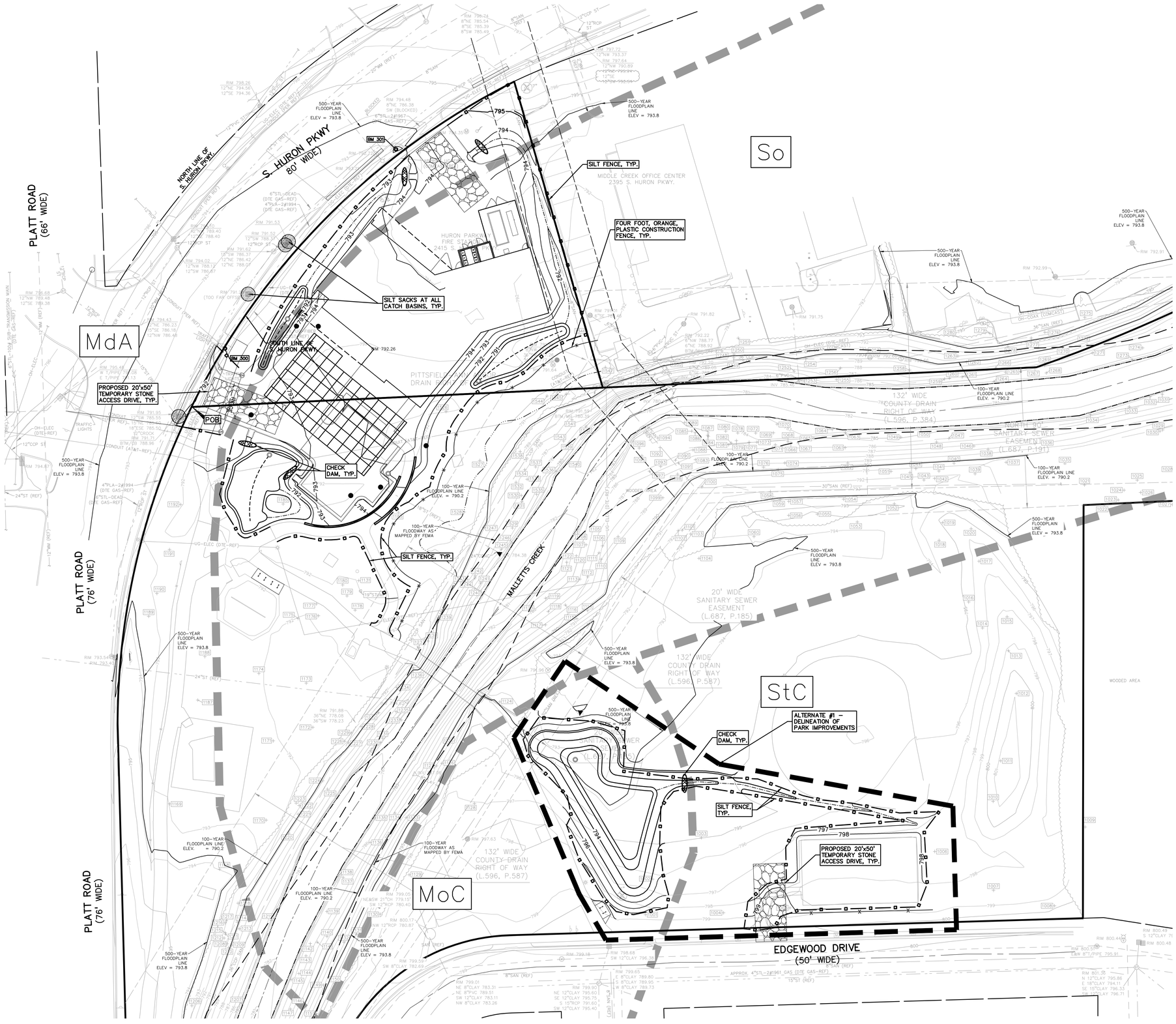
SHEET C-4.0



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SYMBOLS: EROSION CONTROL

- SILT FENCE (REFER TO DETAIL ON SHEET C-8.1)
- FOUR FOOT, ORANGE, CONSTRUCTION FENCE
- STORM SEWER INLET FILTER (REFER TO DETAIL ON SHEET C-8.1)
- DITCH SEDIMENT TRAP WITH CHECK DAM (REFER TO DETAIL ON SHEET C-8.1)
- TEMPORARY CONSTRUCTION ACCESS DRIVE (REFER TO DETAIL ON SHEET C-8.1)

SOIL INVESTIGATION

PER THE US DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE SOILS MAP FOR WASHTENAW COUNTY, SITE SOILS CONSIST OF:

MdA – MATHERTON SANDY LOAM, 0 TO 4 PERCENT SLOPES; HYDROLOGIC SOIL GROUP B/D

MoC – MORLEY LOAM, 6 TO 12 PERCENT SLOPES; HYDROLOGIC SOIL GROUP C

So – SLOAN SILT LOAM, 0 T 1 PERCENT SLOPES; FREQUENTLY FLOODED; HYDROLOGIC SOIL GROUP B/D

StC – ST. CLAIR CLAY LOAM, 6 TO 12 PERCENT SLOPES; HYDROLOGIC SOIL GROUP D

EROSION CONTROL COST ESTIMATE (CONSTRUCTION)

INSTALL SILT FENCE	1,957 LF.	$1.60	$3,131
INSTALL INLET FILTERS	3 EA.	$120	$360
INSTALL TEMPORARY ACCESS DRIVES	3 EA.	$1,200	$3,600
TEMPORARY SEEDING	±2,775 S.Y.	$1.05	$2,914
EXPOSED SOIL PROTECTION FROM EROSION SHOULD CONSTRUCTION DISCONTINUE	±5,851 S.Y.	$1.15	$6,729
TOTAL			$16,734

NORTH

SCALE: 1" = 30'

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SOIL EROSION & SEDIMENTATION CONTROL PLAN

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
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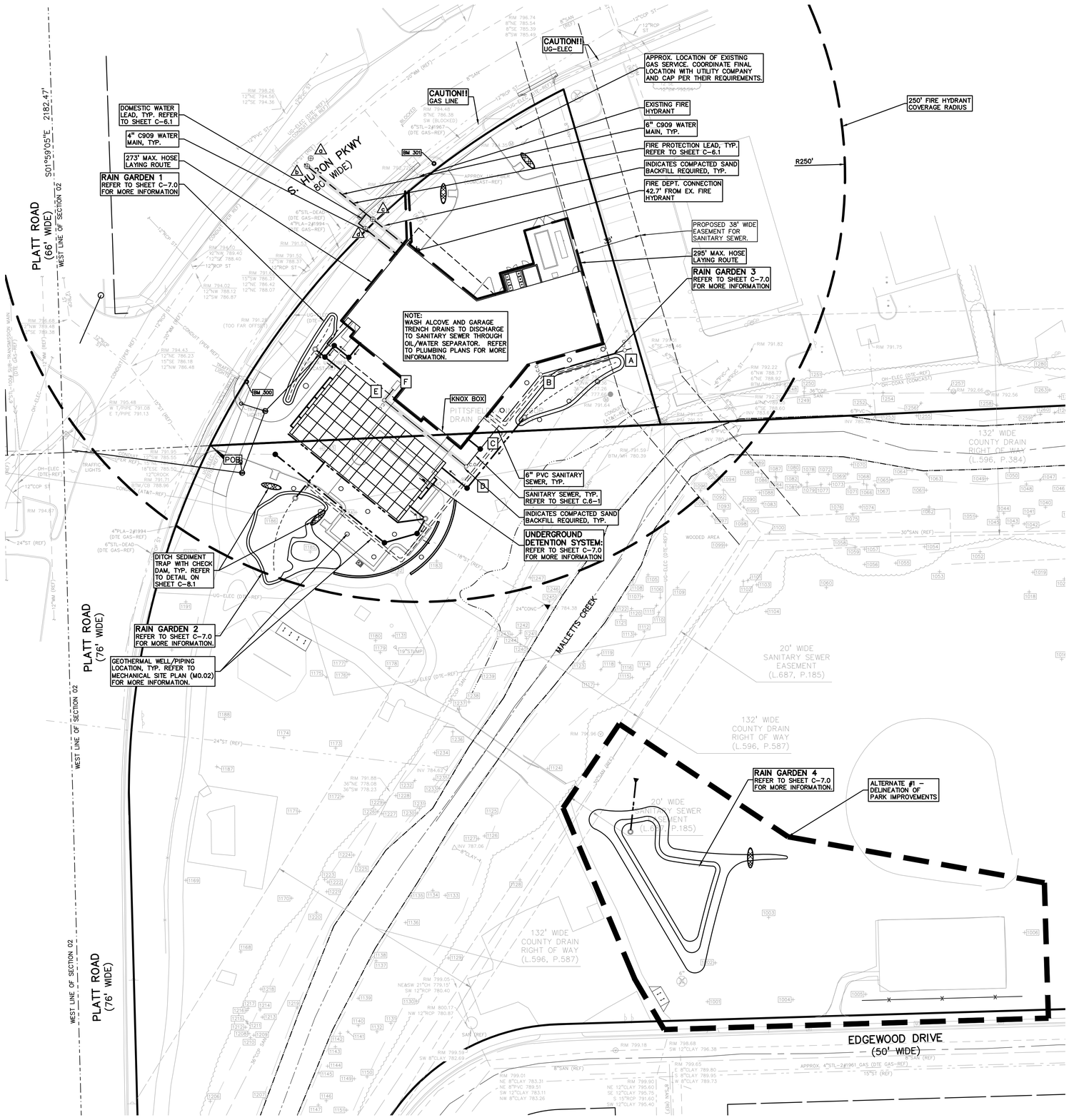
SHEET C-5.0

S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\CONSTRUCTION\(C-5.0) SESC-210184.dwg,09.03.05 4:41 PM



SANITARY SEWER BAIS OF DESIGN:

PROPOSED FIRE STATION:

- 10 EMPLOYEES
- 75 GPD/CAPITA
- UNIVERSITY HOUSING, BOARDING HOUSE, OR APARTMENT UNIT HOUSING MORE THAN FOUR PEOPLE
- AVERAGE DAILY FLOW = 75 GPD/CAPITA x 10 EMPLOYEES = 750 GPD
- TOTAL AVERAGE DAILY FLOW = 750 GPD = 0.0011 CFS
- POPULATION = 10 PEOPLE
- P = 10 / 1000 = 0.01
- PEAKING FACTOR = (18+SQRT(P))/(4+SQRT(P)) = (18+SQRT(0.01))/(4+SQRT(0.01)) = 4.41
- PEAK HOUR FLOW = 4.41 x 750 GPD = 3,308 GPD = 0.0051 CFS
- CAPACITY OF 8" PVC PIPE AT 0.50% = 1.11 CFS (>0.0051 CFS)

NOTE:
CONTRACTOR TO VERIFY ALL QUANTITIES. ANY DEVIATIONS TO THE PLAN QUANTITIES SHALL BE BROUGHT TO THE ATTENTION OF PEA GROUP FOR VERIFICATION, PRIOR TO BIDDING.

PREMIUM TRENCH BACKFILL NOTE:
ALL UTILITIES UNDER PAVEMENT OR WITHIN 3' OF THE EDGE OF PAVEMENT (OR WITHIN THE 45° LINE OF INFLUENCE OF PAVEMENT) SHALL HAVE MDOT CLASS II GRANULAR BACKFILL COMPACTED TO 95% MAX. DRY DENSITY (ASTM D-1557).

REFER TO:
UTILITY NOTES ON SHEET C-8.0
STORM SEWER STRUCTURE INFORMATION ON SHEET C-7.0
STORM SEWER DESIGN ON SHEET C-7.2
UTILITY DETAILS ON SHEET C-8.2 AND C-8.3

STORM SEWER QUANTITIES:

6" HDPE UNDERDRAIN WITH SOCK	98 LF
12" PVC SDR 26	11 LF
12" RCP CL-IV PIPE	194 LF
18" RCP CL-IV PIPE	102 LF
12" CONC. END SECTION	1 EA.
4' DIA. MANHOLE	7 EA.
2' DIA. OUTLET CONTROL STRUCTURE	3 EA.
3' DIA. OUTLET CONTROL STRUCTURE	1 EA.
6' DIA. OUTLET CONTROL STRUCTURE	1 EA.

SANITARY SEWER QUANTITIES:

6" PVC SDR 23.5 PIPE	203 LF
CLEANOUT AND BOX	4 EA.
4' DIA. MANHOLE	1 EA.

WATER MAIN QUANTITIES:

4" D.I.W.M. CLASS 54	36 LF
6" D.I.W.M. CLASS 54	76 LF
4" GATE VALVE AND WELL	1 EA.
6" GATE VALVE AND WELL	2 EA.
20" GATE VALVE AND WELL	1 EA.

CITY OF ANN ARBOR STORM SEWER FRAME AND COVER NOTES

CATCH BASIN - BARRIER CURB
FRAME: EJ 7045
COVER: TYPE "M1"

CATCH BASIN - BARRIER CURB WITH DOUBLE INLET
FRAME: NEENAH FOUNDRY R-3249F
COVER: TYPE "S" GRATE

CATCH BASIN - MOUNTABLE CURB
FRAME: EJ 7065
COVER: TYPE "M1"

CATCH BASIN - GUTTER
FRAME: EJ 5080
COVER: TYPE "M2"

CATCH BASIN - GUTTER WITH DOUBLE INLET
FRAME: EJ 5000
COVER: TYPE "M2"

CATCH BASIN - YARD
FRAME: EJ 1040
COVER: TYPE "02"

CATCH BASIN - CITY PARK
FRAME: EJ 1040
COVER: TYPE "M1"

MANHOLE
FRAME: EJ 1040
COVER: TYPE "A"

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UTILITY NOTES
1. NO FIREWALLS WILL BE CONSTRUCTED AS A PART OF THIS PROJECT.
2. NO BOOSTER PUMPS WILL BE USED FOR THE BUILDING WATER SERVICE LEAD AND NO FIRE PUMPS WILL BE USED.

SANITARY STRUCTURES	
C	MH (4' DIA.) RIM = 792.33 6" SW 788.28 6" NW 789.69 6" NE 786.78

WATER MAIN STRUCTURES	
a	GV IN WELL RIM = 794.17
b	GW–b RIM = 794.05
c	GW–c RIM = 792.91
d	GW–d RIM = 792.85

SANITARY CLEANOUTS	
A	C.O. IN BOX RIM = 791.33 INV. 785.71
B	C.O. IN BOX RIM = 792.25 INV. 786.22
D	C.O. IN BOX RIM = 793.07 INV. 788.41
E	C.O. IN BOX RIM = 794.63 INV. 789.03

DEVELOPMENT SEWAGE FLOW OFFSET MITIGATION PROGRAM:

10 FIRE STATION EMPLOYEES

- 10 EMPLOYEES x 75 GPD / CAPITA = 750 GPD
  (TABLE A: UNIVERSITY HOUSING, BOARDING HOUSE, OR APARTMENT UNIT HOUSING MORE THAN FOUR PEOPLE)
- PEAK FLOW = 750 GPD x 4 (PEAKING FACTOR) X 1.1 (SYSTEM RECOVERY FACTOR) = 3,300 GPD
- 3,300 GPD x 1 DAY/24 HRS x 1 HR/60 MIN = 2.3 GPM PEAK FLOW
- PER THE CITY OF ANN ARBOR "SANITARY FLOW OFFSET MITIGATION FOR DEVELOPMENT" (2/12/2019)

EXISTING AND PROPOSED POPULATION WILL BE THE SAME. EXISTING AND PROPOSED BUILDINGS INCLUDE WASH ALCOVE AND GARAGE AREA TRENCH DRAINS. THEREFORE, THE PEAK FLOW WILL BE THE SAME AND NO OFFSET MITIGATION WILL BE REQUIRED.

UTILITY LEGEND:

- EX. OH. ELEC, POLE & GUY WIRE
- EX. U.G. CABLE TV & PEDESTAL
- EX. U.G. COMMUNICATION LINE, PEDESTAL & MANHOLE
- EX. U.G. ELEC.MANHOLE, METER & HANDHOLE
- EX. GAS LINE
- EX. GAS VALVE & GAS LINE MARKER
- EX. TRANSFORMER & IRRIGATION VALVE
- EX. WATER MAIN
- EX. HYDRANT, GATE VALVE & POST INDICATOR VALVE
- EX. WATER VALVE BOX & SHUTOFF
- EX. SANITARY SEWER
- EX. SANITARY CLEANOUT & MANHOLE
- EX. COMBINED SEWER MANHOLE
- EX. STORM SEWER
- EX. CLEANOUT & MANHOLE
- EX. SQUARE, ROUND, & BEEHIVE CATCH BASIN
- EX. YARD DRAIN & ROOF DRAIN
- EX. UNIDENTIFIED STRUCTURE
- PROPOSED WATER MAIN
- PROPOSED HYDRANT AND GATE VALVE
- PROPOSED TAPPING SLEEVE, VALVE & WELL
- PROPOSED POST INDICATOR VALVE
- PROPOSED SANITARY SEWER
- PROPOSED SANITARY CLEANOUT & MANHOLE
- PROPOSED STORM SEWER
- PROPOSED STORM SEWER CLEANOUT & MANHOLE
- PROPOSED CATCH BASIN, INLET & YARD DRAIN

NORTH

0 15 30 60
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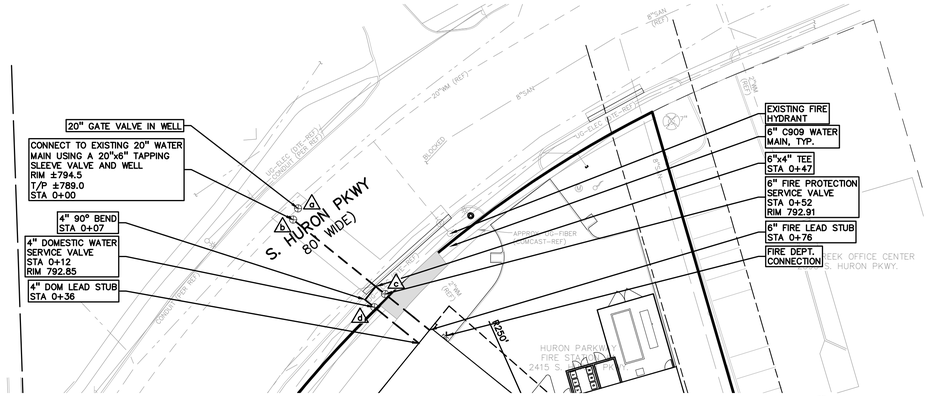
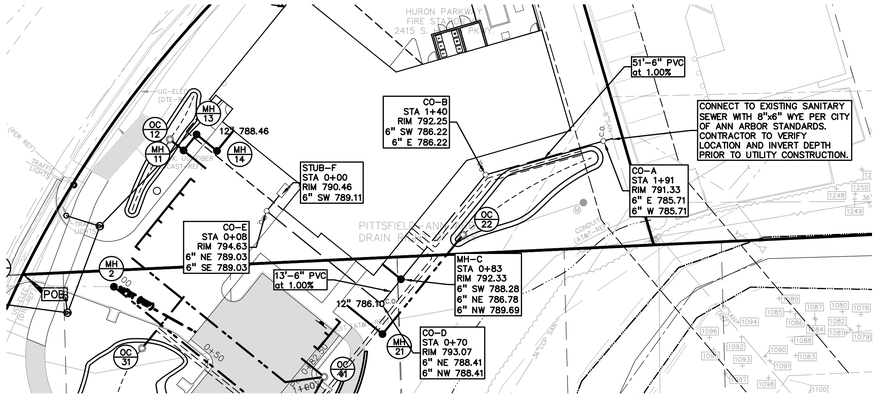
SHEET C-6.0

S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\CONSTRUCTION\(C-6.0) UTIL-210184.dwg,09.03.05 4:41 PM



FIRE PROTECTION AND DOMESTIC WATER MAIN PLAN

NORTH



SANITARY PLAN

NORTH

LEGAL DESCRIPTION
(Per City of Ann Arbor Assessing)

PARCEL ID 09-12-02-209-017

Land in the City of Ann Arbor, Washtenaw County, Michigan, described as follows:

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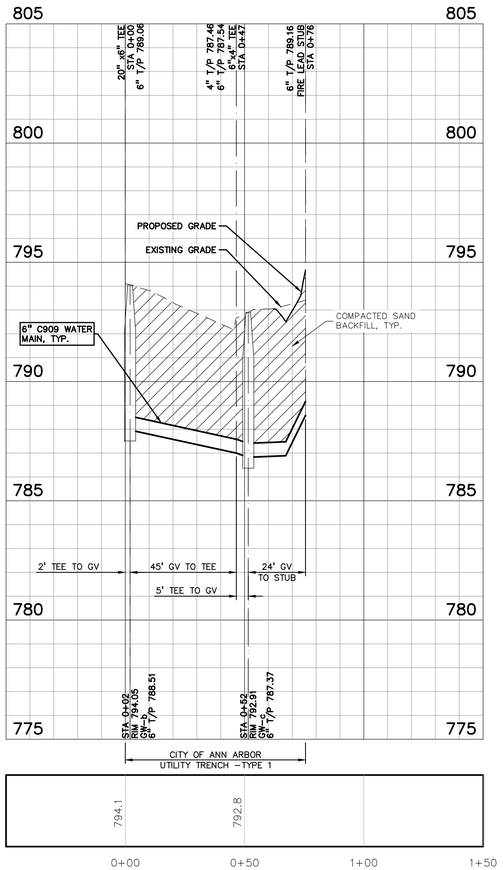
BENCHMARKS
(GPS DERIVED – NAVD88)

BM #300
BOLT ON THE SOUTH SIDE OF A SIGNAL POLE LOCATED ON THE EAST SIDE OF S. HURON PWKY AT THE INTERSECTION OF PLATT ROAD & S. HURON PKWY.
ELEV. – 793.38

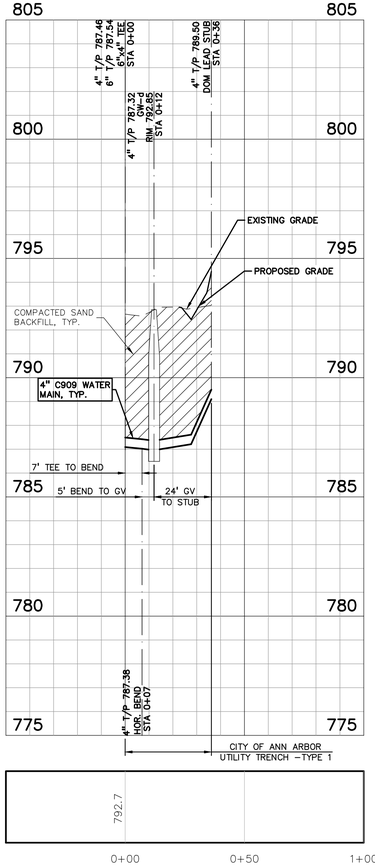
BM #301
BOLT ON THE SOUTH SIDE OF A LIGHT POLE LOCATED ON THE SOUTH WIDE OF S. HURON PKWY, IN FRONT OF THE ANN ARBOR FIRE STATION #4.
ELEV. – 794.11

FLOODPLAIN NOTE:
BY GRAPHICAL PLOTTING, SITE IS WITHIN SEVERAL FLOOD ZONES PER FLOOD INSURANCE RATE MAP NUMBER 26161C0264E DATED APRIL 3, 2012. SEE SHEET P-1.0, TOPOGRAPHICAL SURVEY FOR MORE DETAILED INFORMATION.



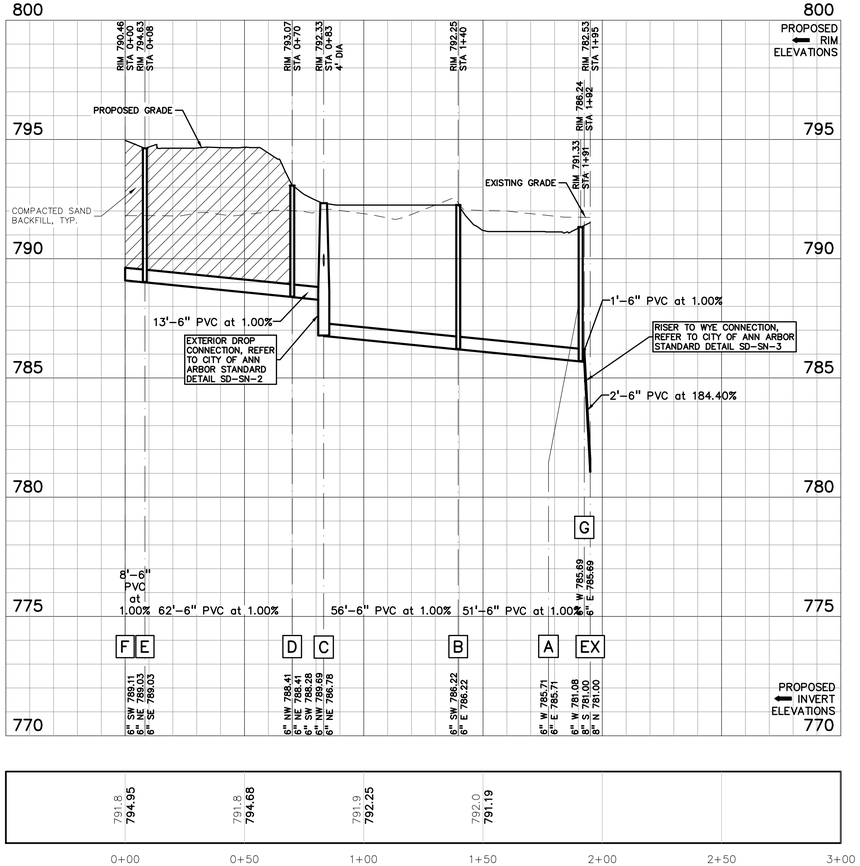
WATER–FIRE PROFILE

HORIZ: 1" = 30'
VERT: 1" = 3'



WATER–DOM PROFILE

HORIZ: 1" = 30'
VERT: 1" = 3'



SANITARY D–A PROFILE

HORIZ: 1" = 30'
VERT: 1" = 3'

NORTH

0 15 30 60
SCALE: 1" = 30'

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JOSEPH B. WYWROT
ENGINEER
No. 6201046674
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

PROJECT NUMBER 21018

ISSUE		
	Bids/Permits	10.11.24
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	WCWRC Resubmittal	01.13.23
	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

SANITARY SEWER AND WATER MAIN PLAN & PROFILE

A3C COLLABORATIVE ARCHITECTURE
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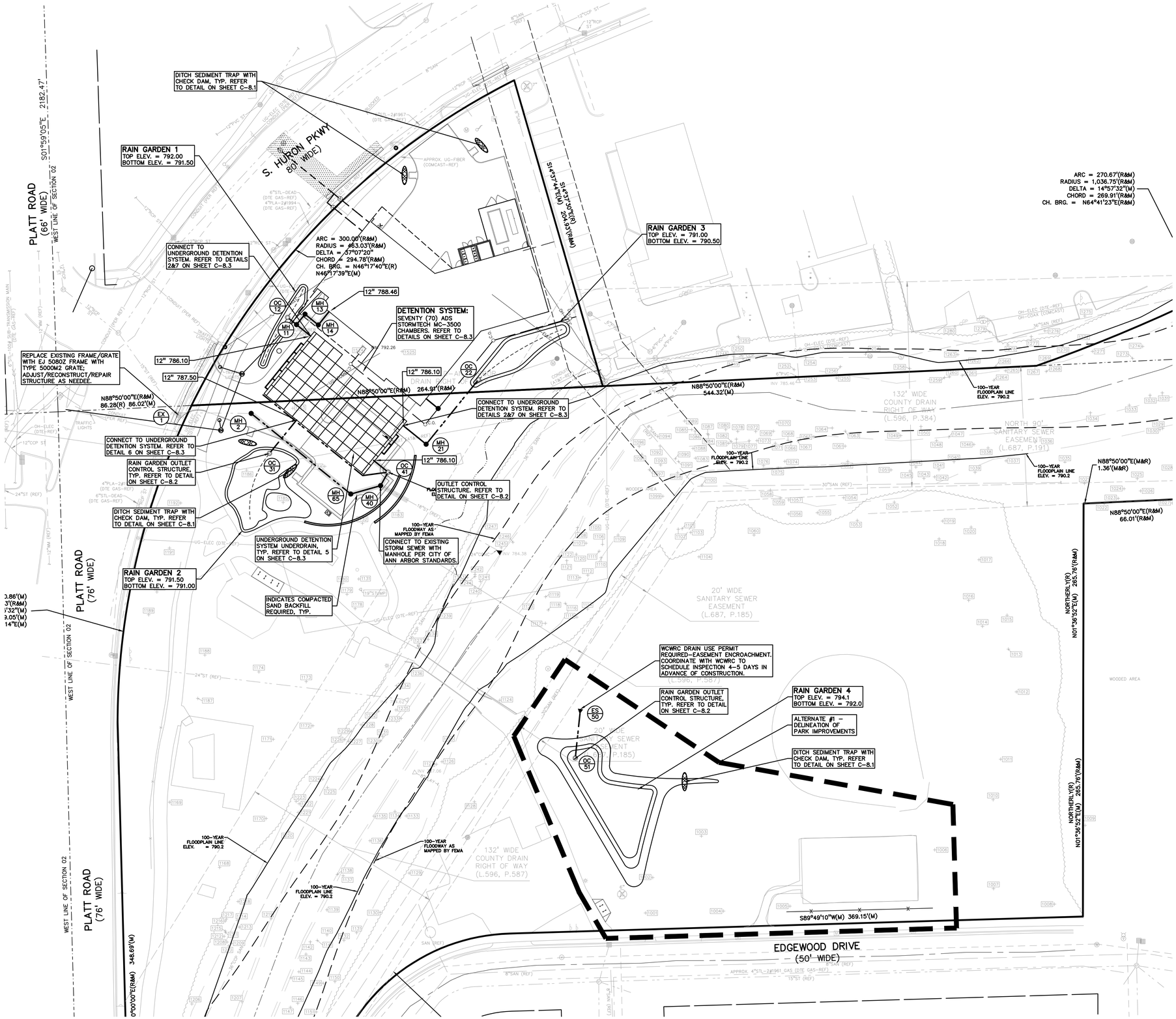
SHEET C-6.1



LEGAL DESCRIPTION
(Per City of Ann Arbor Assessing)

PARCEL ID 09-12-02-209-017

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ELEV. = 793.38

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ELEV. = 794.11

FLOODPLAIN NOTE:
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UTILITY NOTES
SEE SHEET C-6.0 FOR SANITARY SEWER AND WATER MAIN STRUCTURE INFORMATION.

EXISTING STORM STRUCTURES		
EX	1	EXISTING STRUCTURE RIM = 791.95 18" E 785.50

END SECTIONS		
50		END SECTION 12" 791.90

STORM STRUCTURES		
MH	2	(4' DIA./2' SUMP) RIM = 792.16 18" SE 785.26 18" W 785.26 18" SE 785.26
MH	11	(4' DIA./0' SUMP) RIM = 792.94 12" NW 786.26 12" NE 788.31 12" SE 786.16
OC	12	(2' DIA./0' SUMP) RIM = 792.00 6" SW 789.00 6" NE 789.00 12" SE 786.30
MH	13	(4' DIA./0' SUMP) RIM = 793.15 12" SE 788.35 12" SW 788.35
MH	14	(4' DIA./0' SUMP) RIM = 794.45 12" NE 788.40 12" NW 788.40
MH	21	(4' DIA./0' SUMP) RIM = 792.26 12" NE 786.26 12" NW 786.16
OC	22	(2' DIA./0' SUMP) RIM = 791.00 6" NE 788.59 12" SW 786.49
OC	31	(2' DIA./0' SUMP) RIM = 791.50 6" S 788.50 12" NE 787.64
MH	40	(4' DIA./0' SUMP) RIM = 793.88 18" SE 784.81 12" NE 784.95 18" W 784.81 18" NW 784.81
OC	41	(6' DIA./2' SUMP) RIM = 794.16 12" NW 786.04 6" W 785.25 12" SW 785.00
OC	51	(3' DIA./2' SUMP) RIM = 794.00 12" N 792.00
MH	65	(4' DIA./0' SUMP) RIM = 793.47 18" NW 784.94 18" E 784.94

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JOSEPH B. WYWROT
ENGINEER
No. 6201046874
LICENSED PROFESSIONAL ENGINEER

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PROJECT NUMBER 21018

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	WCWRC Resubmittal	01.13.23
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	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

DRAINAGE PLAN

A 3 C
COLLABORATIVE ARCHITECTURE
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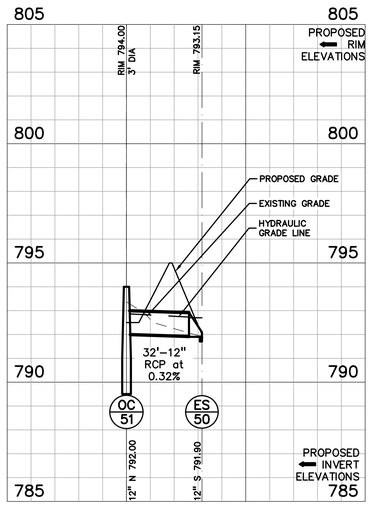
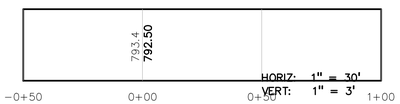
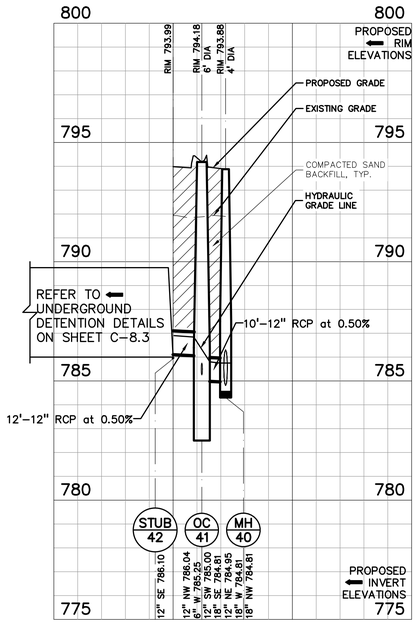
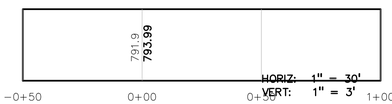
S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\CONSTRUCTION\(C-7.0) STRM-210184.dwg,09.03.05 4:41 PM



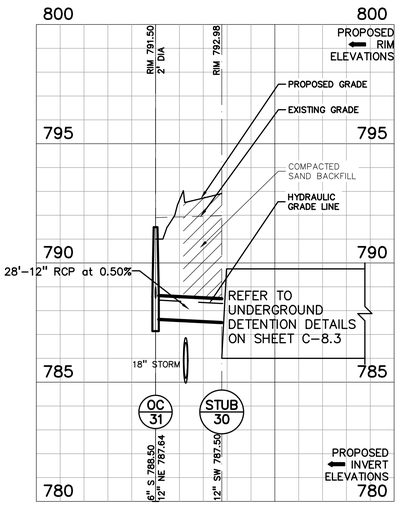


STORM 51–50 PROFILE

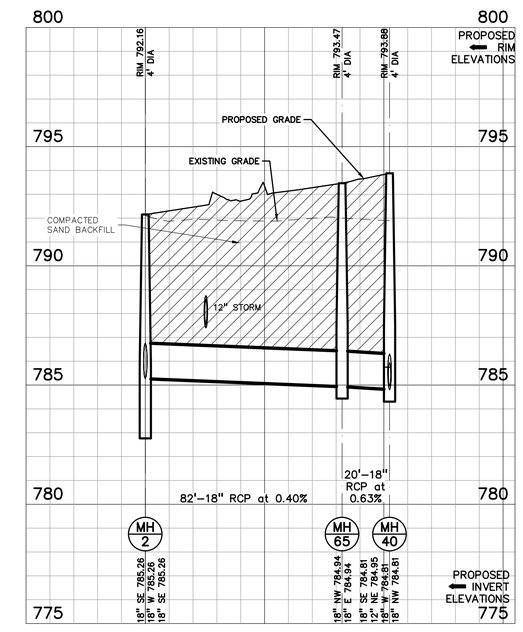


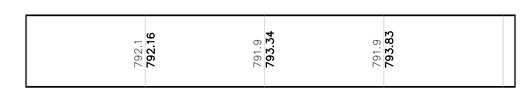


STORM 42–40 PROFILE

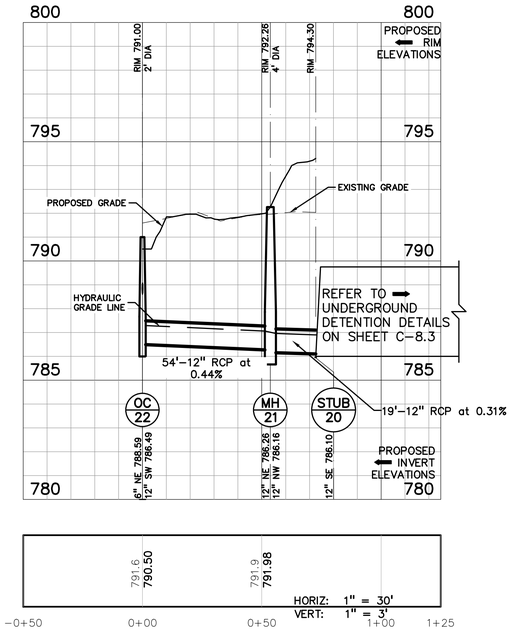


STORM 31–30 PROFILE

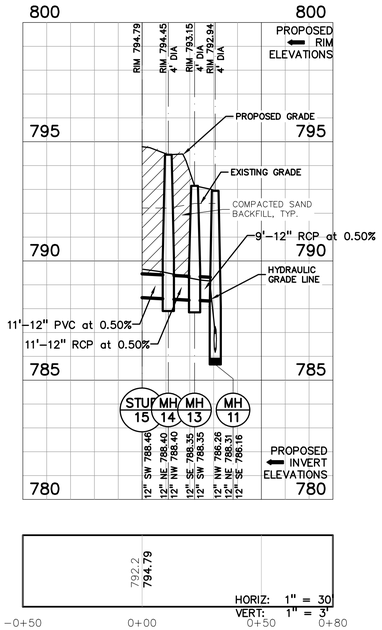




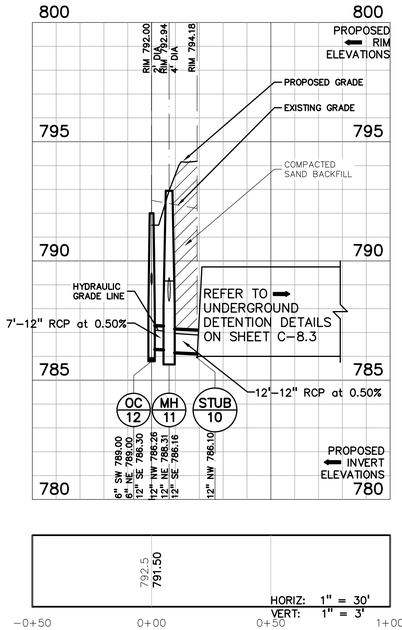
STORM NEW ROUTE PROFILE



STORM 22–20 PROFILE



STORM 15–11 PROFILE



STORM 12–10 PROFILE

LEGAL DESCRIPTION
(Per City of Ann Arbor Assessing)

PARCEL ID 09-12-02-209-017

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JOSEPH B. WYWROT
ENGINEER
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LICENSED PROFESSIONAL ENGINEER

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PROJECT NUMBER 21018

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DRN: JW CHK'D: JC

STORM WATER PROFILES

A3C COLLABORATIVE ARCHITECTURE
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NORTH

SCALE: 1" = 30'

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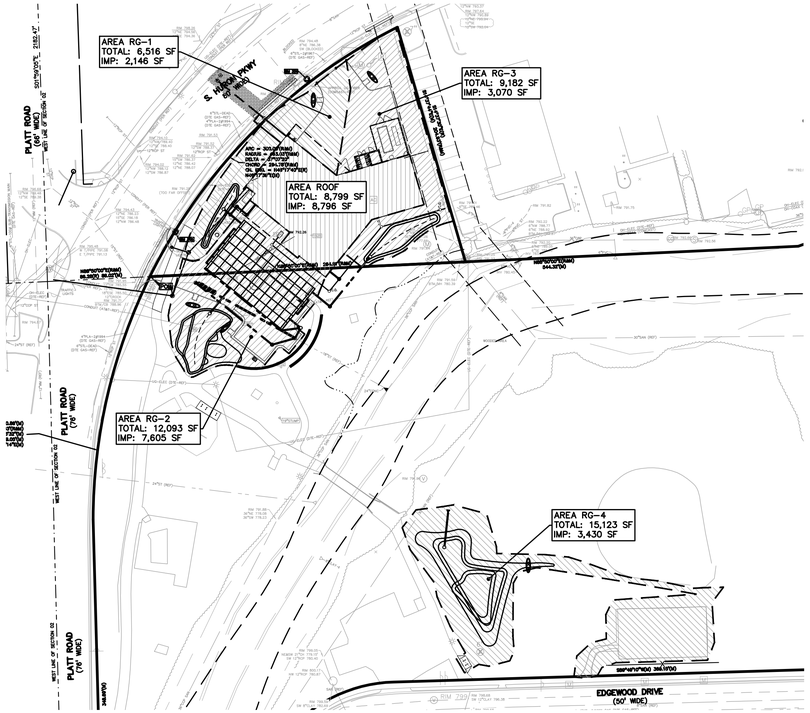

DRAINAGE AREA PLAN

SCALE: 1" = 60'

Drainage Area	Impervious Area sf	Pervious Area sf	Total Area sf	Total Area ac
RG-1	2,146	4,370	6,516	0.15
RG-2	7,605	4,488	12,093	0.28
RG-3	3,070	6,112	9,182	0.21
Roof	8,800	0	8,800	0.20
Sub-total	21,621	14,970	36,591	0.84
RG-4	3,430	11,693	15,123	0.35
Sub-total	3,430	11,693	15,123	0.35
Total	25,051	26,663	51,714	1.19

STORM WATER NARRATIVE

THE EXISTING PARCEL CURRENTLY DRAINS, UN-DETAINED, VIA SHEET FLOW TO THE SOUTH HURON PARKWAY RIGHT-OF-WAY AND MALLETT'S CREEK.

INFILTRATION TESTING WAS PERFORMED ON THE SUBJECT PARCEL IN ACCORDANCE WITH THE WASHTENAW COUNTY WATER RESOURCES COMMISSIONER RULES AND GUIDELINES. NONE OF THE TESTED LOCATIONS PROVED TO BE SUITABLE FOR INFILTRATION. CONSEQUENTLY, INFILTRATION WILL NOT BE INCLUDED AND THE SUBSEQUENT PENALTY FOR NOT PROVIDING INFILTRATION WILL BE INCORPORATED.

WHERE POSSIBLE, OVERLAND FLOW THROUGH CURB SPILLWAYS AND SWALES HAS BEEN INCORPORATED INTO THE DESIGN. IN SOME INSTANCES, A NEW ON-SITE ENCLOSED STORM SEWER SYSTEM DESIGNED PER THE WASHTENAW COUNTY WATER RESOURCES COMMISSIONER STANDARDS WILL BE INCLUDED.

RAIN GARDENS WILL ALSO BE INCLUDED THROUGHOUT THE SITE. EVEN THOUGH ULTIMATE INFILTRATION TO THE GROUND WATER SYSTEM IS UNLIKELY, INFILTRATION WILL OCCUR WITHIN THE RAIN GARDENS AND SOME BENEFIT TO THE QUALITY OF THE STORM WATER WILL BE REALIZED. THE RAIN GARDENS WILL ALSO PROVIDE A SMALL AMOUNT OF SURFACE AND SUBSURFACE STORAGE, ALLOWING THE UNDERGROUND DETENTION SYSTEM TO BE SLIGHTLY SMALLER.

THE DETENTION BASIN WILL CAPTURE STORM WATER RUNOFF FROM ON-SITE TRIBUTARY DRAINAGE AREAS. AFTER DETENTION, THE DETENTION BASIN WILL DISCHARGE TO AN EXISTING STORM SEWER PIPE THAT ULTIMATELY OUTLETS TO MALLETT'S CREEK. PLEASE REFER TO THE CALCULATIONS PROVIDED ON SHEET C-7.2 FOR VOLUMES AND RELEASE RATES.

Rain Garden 1

CONTOUR ELEV	DETENTION AREA	INCR. VOLUME	CUMUL. VOLUME
792.00	462	184	184
791.50	275	0	0

Rain Garden 2

CONTOUR ELEV	DETENTION AREA	INCR. VOLUME	CUMUL. VOLUME
791.50	1164	527	527
791.00	943	0	0

Rain Garden 3

CONTOUR ELEV	DETENTION AREA	INCR. VOLUME	CUMUL. VOLUME
791.00	1018	432	432
790.50	711	0	0

Rain Garden 4

CONTOUR ELEV	DETENTION AREA	INCR. VOLUME	CUMUL. VOLUME
794.00	3787	2985	4327
793.00	2183	944	1342
792.50	1593	398	398
792.00	0	0	0

Rain Garden	Avg Bed Area, sf	Max Water Depth, ft	Surface Storage Volume, cf	Subsurface Depth, ft	Subsurface Mat. Void Ratio	Subsurface Volume, cf
1	**369**	**0.50**	**184**	2	30	**165**
2	**1054**	**0.50**	**527**	2	30	**566**
3	**865**	**0.50**	**432**	2	30	**427**
Total Surface Storage Volume (Station Side)			**1,143**	Total Subsurface Storage Volume (Station Side)		**1,157**
4	**1891**	**2.00**	**4327**	2	30	**956**
Total Surface Storage Volume (Park Side)			**4,327**	Total Subsurface Storage Volume (Park Side)		**956**

STORM SEWER SYSTEM DESIGN

Location: Washtenaw County

I = B/(T+D) ^ E **B = 175.00** **D = 25.00** **E = 1.00**
C = varies
T = 15 ` (min.) **Pipe "n" Value = 0.013**

FROM STR	TO STR	AREA (A) (Acres)	COEF. C	A x C	TOTAL AREA (AxC)	TOTAL AREA (Acres)	TIME t (min.)	INT. I (in/hr)	FLOW Q (cfs)	PIPE CAP. (cfs)	PIPE DIA. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (%)	MIN HG PER "Q"	VEL. FULL (ft./sec)	TIME FLOW (min.)	H.G.L. ELEV. UP STREAM	H.G.L. ELEV. DOWN STREAM	RIM ELEV. UP STREAM	RIM ELEV. DOWN STREAM	INVERT ELEV. UP STREAM	INVERT ELEV. DOWN STREAM	PIPE COVER UP STREAM	PIPE COVER DOWN STREAM	HGL COVER UP STREAM	HGL COVER DOWN STREAM
51	50	0.31	0.47	0.14	0.14	0.31	15.00	4.38	0.63	2.02	12	31	0.32	0.03%	2.6	0.2	792.80	792.70	793.17	793.15	792.00	791.90	0.00	0.08	0.37	0.45
42	41	0.00	0.00	0.00	0.00	0.00	15.00	4.38	0.00	2.52	12	12	0.50	0.00%	3.2	0.1	786.90	786.84	793.99	794.18	786.10	786.04	6.72	6.98	7.09	7.34
41	40	0.00	0.00	0.00	0.00	0.00	15.10	4.36	0.00	2.52	12	10	0.50	0.00%	3.2	0.1	785.80	785.75	794.18	793.88	785.00	784.95	8.02	7.77	8.38	8.13
31	30	0.30	0.70	0.21	0.21	0.30	15.00	4.38	0.93	2.52	12	28	0.50	0.07%	3.2	0.1	787.44	787.30	791.50	792.98	786.64	786.50	3.69	5.31	4.06	5.68
22	21	0.19	0.53	0.10	0.10	0.19	15.00	4.38	0.45	2.52	12	47	0.50	0.02%	3.2	0.2	787.29	787.06	791.00	793.00	786.49	786.26	3.34	5.57	3.71	5.94
21	20	0.00	0.00	0.00	0.10	0.19	15.20	4.35	0.45	2.52	12	12	0.50	0.02%	3.2	0.1	786.96	786.90	793.00	794.47	786.16	786.10	5.67	7.21	6.04	7.57
15	14	0.20	0.95	0.19	0.19	0.20	15.00	4.38	0.84	2.52	12	22	0.50	0.06%	3.2	0.1	789.65	789.54	795.00	794.47	788.85	788.74	4.98	4.57	5.35	4.94
14	13	0.00	0.00	0.00	0.19	0.20	15.10	4.36	0.84	2.52	12	29	0.50	0.06%	3.2	0.1	789.44	789.29	794.47	793.15	788.64	788.49	4.67	3.49	5.04	3.86
13	11	0.00	0.00	0.00	0.19	0.20	15.20	4.35	0.84	2.52	12	9	0.50	0.06%	3.2	0.0	789.20	789.16	793.15	792.94	788.40	788.36	3.58	3.42	3.95	3.78
12	11	0.14	0.51	0.07	0.07	0.14	15.00	4.38	0.31	2.52	12	7	0.50	0.01%	3.2	0.0	787.10	787.06	792.00	792.94	786.30	786.26	4.54	5.52	4.90	5.89
11	10	0.00	0.00	0.00	0.26	0.34	15.00	4.38	1.15	2.52	12	12	0.50	0.10%	3.2	0.1	786.96	786.90	792.94	794.04	786.16	786.10	5.62	6.77	5.99	7.14

STORM WATER CONVEYANCE CALCULATIONS

TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
JOSEPH B. WYWROT
ENGINEER
No. 6201040674
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

PROJECT NUMBER 21018

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	Final Site Plan	09.08.23
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	WCWRC Resubmittal	01.13.23
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	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

STORM WATER DRAINAGE AREAS AND CALCULATIONS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

SHEET C-7.2

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Part E.

STANDARD METHOD RUNOFF VOLUME WORK SHEETS

W1 Determining Post-Development Cover Types, Areas, Curve Numbers, and Runoff Coefficients

Total Site Area = 0.84 ac
Total Site Area Excluding "Self- Crediting" BMPs = 0.84 ac*

Rational Method Worksheet

Cover Type	Soil Type	Area (ft²)	Area(ac)	Runoff Coefficient (C)	(C) (Area)
Pervious	D	14,970	0.34	0.45	6,736.5
Impervious	D	21,621	0.50	0.95	20,540.0

Total - ∑(C)(Area) = 27,276.5
Area Total - ∑ac or ∑sf = 36,591.0
Weighted C - ∑(C)(Area)/∑ac or ∑sf = 0.75

NRCS Worksheet[2]

Pervious Cover Type	Soil Type	Area (ft²)	Area(ac)	Curve Number	(CN) (Area)
Pervious	D	14,970	0.34	80	1,197,600

Total - ∑(CN)(Area) = 1,197,600
Area Total - ∑ac or ∑sf = 14,970
Weighted CN - ∑(CN)(Area)/∑ac or ∑sf = 80

NRCS Worksheet[3]

Impervious Cover Type	Soil Type	Area (ft²)	Area(ac)	Curve Number	(CN) (Area)
Impervious	D	21,621	0.50	98	2,118,858

Total - ∑(CN)(Area) = 2,118,858
Area Total - ∑ac or ∑sf = 21,621
Weighted CN - ∑(CN)(Area)/∑ac or ∑sf = 98

* Use this area for the remainder of the runoff calculations
[2] Required for first flush runoff calculations
[3] Required for bankfull and 100-year runoff calculations

W2 Standard Method Runoff Volume Calculations

First Flush Runoff Calculations (V_{ff})

A.

$V_{ff} = (1") \left(\frac{1'}{12"}\right) \left(\frac{43560 ft^2}{1ac}\right) AC$ $\quad V_{ff} = (1") \left(\frac{1'}{12"}\right) \left(\frac{43560 ft^2}{1ac}\right) (0.84)(0.75)$

$V_{ff} = 2,287 ft^3$

A = Total Site Areas (ac) excluding "Self-Crediting" BMPs from Worksheet 1
C= Weighted Runoff Coefficient from Worksheet 1

W3 Standard Method Runoff Volume Calculations

Pre-development Bankfull Runoff Calculations ($V_{bf\,pre}$)

A. 2 year/24 hour storm event — $P = 2.35in$

B. The pre-development land cover will be **Good Cover Woods or Meadow**. Determine the associated soil hydrologic group for the entire site and choose the curve number. — $CN = 78$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{78} - 10$

$S = 2.82 in$

D. $Q = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q = \frac{(2.35-(0.2)(2.82))^2}{(2.35+(0.8)(2.82))}$

$Q = 0.69 in$

E. Total Site Area (sf) excluding "Self- Crediting" BMPs — $Area = 36,591 sf$

F. $V_{bf\,pre} = Q(1/12)Area$ $\quad V_{bf\,pre} = (0.69)(1/12)(36,591)$

$V_{bf\,pre} = 2,104 ft^3$

W4 Standard Method Runoff Volume Calculations

Pervious Cover Post-Development Bankfull Runoff Calculations ($V_{bf\,per\text{-}post}$)

A. 2 year/24 hour storm event — $P = 2.35in$

B. Pervious Cover CN From Worksheet 1 — $CN = 80$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{80} - 10$

$S = 2.50 in$

D. $Q = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q = \frac{(2.35-(0.2)(2.50))^2}{(2.35+(0.8)(2.50))}$

$Q = 0.787 in$

E. Pervious Cover Area from Worksheet 1 — $Area = 14,970 sf$

F. $V_{bf\,per\text{-}post} = Q(1/12)Area$ $\quad V_{bf\,per\text{-}post} = (0.787)(1/12)(14,970)$

$V_{bf\,per\text{-}post} = 982 ft^3$

W5 Standard Method Runoff Volume Calculations

Impervious Cover Post-Development Bankfull Runoff Calculations ($V_{bf\,imp\text{-}post}$)

A. 2 year/24 hour storm event — $P = 2.35in$

B. Impervious Cover CN From Worksheet 1 — $CN = 98$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{98} - 10$

$S = 0.20 in$

D. $Q = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q = \frac{(2.35-(0.2)(0.20))^2}{(2.35+(0.8)(0.20))}$

$Q = 2.13 in$

E. Impervious Cover Area from Worksheet 1 — $Area = 21,621 sf$

F. $V_{bf\,imp\text{-}post} = Q(1/12)Area$ $\quad V_{bf\,imp\text{-}post} = (2.13)(1/12)(21,621)$

$V_{bf\,imp\text{-}post} = 3,838 ft^3$

W6 Standard Method Runoff Volume Calculations

Pervious Cover Post-Development 100-year Storm Runoff Calculations ($V_{100\text{-}per\text{-}post}$)

A. 100-year Storm Event — $P = 5.11in$

B. Pervious Cover CN From Worksheet 1 — $CN = 80$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{80} - 10$

$S = 2.50 in$

D. $Q_{100per} = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q_{100per} = \frac{(5.11-(0.2)(2.50))^2}{(5.11+(0.8)(2.50))}$

$Q_{100per} = 2.99 in$

E. Pervious Cover Area from Worksheet 1 — $Area = 14,970 sf$

F. $V_{100\text{-}per\text{-}post} = Q(1/12)Area$ $\quad V_{100per\text{-}post} = (2.99)(1/12)(14,970)$

$V_{100per\text{-}post} = 3,730 ft^3$

W7 Standard Method Runoff Volume Calculations

Impervious Cover Post-Development 100-year Storm Runoff Calculations ($V_{100\text{-}imp\text{-}post}$)

A. 100-year Storm Event — $P = 5.11in$

B. Impervious Cover CN From Worksheet 1 — $CN = 98$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{98} - 10$

$S = 0.20 in$

D. $Q_{100imp} = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q_{100imp} = \frac{(5.11-(0.2)(0.20))^2}{(5.11+(0.8)(0.20))}$

$Q_{100imp} = 4.88 in$

E. Impervious Cover CN From Worksheet 1 — $Area = 21,621 sf$

F. $V_{100imp\text{-}post} = Q(1/12)Area$ $\quad V_{100imp\text{-}post} = (4.88)(1/12)(21,621)$

$V_{100imp\text{-}post} = 8,793 ft^3$

W8 Standard Method Runoff Volume Calculations

Determine Time of Concentration for Applicable Flow Types ($T_{c\,thru}$)

Flow Type	K	Change in Elevation	Length (L)	Slope % (S)	$S^{1/2}$	$V=K*S^{1/2}$	$T_c=L/(V*3600)$
Sheet Flow*	0.48						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						

* Sheet flow cannot exceed 300 feet. Anything beyond this is considered waterway.

Total Time of Concentration ($T_{c\,thru}$) = 0.25

W9 Standard Method Runoff Volume Calculations

Runoff Summary & Onsite Infiltration Requirement

A. Runoff Summary from Previous Worksheets

First Flush Volume (V_{ff})	2,287	ft³
Pre-Development Bankfull Runoff Volume ($V_{bf\,pre}$)	2,104	ft³
Pervious Cover Post-Development Bankfull Volume ($V_{bf\,per\text{-}post}$)	982	ft³
Impervious Cover Post-Development Bankfull Volume ($V_{bf\,imp\text{-}post}$)	3,838	ft³
Total BF Volume ($V_{bf\text{-}post}$)	4,820	ft³
Pervious Cover Post-Development 100-year Volume ($V_{100\text{-}per\text{-}post}$)	3,730	ft³
Impervious Cover Post-Development 100-year Volume ($V_{100\text{-}imp\text{-}post}$)	8,793	ft³
Total 100-year Volume (V_{100})	12,523	ft³

B. Determine Onsite Infiltration Requirement

Subtract the Pre-Development Bankfull from the Post-Development Bankfull volume

Total Post-Development Bankfull Volume ($V_{bf\,post}$)	4,820	ft³
Pre-Development Bankfull Runoff Volume ($V_{bf\,pre}$)	2,104	ft³
Bankfull Volume Difference	2,716	ft³

Compare the Bankfull Volume Difference with the First Flush Volume. The ***greater*** of the two is the Onsite Infiltration Requirement.

Onsite Infiltration Requirement (V_{inf})	2,716	ft³

W10 Standard Method Runoff Volume Calculations

Detention/Retention Requirement

Detention

A. $Q_p = 238.6 T_c^{0.82}$ $\quad Q_p = 238.6(0.25)^{0.82}$

Peak of the Unit Hydrograph $\quad Q_p = 744 \frac{cfs}{in - mi^2}$

B. *Total Site Area (ac) excluding "Self-Crediting" BMPs* — $Area = 0.84 ac$

C. $Q_{100} = Q_{100per} + Q_{100imp}$ $\quad Q_{100} = 2.99 + 4.88$

Note: Q_{100per} and Q_{100imp} from W6 and W7, respectively $\quad Q_{100} = 7.87 in$

D. *Peak Flow (PF)* $= \frac{Q_p \left(\frac{cfs}{in-mi^2}\right) Q_{100(in)} Area(ac)}{640}$ $\quad PF = \frac{(744)(7.87)(0.84)}{640}$

$PF = 7.68$ cfs

E. Δ = PF (cfs) – 0.15 Area(ac) $\quad \Delta = (7.68) - 0.15 (0.84)$

$\Delta = 7.55$ cfs

F. $V_{det} = \frac{\Delta (cfs)}{PF (cfs)} V_{100}$ (ft³) $\quad V_{det} = \frac{(7.55)}{(7.68)} (12,311)$

$V_{det} = 14,773$ ft³

V_{det} = Calculated Detention (ft³), not including volume reduction credit for infiltration or penalty

Note: Projects/sites where the required infiltration volume cannot be achieved must increase the required detention volume by up to an additional 20%.

Retention

A. $V_{ret} = 2(V_{100})$ $\quad V_{ret} = 2(12,523)$

$V_{ret} = 25,046$ ft³

W11 Standard Method Runoff Volume Calculations

Determine Applicable BMPs and Associated Volume Credits

Proposed BMP*	Area (ft²)	Storage Volume[2] (ft³) Surface	Storage Volume[2] (ft³) Soil	Ave. Design Infiltration Rate (in/hr)	Infiltration Volume During Storm[3] (ft³)	Total Volume Reduction[3] (ft³)
Pervious Pavement w/Infiltration Bed						
Infiltration Basin						
Subsurface Infiltration Bed						
Infiltration Trench						
Bioretention Systems						
Rain Gardens		1,144	1,157	0	0	2,301
Dry Well						
Bioswale						
Vegetated Filter Strip						
Green Roof						

Total Volume Reduction Credit by Proposed Structural BMPs (ft³)	2,301	
Runoff Volume Infiltration Requirement (V_{inf}) from Worksheet 9	- 2,716	
Runoff Volume Credit (ft³)	= 0	

* Complete checklist from Section VI for each Structural BMP type
[2] Storage volume as defined in individual BMP write-ups
[3] Approximated as the average design infiltration rate over 6 hours multiplied by the BMP area:
Infiltration Rate x 6 hours x BMP Area x Unit Conversions = Infiltration Volume (ft³)
[3] Total Volume Reduction Credit is the sum of the Storage Volume and the Infiltration Volume During Storm

W13 Summary

Site Summary of Infiltration & Detention

A. Stormwater Management Summary

Minimum Onsite Infiltration Requirement, V_{inf}	2,716	ft³
Designed/Provided Infiltration Volume	0	ft³
% Minimum Required Infiltration Provided	0	%
Total Calculated Detention Volume, V_{det}	12,311	ft³
Net Required Detention Volume *(V_{det} - Designed/Provided Infiltration Volume)*	12,311	ft³

B. Detention Volume Increase for sites where the required infiltration volume cannot be achieved

% Required Infiltration NOT provided *(100% - % Minimum Required Infiltration Provided)*	100	%
Net % Penalty *(20% x % Required Infiltration NOT Provided)*	20	%
Total Required Detention Volume, including penalty *[(100% + Net % Penalty) x Net Required Detention Volume)]*	14,773	ft³

Note:
The Rain Gardens will provide 2,301 cubic feet of storage; therefore, the Detention system will need to provide 12,502 cubic feet of storage.

TCA ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
JOSEPH B. WYWROT
ENGINEER
No. 6201046674
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

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WCWRC WORKSHEETS - FIRE STATION SIDE

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

SHEET C-7.3

Part E.

STANDARD METHOD RUNOFF VOLUME WORK SHEETS

W1 Determining Post-Development Cover Types, Areas, Curve Numbers, and Runoff Coefficients

Total Site Area = 0.35 ac
Total Site Area Excluding "Self- Crediting" BMPs = 0.35 ac[A]

Rational Method Worksheet[1]

Cover Type	Soil Type	Area (ft²)	Area(ac)	Runoff Coefficient (C)	(C) (Area)
Pervious	C	8,489	0.19	0.30	2,546.7
Pervious	D	3,204	0.07	0.45	1,441.8
Impervious	D	3,430	0.08	0.95	3,258.5

Total - ∑(C)(Area) = 7,247.0
Area Total - ∑ac or ∑sf = 15,123.0
Weighted C - ∑(C)(Area)/∑ac or ∑sf = 0.48

NRCS Worksheet[2]

Pervious Cover Type	Soil Type	Area (ft²)	Area(ac)	Curve Number	(CN) (Area)
Pervious	C	8,489	0.19	74	628,186.0
Pervious	D	3,204	0.07	80	256,320.0

Total - ∑(CN)(Area) = 884,506
Area Total - ∑ac or ∑sf = 11,693
Weighted CN - ∑(CN)(Area)/∑ac or ∑sf = 76

NRCS Worksheet[2]

Impervious Cover Type	Soil Type	Area (ft²)	Area(ac)	Curve Number	(CN) (Area)
Impervious	D	3,430	0.08	98	336,140

Total - ∑(CN)(Area) = 336,140
Area Total - ∑ac or ∑sf = 3,430
Weighted CN - ∑(CN)(Area)/∑ac or ∑sf = 98

[A] Use this area for the remainder of the runoff calculations
[1] Required for first flush runoff calculations
[2] Required for bankfull and 100-year runoff calculations

W2 Standard Method Runoff Volume Calculations

First Flush Runoff Calculations (V_{ff})

A.

$V_{ff} = (1") \left(\frac{1'}{12"}\right) \left(\frac{43560 ft^2}{1ac}\right) AC$ $\quad V_{ff} = (1") \left(\frac{1'}{12"}\right) \left(\frac{43560 ft^2}{1ac}\right) (0.35)(0.48)$

$V_{ff} = 610\ ft^3$

A = Total Site Areas (ac) excluding "Self-Crediting" BMPs from Worksheet 1
C= Weighted Runoff Coefficient from Worksheet 1

W3 Standard Method Runoff Volume Calculations

Pre-development Bankfull Runoff Calculations ($V_{bf\,pre}$)

A. 2 year/24 hour storm event — $P = 2.35in$

B. The pre-development land cover will be **Good Cover Woods or [Meadow]** Determine the associated soil hydrologic group for the entire site and choose the curve number. — $CN = 78$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{78} - 10$

$S = 2.82\ in$

D. $Q = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q = \frac{(2.35-(0.2)(2.82))^2}{(2.35+(0.8)(2.82))}$

$Q = 0.69\ in$

E. Total Site Area (sf) excluding "Self- Crediting" BMPs — $Area = 15,123\ sf$

F. $V_{bf\,pre} = Q(1/12)Area$ $\quad V_{bf\,pre} = (0.69)(1/12)(15,123)$

$V_{bf\,pre} = 870\ ft^3$

W4 Standard Method Runoff Volume Calculations

Pervious Cover Post-Development Bankfull Runoff Calculations ($V_{bf\,per\text{-}post}$)

A. 2 year/24 hour storm event — $P = 2.35in$

B. Pervious Cover CN From Worksheet 1 — $CN = 76$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{76} - 10$

$S = 3.16\ in$

D. $Q = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q = \frac{(2.35-(0.2)(3.16))^2}{(2.35+(0.8)(3.16))}$

$Q = 0.605\ in$

E. Pervious Cover Area from Worksheet 1 — $Area = 11,693\ sf$

F. $V_{bf\,per\text{-}post} = Q(1/12)Area$ $\quad V_{bf\,per\text{-}post} = (0.605)(1/12)(11,693)$

$V_{bf\,per\text{-}post} = 590\ ft^3$

W5 Standard Method Runoff Volume Calculations

Impervious Cover Post-Development Bankfull Runoff Calculations ($V_{bf\,imp\text{-}post}$)

A. 2 year/24 hour storm event — $P = 2.35in$

B. Impervious Cover CN From Worksheet 1 — $CN = 98$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{98} - 10$

$S = 0.20\ in$

D. $Q = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q = \frac{(2.35-(0.2)(0.20))^2}{(2.35+(0.8)(0.20))}$

$Q = 2.13\ in$

E. Impervious Cover Area from Worksheet 1 — $Area = 3,430\ sf$

F. $V_{bf\,imp\text{-}post} = Q(1/12)Area$ $\quad V_{bf\,imp\text{-}post} = (2.13)(1/12)(3,430)$

$V_{bf\,imp\text{-}post} = 609\ ft^3$

W6 Standard Method Runoff Volume Calculations

Pervious Cover Post-Development 100-year Storm Runoff Calculations ($V_{100\text{-}per\text{-}post}$)

A. 100-year Storm Event — $P = 5.11in$

B. Pervious Cover CN From Worksheet 1 — $CN = 76$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{76} - 10$

$S = 3.16\ in$

D. $Q_{100per} = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q_{100per} = \frac{(5.11-(0.2)(3.16))^2}{(5.11+0.8(3.16))}$

$Q_{100per} = 2.63\ in$

E. Pervious Cover Area from Worksheet 1 — $Area = 11,693\ sf$

F. $V_{100\text{-}per\text{-}post} = Q(1/12)Area$ $\quad V_{100\text{-}per\text{-}post} = (2.63)(1/12)(11,693)$

$V_{100\text{-}per\text{-}post} = 2,593\ ft^3$

W7 Standard Method Runoff Volume Calculations

Impervious Cover Post-Development 100-year Storm Runoff Calculations ($V_{100\text{-}imp\text{-}post}$)

A. 100-year Storm Event — $P = 5.11in$

B. Impervious Cover CN From Worksheet 1 — $CN = 98$

C. $S = \frac{1000}{CN} - 10$ $\quad S = \frac{1000}{98} - 10$

$S = 0.20\ in$

D. $Q_{100imp} = \frac{(P-0.2S)^2}{(P+0.8S)}$ $\quad Q_{100imp} = \frac{(5.11-(0.2)(0.20))^2}{(5.11+0.8(0.20))}$

$Q_{100imp} = 4.88\ in$

E. Impervious Cover CN From Worksheet 1 — $Area = 3,430\ sf$

F. $V_{100imp\text{-}post} = Q(1/12)Area$ $\quad V_{100imp\text{-}post} = (4.88)(1/12)(3,430)$

$V_{100imp\text{-}post} = 1,395\ ft^3$

W8 Standard Method Runoff Volume Calculations

Determine Time of Concentration for Applicable Flow Types ($T_{c\,thru}$)

Flow Type	K	Change in Elevation	Length (L)	Slope % (S)	$S^{1/2}$	$V=K*S^{1/2}$	$T_c=L/(V*3600)$
Sheet Flow*	0.48						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Waterway	1.2						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						
Small Tributary	2.1						

* Sheet flow cannot exceed 300 feet. Anything beyond this is considered waterway.

Total Time of Concentration ($T_{c\,thru}$) = 0.25

W9 Standard Method Runoff Volume Calculations

Runoff Summary & Onsite Infiltration Requirement

A. Runoff Summary from Previous Worksheets

First Flush Volume (V_{ff})	610	ft³
Pre-Development Bankfull Runoff Volume ($V_{bf\,pre}$)	870	ft³
Pervious Cover Post-Development Bankfull Volume ($V_{bf\,per\text{-}post}$)	590	ft³
Impervious Cover Post-Development Bankfull Volume ($V_{bf\,imp\text{-}post}$)	609	ft³
Total BF Volume ($V_{bf\,post}$)	1,199	ft³
Pervious Cover Post-Development 100-year Volume ($V_{100\text{-}per\text{-}post}$)	2,563	ft³
Impervious Cover Post-Development 100-year Volume ($V_{100\text{-}imp\text{-}post}$)	1,395	ft³
Total 100-year Volume (V_{100})	3,958	ft³

B. Determine Onsite Infiltration Requirement

Subtract the Pre-Development Bankfull from the Post-Development Bankfull volume

Total Post-Development Bankfull Volume ($V_{bf\,post}$)	1,199	ft³
Pre-Development Bankfull Runoff Volume ($V_{bf\,pre}$)	870	ft³
Bankfull Volume Difference	329	ft³

Compare the Bankfull Volume Difference with the First Flush Volume. The ***greater*** of the two is the Onsite Infiltration Requirement.

Onsite Infiltration Requirement (V_{inf})	610	ft³

W10 Standard Method Runoff Volume Calculations

Detention/Retention Requirement

Detention

A. $Q_p = 238.6 T_c^{-0.82}$ $\quad Q_p = 238.6(0.25)^{-0.82}$

Peak of the Unit Hydrograph $\quad Q_p = 744\ cfs/in-mi^2$

B. *Total Site Area (ac) excluding "Self-Crediting" BMPs* — $Area = 0.35\ ac$

C. $Q_{100} = Q_{100per} + Q_{100imp}$ $\quad Q_{100} = 2.63 + 4.88$

Note: Q_{100per} and Q_{100imp} from W6 and W7, respectively $\quad Q_{100} = 7.51\ in$

D. *Peak Flow (PF)* $= \frac{Q_P\left(\frac{cfs/}{in-mi^2}\right) Q_{100(in)} Area(ac)}{640}$ $\quad PF = \frac{(744)(7.51)(0.35)}{640}$

$PF = 3.05$ cfs

E. Δ = PF (cfs) – 0.15 Area(ac) $\quad \Delta = (3.05) - 0.15\ (0.35)$

$\Delta = 3.00$ cfs

F. $V_{det} = \frac{\Delta\ (cfs)}{PF\ (cfs)} V_{100}$ (ft³) $\quad V_{det} = \frac{(3.00)}{(3.05)}(3,958)$

$V_{det} = 3,893$ ft³

V_{det} = Calculated Detention (ft³), not including volume reduction credit for infiltration or penalty

Note: Projects/sites where the required infiltration volume cannot be achieved must increase the required detention volume by up to an additional 20%.

Retention

A. $V_{ret} = 2(V_{100})$ $\quad V_{ret} = 2(3,893)$

$V_{ret} = 7,786$ ft³

W11 Standard Method Runoff Volume Calculations

Determine Applicable BMPs and Associated Volume Credits

Proposed BMP[A]	Area (ft²)	Storage Volume[B] (ft³) Surface	Soil	Ave. Design Infiltration Rate (in/hr)	Infiltration Volume During Storm[C] (ft³)	Total Volume Reduction[C] (ft³)
Pervious Pavement w/Infiltration Bed						
Infiltration Basin						
Subsurface Infiltration Bed						
Infiltration Trench						
Bioretention Systems						
Rain Gardens						
Dry Well						
Bioswale						
Vegetated Filter Strip						
Green Roof						

Total Volume Reduction Credit by Proposed Structural BMPs (ft³) _____
Runoff Volume Infiltration Requirement (V_{inf}) from Worksheet 9 - _____
Runoff Volume Credit (ft³) = _____

* Complete checklist from Section VI for each Structural BMP type
[B] Storage volume as defined in individual BMP write-ups
[C] Approximated as the average design infiltration rate over 6 hours multiplied by the BMP area:
Infiltration Rate x 6 hours x BMP Area x Unit Conversions = Infiltration Volume (ft³)
[C] Total Volume Reduction Credit is the sum of the Storage Volume and the Infiltration Volume During Storm

W13 Summary

Site Summary of Infiltration & Detention

A. Stormwater Management Summary

Minimum Onsite Infiltration Requirement, V_{inf}	610	ft³
Designed/Provided Infiltration Volume	0	ft³
% Minimum Required Infiltration Provided	0	%
Total Calculated Detention Volume, V_{det}	3,893	ft³
Net Required Detention Volume *(V_{det} - Designed/Provided Infiltration Volume)*	3,893	ft³

B. Detention Volume Increase for sites where the required infiltration volume cannot be achieved

% Required Infiltration NOT provided *(100% - % Minimum Required Infiltration Provided)*	100	%
Net % Penalty *(20% x % Required Infiltration NOT Provided)*	20	%
Total Required Detention Volume, including penalty *[(100% + Net % Penalty) x Net Required Detention Volume)]*	4,671	ft³

TCA ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
JOSEPH B. WYWROT
ENGINEER
No. 6201046674
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

PROJECT NUMBER 21018

ISSUE		
	Bids/Permits	10.11.24
	Site Plan-Engineering	08.21.24
	Final Site Plan-Rev	11.08.23
	Final Site Plan	09.08.23
	Bids/Permits	08.04.23
	WCWRC Resubmittal	01.13.23
	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

WCWRC WORKSHEETS - BASKETBALL COURT SIDE

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

SHEET C-7.4

Project:	Ann Arbor Fire Station No. 4				
Location:	Ann Arbor, Michigan				
Project No:	2021-0184				
	Underground Detention				
DESIGN STORM EVENT:	**100** YEAR STORM			**POND OUTLET:**	**ORIFICE**
ALLOWABLE OUTFLOW:	**0.15** CFS / AC.				
Input Parameters					
A	TOTAL DRAINAGE AREA:		.84 Ac.		
C	WEIGHTED C:		0.75		
DETENTION CALCS					
Q_a = OUTFLOW		(.15 CFS/AC.) =	0.126	CFS	
Q_o = Q_a / (AREA x C) =			0.20	CFS/ACRE IMPERVIOUS	
NET REQUIRED DETENTION VOLUME					
V_{NET} = (Per Sec. W13)				**12,472**	CF
INFILTRATION VOLUME DURING STORM					
V_{STORM} = (Per WCWRC Worksheets)				-	CF
FIRST FLUSH VOLUME					
$V_{F.F.}$ = (Per WCWRC Worksheets)				**2,287**	CF
NET FIRST FLUSH VOLUME					
$V_{F.F.(NET)}$ = $V_{F.F.}$ - V_{STORM}				**2,287**	CF
BANK FULL VOLUME					
$V_{BF-POST}$ = (Per WCWRC Worksheets)				**4,820**	CF
NET BANK FULL VOLUME					
$V_{BF-POST(NET)}$ = $V_{BF-POST}$ - V_{STORM}				**4,820**	CF
SEDIMENT FOREBAY VOLUME					
$V_{SED.}$ = 5% of V_{det}				**739**	CF

BASIN SIZING			CONTOUR INTERPOLATION CALCS.		
	CONTOUR ELEV	CUMUL. VOLUME	100-YR HWL	NET BANK FULL	NET FIRST FLUSH
			12,472	4,820	2,287
TOP OF DET.	790.75	12,568	**790.68**	-	-
	789.75	11,290	-	-	-
	789.00	9,990	-	-	-
	788.25	8,082	-	-	-
	787.50	5,873	-	**787.17**	-
	786.75	3,475	-	-	**786.40**
	786.00	958	-	-	-
BOT. OF DET.	785.25	0	-	-	-
			790.68	**787.17**	**786.40**
			Detention Outlet Invert:		**785.25**

First Flush Calculations

Total First Flush Storage Volume, V(ff) =	2,287	CF	
Elevation of First Flush, X(ff-actual) =	**786.40**		
Outlet Sizing for First Flush:			
Q_{ave} = V(ff)/86,400 sec		0.026	CFS
Average Head for Orifice Equation:			
Elevation Difference from X(ff) to Outlet Elevation		1.15	FT
h_{ave}= 2/3 * (elev diff)		0.76	FT
Orifice Area Required			
A = Q/(0.62*sqrt(2gh))		0.0061	SF
Number of Orifice Holes Required			
Hole Diameter (at bottom elev.)	**1.00** in.	Hole Area = 0.0055	SF
Holes =A/.0055			
		therefore, use **1**	HOLES
Actual Release Rate:			
A(ff) = # holes * (hole area)		0.0055	SF
Q_{act} = 0.62*A*sqrt(2gh))		0.024	CFS
Actual Holding Time			
T_{act} = V/Q_{act}		26.78	HR
		>24 hr = OK	

Bankfull Calculations

Bank Full Storage Volume, V(bf) =	4,820	CF
Bank Full Volume above First Flush =	2,533	CF
Elevation of Bank Full, X(bf-actual) =	**787.17**	

Avg. discharge through the first flush orifices (bottom holes) when water is above FF elevation

Elevation Difference from X(bf) to FF	0.77	FT
h_{ave} = 2/3 * (BF to FF) + (ff to outlet diff)	1.66	FT
Release Rate thru Bottom of Det. Orifices:		
Q = 0.62*A(ff)*sqrt(2gh))	0.035	CFS

Avg. discharge through the bank full orifices (at FF elev.) when water is above FF elevation

Elevation Difference from X(bf) to First Flush Elevation			0.77	FT
h_{ave} = 2/3 * (elev diff)			0.52	FT
Hole Diameter (at FF elev.)	**0.00** in.	Hole Area =	0.0000	SF
Holes =A/.			**0**	HOLES
Release Rate thru Orifices at FF elev:				
Q = 0.62*A(bf)*sqrt(2gh))			0.000	CFS
Actual Holding Time (BF Elev. to FF Elev.)				
T_{act} = V/Q_{act}	=2533/(0.035+0)x(1/3600)		20.11	HR
Total Holding Time (BF Elev. to Bottom Elev.)				
T_{act} = V/Q_{act}	=26.78+20.11=		46.89	HR
			>36 & <48 = OK	

100-Year Storm Calculations

100-yr Detention Volume, V(100) =	**12,472**	CF
100-yr Detention Volume above Bank Full elevation	7,652	CF
Elevation of 100-Year Storm, X(100-actual) =	**790.68**	
Design Rim Elevation for 100-Yr Storm, X(100) =	**790.75**	
Allowable Outflow Rate, Q(allow) = 0.15 cfs/acre =	0.126	CFS
Peak Release Rate Provided by First Flush Orifices for 100-yr Storm:		
h = Elevation Difference from X(100) to X (bot)	5.43	FT
Q(ff) = 0.62*A(ff)*sqrt(2gh))	0.063	CFS

Peak Release Rate Provided by Bank Full Orifices for 100-yr Storm:

h = Elevation Difference from X(100) to X (ff)			4.28	FT
Q(bf) = 0.62*A(bf)*sqrt(2gh))			0.000	CFS
Q(max) = Q(allow) - Q(bf) - Q(ff) =			0.063	CFS
Maximum Head for Orifice Equation:				
Elevation Difference from X(100) to X (BF)			3.58	FT
Orifice Area Required				
A = Q/(0.62*sqrt(2gh))			0.007	SF
Number of Orifice Holes Required				
Hole Diameter (at BF elev.)	**1.00**	Hole Area =	0.0055	SF
Holes =A/.0055			1.22	HOLES
		therefore, use	**1**	HOLES
Peak Release Rate Provided by 100-YR Orifices for 100-yr Storm:				
A(100) = # holes * (hole area)			0.0055	SF
Q(100) = 0.62*A*sqrt(2gh))			0.05	CFS
Q(out) = Q(100) + Q(BF) + Q(ff)=			0.11	CFS
Q(out) < Q(allow) :	0.11	<= 0.13	**OK**	

Avg. discharge through the first flush orifices (bottom holes) when water is above BF elevation

h(ave)= (2/3)(X100- Xbf)+(Xbf - Xbot)	4.26	FT
Q = 0.62*A(ff)*sqrt(2gh))	0.056	CFS

Avg. discharge through the bank full orifices (at FF elev.) when water is above BF elevation

h(ave)= (2/3)(X100- Xbf)+(Xbf - Xff)	3.11	FT
Q = 0.62*A(bf)*sqrt(2gh))	0.000	CFS

Avg. Discharge Through the 100 yr orifices (at BF elev.) when water is above BF elevation

h(100-ave)= (2/3)*(X100-Xbf)	2.34	FT
Q = 0.62*A(bf)*sqrt(2gh))	0.041	CFS

Actual Holding Time (100 yr Elev. to BF Elev.)			
T_{act} = V/Q_{act}	=7652/(0.056+0+0.041)x(1/3600)	21.81	HR
Total Holding Time (BF Elev. to Bottom Elev.)			
T_{act} = V/Q_{act}	=46.89+21.81=	68.70	HR
		<72 = OK	

STORM WATER DETENTION OUTLET CALCULATIONS – FIRE STATION SIDE

Project:	Ann Arbor Fire Station No. 4				
Location:	Ann Arbor, Michigan				
Project No:	2021-0184				
	Surface Detention				
DESIGN STORM EVENT:	**100** YEAR STORM			**POND OUTLET:**	**ORIFICE**
ALLOWABLE OUTFLOW:	**0.15** CFS / AC.				
Input Parameters					
A	TOTAL DRAINAGE AREA:		.35 Ac.		
C	WEIGHTED C:		0.48		
DETENTION CALCS					
Q_a = OUTFLOW		(.15 CFS/AC.) =	0.053	CFS	
Q_o = Q_a / (AREA x C) =			0.31	CFS/ACRE IMPERVIOUS	
NET REQUIRED DETENTION VOLUME					
V_{NET} = (Per Sec. W13)				**4,671**	CF
INFILTRATION VOLUME DURING STORM					
V_{STORM} = (Per WCWRC Worksheets)				-	CF
FIRST FLUSH VOLUME					
$V_{F.F.}$ = (Per WCWRC Worksheets)				**610**	CF
NET FIRST FLUSH VOLUME					
$V_{F.F.(NET)}$ = $V_{F.F.}$ - V_{STORM}				**610**	CF
BANK FULL VOLUME					
$V_{BF-POST}$ = (Per WCWRC Worksheets)				**1,199**	CF
NET BANK FULL VOLUME					
$V_{BF-POST(NET)}$ = $V_{BF-POST}$ - V_{STORM}				**1,199**	CF
SEDIMENT FOREBAY VOLUME					
$V_{SED.}$ = 5% of V_{det}				**234**	CF

BASIN SIZING					CONTOUR INTERPOLATION CALCS.		
	CONTOUR ELEV	DETENTION AREA	INCR. VOLUME	CUMUL. VOLUME	100-YR HWL	NET BANK FULL	NET FIRST FLUSH
					4,671	1,199	610
					-	-	-
					-	-	-
					-	-	-
	795.00	5,629	4,708	9,035	**794.07**	-	-
TOP OF DET.	794.00	3,787	2,985	4,327	-	-	-
	793.00	2,183	944	1,342	-	**792.92**	**792.61**
	792.50	1,593	398	398	-	-	-
BOT. OF DET.	792.00	0	-	-	-	-	-
					794.07	**792.92**	**792.61**
					Detention Outlet Invert:		**792.00**

First Flush Calculations

Total First Flush Storage Volume, V(ff) =	610	CF	
Elevation of First Flush, X(ff-actual) =	**792.61**		
Outlet Sizing for First Flush:			
Q_{ave} = V(ff)/86,400 sec		0.007	CFS
Average Head for Orifice Equation:			
Elevation Difference from X(ff) to Outlet Elevation		0.61	FT
h_{ave}= 2/3 * (elev diff)		0.41	FT
Orifice Area Required			
A = Q/(0.62*sqrt(2gh))		0.0022	SF
Number of Orifice Holes Required			
Hole Diameter (at bottom elev.)	**0.75** in.	Hole Area = 0.0031	SF
Holes =A/.0031			
		therefore, use **1**	HOLES
Actual Release Rate:			
A(ff) = # holes * (hole area)		0.0031	SF
Q_{act} = 0.62*A*sqrt(2gh))		0.010	CFS
Actual Holding Time			
T_{act} = V/Q_{act}		17.38	HR
		<24 hr - ADJUST	

Bankfull Calculations

Bank Full Storage Volume, V(bf) =	1,199	CF
Bank Full Volume above First Flush =	589	CF
Elevation of Bank Full, X(bf-actual) =	**792.92**	

Avg. discharge through the first flush orifices (bottom holes) when water is above FF elevation

Elevation Difference from X(bf) to FF	0.31	FT
h_{ave} = 2/3 * (BF to FF) + (ff to outlet diff)	0.82	FT
Release Rate thru Bottom of Det. Orifices:		
Q = 0.62*A(ff)*sqrt(2gh))	0.014	CFS

Avg. discharge through the bank full orifices (at FF elev.) when water is above FF elevation

Elevation Difference from X(bf) to First Flush Elevation			0.31	FT
h_{ave} = 2/3 * (elev diff)			0.21	FT
Hole Diameter (at FF elev.)	**0.00** in.	Hole Area =	0.0000	SF
Holes =A/.			**0**	HOLES
Release Rate thru Orifices at FF elev:				
Q = 0.62*A(bf)*sqrt(2gh))			0.000	CFS
Actual Holding Time (BF Elev. to FF Elev.)				
T_{act} = V/Q_{act}	=589/(0.014+0)x(1/3600)		11.84	HR
Total Holding Time (BF Elev. to Bottom Elev.)				
T_{act} = V/Q_{act}	=17.38+11.84=		29.21	HR
			Must be >36 & <48	

100-Year Storm Calculations

100-yr Detention Volume, V(100) =	**4,671**	CF
100-yr Detention Volume above Bank Full elevation	3,472	CF
Elevation of 100-Year Storm, X(100-actual) =	**794.07**	
Design Rim Elevation for 100-Yr Storm, X(100) =	**794.00**	
Allowable Outflow Rate, Q(allow) = 0.15 cfs/acre =	0.053	CFS
Peak Release Rate Provided by First Flush Orifices for 100-yr Storm:		
h = Elevation Difference from X(100) to X (bot)	2.07	FT
Q(ff) = 0.62*A(ff)*sqrt(2gh))	0.022	CFS

Peak Release Rate Provided by Bank Full Orifices for 100-yr Storm:

h = Elevation Difference from X(100) to X (ff)			1.46	FT
Q(bf) = 0.62*A(bf)*sqrt(2gh))			0.000	CFS
Q(max) = Q(allow) - Q(bf) - Q(ff) =			0.031	CFS
Maximum Head for Orifice Equation:				
Elevation Difference from X(100) to X (BF)			1.08	FT
Orifice Area Required				
A = Q/(0.62*sqrt(2gh))			0.006	SF
Number of Orifice Holes Required				
Hole Diameter (at BF elev.)	**1.00**	Hole Area =	0.0055	SF
Holes =A/.0055			1.08	HOLES
		therefore, use	**1**	HOLES
Peak Release Rate Provided by 100-YR Orifices for 100-yr Storm:				
A(100) = # holes * (hole area)			0.0055	SF
Q(100) = 0.62*A*sqrt(2gh))			0.03	CFS
Q(out) = Q(100) + Q(BF) + Q(ff)=			0.05	CFS
Q(out) < Q(allow) :	0.050	<= 0.053	**OK**	

Avg. discharge through the first flush orifices (bottom holes) when water is above BF elevation

h(ave)= (2/3)(X100- Xbf)+(Xbf - Xbot)	1.69	FT
Q = 0.62*A(ff)*sqrt(2gh))	0.020	CFS

Avg. discharge through the bank full orifices (at FF elev.) when water is above BF elevation

h(ave)= (2/3)(X100- Xbf)+(Xbf - Xff)	1.08	FT
Q = 0.62*A(bf)*sqrt(2gh))	0.000	CFS

Avg. Discharge Through the 100 yr orifices (at BF elev.) when water is above BF elevation

h(100-ave)= (2/3)*(X100-Xbf)	0.77	FT
Q = 0.62*A(bf)*sqrt(2gh))	0.024	CFS

Actual Holding Time (100 yr Elev. to BF Elev.)			
T_{act} = V/Q_{act}	=3472/(0.02+0+0.024)x(1/3600)	22.13	HR
Total Holding Time (BF Elev. to Bottom Elev.)			
T_{act} = V/Q_{act}	=29.21+22.13=	51.34	HR
		<72 = OK	

STORM WATER DETENTION OUTLET CALCULATIONS – BASKETBALL COURT SIDE

S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\CONSTRUCTION\(C-7.1) STRM-210184.dwg,09.03.05 4:41 PM

TCA ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN JOSEPH B. WYWROT ENGINEER No. 6201046874 LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

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115 1/2 E. LIBERTY STREET
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www.a3c.com

SHEET C-7.5

GENERAL NOTES:

THESE NOTES APPLY TO ALL CONSTRUCTION ACTIVITIES ON THIS PROJECT.

1. ALL CONSTRUCTION, WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH CURRENT OSHA, MDOT AND MUNICIPALITY STANDARDS AND REGULATIONS.
2. THE CONTRACTOR SHALL NOTIFY THE ENGINEER AND/OR THE AUTHORITY HAVING JURISDICTION 3 BUSINESS DAYS PRIOR TO THE BEGINNING OF CONSTRUCTION.
3. THE CONTRACTOR SHALL CONTACT THE ENGINEER SHOULD THEY ENCOUNTER ANY DESIGN ISSUES DURING CONSTRUCTION. IF THE CONTRACTOR MAKES DESIGN MODIFICATIONS WITHOUT THE WRITTEN DIRECTION OF THE DESIGN ENGINEER, THE CONTRACTOR DOES SO AT HIS OWN RISK.
4. ALL NECESSARY PERMITS, TESTING, BONDS AND INSURANCES ETC., SHALL BE PAID FOR BY THE CONTRACTOR. THE OWNER SHALL PAY FOR ALL CITY INSPECTION FEES.
5. THE CONTRACTOR SHALL NOTIFY THE APPROPRIATE 811/ONE CALL UTILITY LOCATING CENTER, THE CITY ENGINEER AND/OR THE AUTHORITY HAVING JURISDICTION 3 BUSINESS DAYS PRIOR TO THE BEGINNING OF CONSTRUCTION. IF NO NOTIFICATION IS GIVEN AND DAMAGE RESULTS, SAID DAMAGE WILL BE REPAIRED AT SOLE EXPENSE OF THE CONTRACTOR. IF EXISTING UTILITY LINES ARE ENCOUNTERED THAT CONFLICT IN LOCATION WITH NEW CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY THE DESIGN ENGINEER SO THAT THE CONFLICT MAY BE RESOLVED.
6. CONTRACTOR SHALL VERIFY THAT THE PLANS AND SPECIFICATIONS ARE THE VERY LATEST PLANS AND SPECIFICATIONS AND FURTHERMORE, VERIFY THAT THESE PLANS AND SPECIFICATIONS HAVE BEEN APPROVED. ALL ITEMS CONSTRUCTED BY THE CONTRACTOR PRIOR TO RECEIVING FINAL APPROVAL, HAVING TO BE ADJUSTED OR RE-DONE, SHALL BE AT THE CONTRACTORS EXPENSE. SHOULD THE CONTRACTOR ENCOUNTER A CONFLICT BETWEEN THESE PLANS AND/OR SPECIFICATIONS, THEY SHALL SEEK CLARIFICATION IN WRITING FROM THE ENGINEER BEFORE COMMENCEMENT OF CONSTRUCTION. FAILURE TO DO SO SHALL BE AT SOLE EXPENSE TO THE CONTRACTOR.
7. ANY WORK WITHIN THE STREET OR HIGHWAY RIGHTS-OF-WAY SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF THE AGENCIES HAVING JURISDICTION AND SHALL NOT BEGIN UNTIL ALL NECESSARY PERMITS HAVE BEEN ISSUED FOR THE WORK.
8. ALL PROPERTIES OR FACILITIES IN THE SURROUNDING AREAS, PUBLIC OR PRIVATE, DESTROYED OR OTHERWISE DISTURBED DUE TO CONSTRUCTION, SHALL BE REPLACED AND/OR RESTORED TO THE ORIGINAL CONDITION BY THE CONTRACTOR.
9. THE CONTRACTOR SHALL PROVIDE ALL NECESSARY BARRICADING, SIGNAGE, LIGHTS AND TRAFFIC CONTROL DEVICES TO PROTECT THE WORK AND SAFELY MAINTAIN TRAFFIC IN ACCORDANCE WITH LOCAL REQUIREMENTS AND THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (LATEST EDITION). THE DESIGN ENGINEER, OWNER, AND STATE SHALL NOT BE HELD LIABLE FOR ANY CLAIMS RESULTING FROM ACCIDENTS OR DAMAGES CAUSED BY THE CONTRACTOR'S FAILURE TO COMPLY WITH TRAFFIC AND PUBLIC SAFETY REGULATIONS DURING THE CONSTRUCTION PERIOD.
10. THE USE OF CRUSHED CONCRETE IS PROHIBITED ON THE PROJECT WITHIN 100 FEET OF ANY WATER COURSE (STREAM, RIVER, COUNTY DRAIN, ETC.) AND LAKE, REGARDLESS OF THE APPLICATION OR LOCATION OF THE WATER COURSE OR LAKE RELATIVE TO THE PROJECT LIMITS.
11. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO ADJUST THE TOP OF ALL EXISTING AND PROPOSED STRUCTURES (MANHOLES, CATCH BASINS, INLETS, GATE WELLS ETC.) WITHIN GRADED AND /OR PAVED AREAS TO FINAL GRADE SHOWN ON THE PLANS. ALL SUCH ADJUSTMENTS SHALL BE INCIDENTAL TO THE JOB AND WILL NOT BE PAID FOR SEPARATELY.

PAVING NOTES:

1. IN AREAS WHERE NEW PAVEMENTS ARE BEING CONSTRUCTED, THE TOPSOIL AND SOIL CONTAINING ORGANIC MATTER SHALL BE REMOVED PRIOR TO PAVEMENT CONSTRUCTION.
2. REFER TO ARCHITECTURAL PLANS FOR DETAILS OF FROST SLAB AT EXTERIOR BUILDING DOORS.
3. CONSTRUCTION TRAFFIC SHOULD BE MINIMIZED ON THE NEW PAVEMENT. IF CONSTRUCTION TRAFFIC IS ANTICIPATED ON THE PAVEMENT STRUCTURE, THE INITIAL LIFT THICKNESS COULD BE INCREASED AND PLACEMENT OF THE FINAL LIFT COULD BE DELAYED UNTIL THE MAJORITY OF THE CONSTRUCTION ACTIVITIES HAVE BEEN COMPLETED. THIS ACTION WILL ALLOW REPAIR OF LOCALIZED FAILURE, IF ANY DOES OCCUR, AS WELL AS REDUCE LOAD DAMAGE ON THE PAVEMENT SYSTEM.
4. ALL EXPANSION JOINTS AND CONCRETE PAVEMENT JOINTS TO BE SEALED.
5. CONCRETE PAVEMENT JOINTING – UNLESS SHOWN OTHERWISE IN THE PLANS OR REQUIRED BY THE AUTHORITY HAVING JURISDICTION;
   - 5.1. WHERE PROPOSED CONCRETE ABUTS A STRUCTURE, PROVIDE A MINIMUM 1/2" EXPANSION JOINT. THE JOINT FILLER BOARD MUST BE AT LEAST THE FULL DEPTH OF THE CONCRETE AND HELD DOWN A 1/2" TO ALLOW FOR SEALING.
   - 5.2. WHERE PROPOSED CONCRETE ABUTS EXISTING CONCRETE OR IN BETWEEN POURS OF PROPOSED CONCRETE (CONSTRUCTION JOINT), PROVIDE 5/8" DOWELS EVERY 30" CENTER TO CENTER HALF WAY ALONG THE THICKNESS OF THE PROPOSED PAVEMENT. ALTERNATE DOWELS SIZES AND SPACING MUST BE APPROVED THE ENGINEER PRIOR TO COMMENCING WORK AND VIA THE SUBMITTAL PROCESS.
   - 5.3. WHERE PROPOSED CONCRETE ABUTS EXISTING OR PROPOSED SIDEWALK OR CURBING, PROVIDE A MINIMUM 1/2" EXPANSION JOINT.
   - 5.4. CONTROL, LONGITUDINAL AND/OR TRANSVERSE JOINTS SHALL BE PLACED TO PROVIDE PANELS WITHIN THE PAVEMENT AS SQUARE AS POSSIBLE WITH THE FOLLOWING MAXIMUM SPACING PARAMETERS:
     - 5.4.1. 6-INCH THICK CONCRETE PAVEMENT: 12' X 12'
     - 5.4.2. 8-INCH THICK CONCRETE PAVEMENT: 15' X 15'
   - 5.5. IRREGULAR-SHAPED PANELS MAY REQUIRE THE USE OF REINFORCING MESH OR FIBER MESH AS DETERMINED BY THE ENGINEER. THE USE OF MESH MUST BE APPROVED THE ENGINEER PRIOR TO COMMENCING WORK AND VIA THE SUBMITTAL PROCESS.
   - 5.6. IF A JOINT PLAN IS NOT PROVIDED IN THE PLANS, THE CONTRACTOR SHALL SUBMIT ONE TO THE ENGINEER FOR REVIEW PRIOR TO COMMENCING WORK AND VIA THE SUBMITTAL PROCESS.
6. CONCRETE CURBING JOINTING – UNLESS SHOWN OTHERWISE IN THE PLANS OR REQUIRED BY THE AUTHORITY HAVING JURISDICTION
   - 6.1. JOINTS WHEN ADJACENT TO ASPHALT PAVEMENT
     - 6.1.1. PLACE CONTRACTION JOINTS AT 10' INTERVALS
     - 6.1.2. PLACE 1/2" EXPANSION JOINT AT CATCH BASINS, EXISTING AND PROPOSED SIDEWALK OR EXISTING CURBING.
     - 6.1.3. PLACE 1" EXPANSION JOINT:
       - 6.1.3.1. AT SPRING POINTS OF INTERSECTIONS OR ONE OF THE END OF RADIUS LOCATIONS IN A CURVE
       - 6.1.3.2. AT 400' MAXIMUM INTERVALS ON STRAIGHT RUNS
       - 6.1.3.3. AT THE END OF RADIUS AT OPPOSITE ENDS IN A CURBED LANDSCAPE ISLAND
   - 6.2. JOINTS WHEN TIED TO CONCRETE PAVEMENT
     - 6.2.1. PLACE CONTRACTION JOINTS OPPOSITE ALL TRANSVERSE CONTRACTION JOINTS IN PAVEMENT
     - 6.2.2. PLACE 1/2" EXPANSION JOINT AT CATCH BASINS, EXISTING AND PROPOSED SIDEWALK OR EXISTING CURBING.
     - 6.2.3. PLACE 1" EXPANSION JOINT OPPOSITE ALL TRANSVERSE EXPANSION JOINTS IN PAVEMENT
     - 6.2.4. CURB AND GUTTER AND CONCRETE SHALL BE TIED TOGETHER SIMILAR TO A LONGITUDINAL LANE TIE JOINT (MDOT B1 JOINT)
   - 6.3. IN BETWEEN POURS OF PROPOSED CONCRETE CURBING (CONSTRUCTION JOINT):
     - 6.3.1. CARRY THE REBAR CONTINUOUSLY BETWEEN POURS
     - 6.3.2. IF THE REBAR IS NOT LONG ENOUGH TO CARRY CONTINUOUSLY, THEN TIE TWO PIECES OF REBAR PER THE LATEST MDOT SPECIFICATIONS
7. CONCRETE SIDEWALK JOINTING – UNLESS SHOWN OTHERWISE IN THE PLANS OR REQUIRED BY THE AUTHORITY HAVING JURISDICTION
   - 7.1. PLACE TRANSVERSE CONTRACTION JOINTS EQUAL TO THE WIDTH OF THE WALK WHEN WIDTH IS LESS THAN 8'
   - 7.2. PLACE TRANSVERSE AND LONGITUDINAL CONTRACTION JOINTS EQUAL TO 1/2 THE WIDTH OF THE WALK WHEN WIDTH IS EQUAL TO OR GREATER THAN 8'
   - 7.3. PLACE 1" EXPANSION JOINT WHERE ABUTTING SIDEWALK RAMP AND/OR RADIUS IN INTERSECTION
   - 7.4. PLACE TRANSVERSE 1/2" EXPANSION JOINT AT MAXIMUM OF 100' SPACING
   - 7.5. PLACE 1/2" EXPANSION JOINT WHEN ABUTTING A FIXED STRUCTURE, OTHER PAVEMENT (CONCRETE PAVEMENT AND DRIVE APPROACHES), UTILITY STRUCTURES, LIGHT POLE BASES AND COLUMNS

GENERAL GRADING AND EARTHWORK NOTES:

THESE NOTES APPLY TO ALL CONSTRUCTION ACTIVITIES ON THIS PROJECT

1. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING TREES AND BRUSH AND REMOVE ALL THAT ARE NECESSARY TO GRADE SITE.
2. ALL GRADES ARE TO TOP OF PAVEMENT UNLESS OTHERWISE NOTED.
3. THE STAGING OF CONSTRUCTION ACTIVITIES SHALL OCCUR ONLY WITHIN THE SITE BOUNDARIES. ANY CONSTRUCTION ACTIVITIES OUTSIDE OF THE SITE BOUNDARIES SHALL BE AT THE SOLE RESPONSIBILITY AND RISK OF THE CONTRACTOR.
4. ALL SOIL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL MEET THE REQUIREMENTS OF THE AUTHORIZED PUBLIC AGENCY OF JURISDICTION. AN EROSION CONTROL PERMIT MUST BE SECURED FROM THE WASHTENAW COUNTY WATER RESOURCE COMMISSION PRIOR TO CONSTRUCTION.
5. ALL EARTHWORK AND GRADING OPERATIONS SHALL BE PERFORMED IN ACCORDANCE WITH THE SOILS INVESTIGATION AND REPORT.
6. REFER TO SOIL EROSION CONTROL PLAN FOR ADDITIONAL SOIL EROSION AND SEDIMENTATION CONTROL MEASURES AND NOTES.
7. THE DETENTION BASIN SIDE SLOPES AND ALL SLOPE EXCEEDING 1:6 MUST BE STABILIZED BY SODDING OR BY PLACING A MULCH BLANKET PEGGED IN PLACE OVER SEED.
8. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED OR SODDED IN ACCORDANCE WITH THE LANDSCAPE PLANS. PROVIDE A MINIMUM OF 3" OF TOPSOIL IN THESE AREAS UNLESS OTHERWISE NOTED.
9. THE CONTRACTOR SHALL NOTE EXISTING UNDERGROUND UTILITIES WITHIN AND ADJACENT TO THE SITE. BACKFILL FOR EXISTING UTILITY TRENCHES SHALL BE EXAMINED CRITICALLY. ANY TRENCHES FOUND TO HAVE SOFT, UNSTABLE OR UNSUITABLE BACKFILL MATERIAL, IN THE OPINION OF THE THIRD PARTY TESTING COMPANY, THAT ARE TO BE WITHIN THE ZONE OF INFLUENCE OF PROPOSED BUILDINGS OR PAVEMENT SHALL BE COMPLETELY EXCAVATED AND BACKFILLED WITH SUITABLE MATERIAL.
10. ON-SITE FILL CAN BE USED IF THE SPECIFIED COMPACTION REQUIREMENTS CAN BE ACHIEVED. IF ON-SITE SOIL IS USED, IT SHOULD BE CLEAN AND FREE OF FROZEN SOIL, ORGANICS, OR OTHER DELETERIOUS MATERIALS.
11. THE FINAL SUBGRADE/EXISTING AGGREGATE BASE SHOULD BE THOROUGHLY PROOFROLLED USING A FULLY LOADED TANDEM AXLE TRUCK OR FRONT END LOADER UNDER THE OBSERVATION OF A GEOTECHNICAL/PAVEMENT ENGINEER. LOOSE OR YIELDING AREAS THAT CANNOT BE MECHANICALLY STABILIZED SHOULD BE REINFORCED USING GEOGRIDS OR REMOVED AND REPLACED WITH ENGINEERED FILL OR AS DICTATED BY FIELD CONDITIONS.
12. SUBGRADE UNDERCUTTING, INCLUDING BACKFILLING SHALL BE PERFORMED TO REPLACE MATERIALS SUSCEPTIBLE TO FROST HEAVING AND UNSTABLE SOIL CONDITIONS. ANY EXCAVATIONS THAT MAY BE REQUIRED BELOW THE TOPSOIL IN FILL AREAS OR BELOW SUBGRADE IN CUT AREAS WILL BE CLASSIFIED AS SUBGRADE UNDERCUTTING.
13. SUBGRADE UNDERCUTTING SHALL BE PERFORMED WHERE NECESSARY AND THE EXCAVATED MATERIAL SHALL BECOME THE PROPERTY OF THE CONTRACTOR. ANY SUBGRADE UNDERCUTTING SHALL BE BACKFILLED AS RECOMMENDED IN THE GEOTECHNICAL ENGINEERING REPORT FOR THE PROJECT.
14. ANY SUB-GRADE WATERING REQUIRED TO ACHIEVE REQUIRED DENSITY SHALL BE CONSIDERED INCIDENTAL TO THE JOB.

GENERAL UTILITY NOTES:

1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH THE STANDARDS AND SPECIFICATIONS OF THE CITY OF ANN ARBOR.
2. ALL TRENCHES UNDER OR WITHIN THREE (3) FEET OR THE FORTY-FIVE (45) DEGREE ZONE OF INFLUENCE LINE OF EXISTING AND/OR PROPOSED PAVEMENT, BUILDING PAD OR DRIVE APPROACH SHALL BE BACKFILLED WITH MDOT CLASS II SAND COMPACTED TO AT LEAST NINETY-FIVE (95) PERCENT OF MAXIMUM UNIT WEIGHT (ASTM D-1557). ALL OTHER TRENCHES TO BE COMPACTED TO 90% OR BETTER.
3. WHERE EXISTING MANHOLES OR SEWER PIPE ARE TO BE TAPPED, DRILL HOLES 4" CENTER TO CENTER, AROUND PERIPHERY OF OPENING TO CREATE A PLANE OF WEAKNESS JOINT BEFORE BREAKING SECTION OUT.
4. THE LOCATIONS AND DIMENSIONS SHOWN ON THE PLANS FOR EXISTING UTILITIES ARE IN ACCORDANCE WITH AVAILABLE INFORMATION WITHOUT UNCOVERING AND MEASURING. THE DESIGN ENGINEER DOES NOT GUARANTEE THE ACCURACY OF THIS INFORMATION OR THAT ALL EXISTING UNDERGROUND FACILITIES ARE SHOWN. CONTRACTOR SHALL FIELD VERIFY UTILITIES.
5. THE CONTRACTOR SHALL COORDINATE TO ENSURE ALL REQUIRED PIPES, CONDUITS, CABLES AND SLEEVES ARE PROPERLY PLACED FOR THE INSTALLATION OF GAS, ELECTRIC, PHONE, CABLE, IRRIGATION, ETC. IN SUCH A MANNER THAT WILL FACILITATE THEIR PROPER INSTALLATION PRIOR TO THE PLACEMENT OF THE PROPOSED PAVEMENT AND LANDSCAPING.
6. PIPE LENGTHS INDICATED ARE FROM CENTER OF STRUCTURE AND TO END OF FLARED END SECTION UNLESS NOTED OTHERWISE.
7. CONTRACTOR SHALL INSPECT ALL EXISTING PUBLIC STORM SEWER, SANITARY SEWER AND WATER MAIN STRUCTURES WITHIN THE LIMITS OF CONSTRUCTION AND WITH THE GOVERNING AGENCY INSPECTOR PRIOR TO ESTABLISHING FINAL GRADE. NOTIFY THE ENGINEER, OWNER/DEVELOPER, AND GOVERNING AGENCY IF STRUCTURE IS DEEMED TO BE STRUCTURALLY UNSOUND AND/OR IN NEED OF REPAIR.
8. THE CITY OF ANN ARBOR STANDARD DETAILS ARE INCORPORATED INTO AND MADE A PART OF THESE PLANS. CONTRACTOR TO REFER TO THE CITY OF ANN ARBOR STANDARD DETAIL SHEETS FOR ALL STRUCTURE, PIPE MATERIALS, BEDDING, TESTING, ETC. CITY STANDARD DETAILS AS NEEDED FOR SOLID WASTE AND/OR FORESTRY SHALL BE INCLUDED WITHIN THE PLAN SET AS NEEDED.
9. HYDRANT COVERAGE NOTE: HYDRANTS PROVIDING PROTECTION COVERAGE FOR THE BUILDING SHALL BE IN SERVICE AND APPROVED BY PLANNING, ENGINEERING, AND THE FIRE DEPARTMENT BEFORE THE FIRE DEPARTMENT WILL SUPPORT ISSUANCE FOR NEW CONSTRUCTION PHASES AND BEFORE COMBUSTIBLE MATERIALS ARE PLACED ON THE JOB SITE. HYDRANTS SHALL BE IN SERVICE THROUGHOUT CONSTRUCTION.

STORM SEWER NOTES:

1. ALL STORM SEWER 12" DIAMETER OR LARGER SHALL BE REINFORCED CONCRETE PIPE (RCP C-76) CLASS IV WITH MODIFIED TONGUE AND GROOVE JOINT WITH RUBBER GASKETS UNLESS SPECIFIED OTHERWISE (ASTM C-443).
2. ALL STORM SEWER LEADS SHALL BE CONSTRUCTED AT 1.00% MINIMUM SLOPE.
3. ALL STORM SEWER 10" OR LESS AND/OR LEADS SHALL BE SDR 26.
4. JOINTS FOR PVC PIPE SHALL BE ELASTOMERIC (RUBBER GASKET) AS SPECIFIED IN A.S.T.M. DESIGNATION D-3212.

WATER MAIN NOTES:

1. WATER MAIN CONSTRUCTION SHALL CONFORM TO DIVISION IV, SECTION 3 OF THE CITY OF ANN ARBOR PUBLIC SERVICES DEPARTMENT STANDARD SPECIFICATIONS AND DETAILS..
2. ALL WATER MAIN SHALL BE INSTALLED WITH A MINIMUM COVER OF 5.5' BELOW FINISH GRADE. WHEN WATER MAINS MUST DIP TO PASS UNDER A STORM SEWER OR SANITARY SEWER, THE SECTIONS WHICH ARE DEEPER THAN NORMAL SHALL BE KEPT TO A MINIMUM LENGTH BY THE USE OF VERTICAL TWENTY TWO AND A HALF (22.5°) DEGREE BENDS, PROPERLY ANCHORED.
3. PHYSICAL CONNECTIONS SHALL NOT BE MADE BETWEEN EXISTING AND NEW WATER MAINS UNTIL REQUIRED TESTING IS SATISFACTORILY COMPLETED.
4. MAINTAIN 10' HORIZONTAL CLEARANCE BETWEEN OUTER EDGE OF WATERMAIN AND ANY SANITARY/STORM SEWER OR STRUCTURE.
5. NO PHYSICAL CONNECTION TO THE EXISTING WATER MAIN CAN BE MADE UNTIL ALL NEW WATER MAIN PASSES PRESSURE AND BACTERIOLOGICAL TESTS TO THE SATISFACTION OF THE CITY OF ANN ARBOR.
6. ALL WATER MAIN AND FITTINGS (4" DIAMETER AND LARGER) SHALL BE DUCTILE IRON, CLASS 54 AND SHALL BE POLYETHYLENE WRAPPED PER ANSI/AWWA C105/A21.5.
7. WATER MAIN SERVICE LEADS SHALL BE TYPE 'K' ANNEALED SEAMLESS COPPER WITH FLARED FITTINGS, UNLESS OTHERWISE NOTED.
8. ALL FIRE HYDRANTS SHALL BE EAST JORDAN IRON WORKS PRODUCT NUMBER 5593.1D WITH A 5" STORZ. TRAFFIC FLANGES SHALL BE PER THE CITY OF ANN ARBOR SPECIFICATIONS.
9. ALL HYDRANTS SHALL BE CENTERED A MINIMUM 4' AND A MAXIMUM 10' FROM THE FACE OF CONCRETE CURB OR PAVEMENT EDGE, TYP.
10. ALL TEES, BENDS, CONNECTIONS, ETC. ARE CONSIDERED INCIDENTAL TO THE JOB. ALL NECESSARY FITTINGS, THRUST BLOCKS, RESTRAINING GLANDS, BLOW OFFS, ETC. FOR WATER MAIN ARE CONSIDERED INCIDENTAL TO THIS PROJECT. THE CONTRACTOR SHALL INSTALL THESE ITEMS AS NECESSARY AND AS REQUIRED BY THE CITY OF ANN ARBOR.
11. THE WATER MAIN CONTRACTOR SHALL NOTIFY THE CITY OF ANN ARBOR PROJECT MANAGEMENT UNIT AT 734.794.6410 AT LEAST THREE WORKING DAYS IN ADVANCE OF STARTING CONSTRUCTION. INSPECTION SERVICES SHALL BE ARRANGED THROUGH TECHNICIAN SUPERVISOR, DAVE CLEMONS AT 734.219.2909.

SANITARY SEWER NOTES:

1. ALL SEWER CONSTRUCTION SHALL CONFORM TO DIVISION IV, SECTION 2 OF THE CITY OF ANN ARBOR PUBLIC SERVICES DEPARTMENT STANDARD SPECIFICATIONS AND DETAILS.
2. DOWNSPOUTS, WEEP TILE, FOOTING DRAINS OR ANY CONDUIT THAT CARRIES STORM OR GROUND WATER SHALL NOT BE ALLOWED TO DISCHARGE INTO A SANITARY SEWER.
3. ALL SANITARY LEADS SHALL BE CONSTRUCTED AT 1.00% MINIMUM SLOPE.
4. ALL SANITARY SEWER SHALL BE POLYVINYL CHLORIDE (PVC) SDR 35 PIPE AND FITTINGS. ALL JOINTS SHALL BE BELL AND SPIGOT RUBBER O-RING GASKET.
5. SANITARY LEADS SHALL BE PROVIDED WITH CLEANOUTS EVERY 100 FEET AND AT EVERY BEND AS SHOWN. ALL CLEANOUTS TO BE PROVIDED WITH E.J.I.W. #1565 BOX OR EQUAL.
6. SANITARY SEWER DEPTHS SHALL MEET THE CITY OF ANN ARBOR'S REQUIREMENTS AND WILL BE DOCUMENTED ON THE FINAL ENGINEERING PLANS.

CONSTRUCTION MATERIAL SUBMITTALS

UNLESS REQUIRED OTHERWISE IN THE PROJECT SPECIFICATIONS, THE CONTRACTOR SHALL ONLY SUBMIT THE FOLLOWING CONSTRUCTION MATERIAL SUBMITTALS, AS APPLICABLE TO THE PLANS, FOR REVIEW BY THE ENGINEER. UNLESS APPROVED IN ADVANCE AND IN WRITING BY THE ENGINEER, ANY MATERIAL SUBMITTALS PROVIDED TO THE ENGINEER FOR REVIEW IN ADDITION TO THIS LIST SHALL BE RETURNED TO THE CONTRACTOR WITHOUT A REVIEW BEING PERFORMED.

1. SOIL EROSION AND SEDIMENTATION CONTROL MEASURES
2. UTILITY TRENCH BACKFILL MATERIAL WITH ALL MATERIAL DATA INCLUDED IN THE SUBMITTAL BEING DATED WITHIN 30 DAYS OF THE SUBMITTAL UNLESS APPROVED OTHERWISE BY THE ENGINEER
3. RIP RAP MATERIAL WITH ALL MATERIAL DATA INCLUDED IN THE SUBMITTAL BEING DATED WITHIN 60 DAYS OF THE SUBMITTAL UNLESS APPROVED OTHERWISE BY THE ENGINEER
4. STORM AND SANITARY SEWER PIPING INCLUDING JOINTS
5. STORM AND SANITARY SEWER STRUCTURES
6. STORM AND SANITARY SEWER STRUCTURE FRAME AND COVERS INCLUDING CLEAN OUTS
7. WATER DISTRIBUTION SYSTEM PIPING INCLUDING JOINTS
8. WATER DISTRIBUTION SYSTEM STRUCTURES
9. WATER DISTRIBUTION SYSTEM STRUCTURE FRAME AND COVERS
10. WATER DISTRIBUTION SYSTEM SHUT OFF BOXES
11. WATER DISTRIBUTION SYSTEM FIRE HYDRANTS
12. WATER DISTRIBUTION SYSTEM GATE VALVES
13. STORM WATER MANAGEMENT OUTLET CONTROL STRUCTURES INCLUDING COVERS OR GRATES
14. STORM WATER MANAGEMENT OUTLET SEDIMENTATION BASIN RISERS INCLUDING GRATES
15. STORM WATER MANAGEMENT MECHANICAL PRE-TREATMENT UNITS INCLUDING COVERS
16. STORM WATER MANAGEMENT UNDERGROUND DETENTION SYSTEM MATERIAL AND SHOP DRAWINGS DEPICTING THE LAYOUT OF THE SYSTEM
17. PAVEMENT AGGREGATE BASE MATERIAL WITH ALL MATERIAL DATA INCLUDED IN THE SUBMITTAL BEING DATED WITHIN 30 DAYS OF THE SUBMITTAL UNLESS APPROVED OTHERWISE BY THE ENGINEER
18. PAVEMENT UNDERDRAIN MATERIAL AND BACKFILL WITH ALL BACKFILL MATERIAL DATA INCLUDED IN THE SUBMITTAL BEING DATED WITHIN 60 DAYS OF THE SUBMITTAL UNLESS APPROVED OTHERWISE BY THE ENGINEER
19. PAVEMENT MIX DESIGNS SUBMITTED FOR REVIEW BY THE ENGINEER MUST FOLLOW THE CURRENT MDOT REVIEW CHECKLISTS AS SUMMARIZED BELOW AND ALL MATERIAL DATA INCLUDED IN THE SUBMITTAL BEING DATED WITHIN 60 DAYS OF THE SUBMITTAL UNLESS APPROVED OTHERWISE BY THE ENGINEER:
    - CONCRETE MIX DESIGN REVIEW CHECKLIST (FORM 2000)
    - SUPERPAVE MIX DESIGN CHECKLIST (FORM 1862)
    - MARSHALL MIX DESIGN CHECKLIST (FORM 1849)
20. ANY ITEMS SHOWN IN THE PLANS OR DETAIL SHEETS THAT SPECIFICALLY STATE FOR THE CONTRACTOR TO SUBMIT A SHOP DRAWING TO THE ENGINEER FOR REVIEW. THESE ITEMS INCLUDE, BUT ARE NOT LIMITED TO:
    - RETAINING WALL MATERIAL AND STRUCTURAL CALCULATIONS
    - ANY SPECIALITY ITEMS SHOWN IN THE PLANS OR DETAIL SHEETS THAT SPECIFICALLY DO NOT STATE FOR THE CONTRACTOR SHALL SUBMIT A SHOP DRAWING TO THE ENGINEER FOR REVIEW BUT THE CONTRACTOR REQUESTS TO BE REVIEWED. THE CONTRACTOR'S REQUEST FOR REVIEW MUST BE IN WRITING AND APPROVED BY THE ENGINEER PRIOR TO SUBMITTING THE INFORMATION.

TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
JOSEPH B. WYWROT
ENGINEER
No. 6201040674
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

PROJECT NUMBER 21018

ISSUE		
	Bids/Permits	10.11.24
	Site Plan-Engineering	08.21.24
	Final Site Plan-Rev	11.08.23
	Final Site Plan	09.08.23
	Bids/Permits	08.04.23
	WCWRC Resubmittal	01.13.23
	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

NOTES

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

SHEET C-8.0

S:\PROJECTS\2021\2021-0184 ANN ARBOR FIRE STATION\DWG\CONSTRUCTION\(C-8.0) DETS-210184.dwg,09.03.05 4:41 PM

EROSION CONTROL STANDARDS:

1. ALL EROSION AND SEDIMENT CONTROL WORK SHALL CONFORM TO STANDARDS AND SPECIFICATIONS OF THE JURISDICTIONAL AGENCY UNDER PART 91 OF ACT 451 OF 1994, AS AMENDED.

2. DAILY INSPECTIONS SHALL BE MADE BY CONTRACTOR WHILE WORKING TO DETERMINE THE EFFECTIVENESS OF EROSION AND SEDIMENT CONTROL MEASURES. ANY NECESSARY REPAIRS SHALL BE PERFORMED WITHOUT DELAY. ALL SOIL EROSION CONTROL PROVISIONS SHALL BE PROPERLY MAINTAINED DURING CONSTRUCTION.

3. EROSION AND ANY SEDIMENTATION FROM WORK ON THIS SITE SHALL BE CONTAINED ON THE SITE AND NOT ALLOWED TO COLLECT ON ANY OFF-SITE AREAS OR IN WATERWAYS. WATERWAYS INCLUDE BOTH NATURAL AND MAN-MADE OPEN DITCHES, STREAMS, STORM DRAINS, LAKES, AND PONDS.

4. CONTRACTOR SHALL APPLY TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES WHEN REQUIRED AND AS DIRECTED ON THESE PLANS. CONTRACTOR SHALL REMOVE TEMPORARY MEASURES AS SOON AS PERMANENT STABILIZATION OF SLOPES, DITCHES, AND OTHER EARTH CHANGE AREAS HAVE BEEN COMPLETED.

5. STAGING THE WORK WILL BE DONE BY THE CONTRACTOR AS DIRECTED IN THESE PLANS AND AS REQUIRED TO ENSURE PROGRESSIVE STABILIZATION OF DISTURBED EARTH.

6. SOIL EROSION CONTROL PRACTICES WILL BE ESTABLISHED IN EARLY STAGES OF CONSTRUCTION BY THE CONTRACTOR. SEDIMENT CONTROL PRACTICES WILL BE APPLIED AS A PERIMETER DEFENSE AGAINST ANY TRANSPORTING OF SILT OFF THE SITE.

7. DUST SHALL BE CONTROLLED BY WATERING OR BY OTHER APPROVED MEANS THROUGHOUT ALL CONSTRUCTION OPERATIONS.

8. PERMANENT SOIL EROSION CONTROL MEASURES FOR SLOPES, CHANNELS, DITCHES OR ANY DISTURBED LAND AREA SHALL BE COMPLETED WITHIN 5 CALENDAR DAYS AFTER FINAL GRADING OR THE FINAL EARTH CHANGE HAS BEEN COMPLETED. WHEN IT IS NOT POSSIBLE TO PERMANENTLY STABILIZE A DISTURBED AREA AFTER AN EARTH CHANGE HAS BEEN COMPLETED OR WHERE SIGNIFICANT EARTH CHANGE HAS BEEN COMPLETED OR WHERE SIGNIFICANT EARTH CHANGE ACTIVITY CEASES, TEMPORARY SOIL EROSION CONTROL MEASURES SHALL BE IMPLEMENTED WITHIN 5 CALENDAR DAYS. ALL TEMPORARY SOIL EROSION CONTROL MEASURES SHALL BE MAINTAINED UNTIL PERMANENT SOIL EROSION CONTROL MEASURES ARE IMPLEMENTED AND ESTABLISHED BEFORE A CERTIFICATE OF COMPLIANCE IS ISSUED.

9. THE CONTRACTOR SHALL PRESERVE NATURAL VEGETATION AS MUCH AS POSSIBLE.

10. ANY WORK OUTSIDE OF THE LIMITS OF DISTURBANCE SHALL REQUIRE A SEPARATE GRADING PERMIT.

11. FOLLOWING THE PLACEMENT OF 4" OF TOPSOIL AND HYDROSEED, STRAW MULCH BLANKET IS TO BE INSTALLED PERPENDICULAR ALONG THE PROPOSED SLOPES 1:6 OR STEEPER FROM TOP OF SLOPE TO TOE OF SLOPE, INCLUDING DITCH BOTTOMS, AND IT MUST BE PEGGED IN PLACE.

12. ALL MUD/DIRT TRACKED ONTO EXISTING COUNTY/CITY ROADS FROM THIS SITE, DUE TO CONSTRUCTION, SHALL BE PROMPTLY REMOVED BY THE CONTRACTOR.

13. TEMPORARY STABILIZATION OF THE ENTIRE SITE SHALL BE COMPLETED AND APPROVAL OBTAINED FROM THE CITY OF ANN ARBOR

SOIL EROSION MAINTENANCE SCHEDULE AND NOTES:

1. THE CONTRACTOR SHALL INSPECT THE SOIL EROSION AND SEDIMENTATION CONTROL DEVICES ONCE EACH WEEK AND/OR WITHIN 24 HOURS OF A RAINFALL EVENT WHICH RESULTS IN A STORM WATER DISCHARGE FROM THE SITE. THE FOLLOWING STEPS SHALL BE IMPLEMENTED IF ANY DAMAGE HAS OCCURRED.

2. ANY DEBRIS OR DIRT ON ANY PAVED AREA RESULTING FROM CONSTRUCTION TRAFFIC SHALL BE CLEANED IN A PROMPT MANNER BY THE CONTRACTOR. THE CONSTRUCTION DRIVE SHALL BE CLEANED AT THE END OF EACH DAY.

3. ALL DIRT AND MUD TRACKED ONTO PAVED AREAS SHALL BE REMOVED DAILY BY SCRAPING. STREET SWEEPING IS REQUIRED WEEKLY.

4. SILT FENCE MAINTENANCE SHALL INCLUDE THE REMOVAL OF ANY BUILT UP SEDIMENT WHEN THE SEDIMENT HEIGHT ACCUMULATES TO 1/3 TO 1/2 OF THE HEIGHT OF THE FENCE. THE CONTRACTOR IS RESPONSIBLE TO REMOVE, REPLACE, RETRENCH OR REBACKFILL THE SILTATION FENCE SHOULD IT FALL OR BE DAMAGED DURING CONSTRUCTION.

5. INLET FILTER MAINTENANCE SHALL INCLUDE THE REMOVAL OF ANY ACCUMULATED SILT OR OTHER DEBRIS. THE REMOVAL OF SILT SHOULD BE WITH THE USE OF A STIFF BRISTLE BROOM OR SQUARE POINT SHOVEL. IF INLET FILTERS CAN NOT BE CLEANED OR ARE DAMAGED, THEN THE FABRIC MUST BE REPLACED.

6. A WATER TRUCK SHALL BE AVAILABLE TO WATER DOWN THE SITE ON A DAILY BASIS AS REQUIRED TO MAINTAIN DUST CONTROL.

SEQUENCE OF CONSTRUCTION

START DAY	END DAY	ACTIVITY
1	1	CITY OF ANN ARBOR SOIL EROSION AND SEDIMENTATION CONTROL PRE-GRADING MEETING
2	300	INSTALL TEMPORARY SOIL EROSION CONTROL MEASURES, SILT FENCES, INLET FILTERS, ETC. AS NECESSARY.
5	30	REMOVE ALL VEGETATION, TREES AND BRUSH FROM THE AREA OF PROPOSED IMPROVEMENT UNLESS MARKED TO REMAIN. STRIP AND STOCKPILE TOPSOIL. STOCKPILE SHALL BE GRADED AND SEEDED.
5	65	DEMOLISH ALL PAVEMENT, SIDEWALK, AND UTILITIES AS REQUIRED TO INSTALL THE PROPOSED WORK.
5	75	DISPOSE OF ALL EXCESS/UNSUITABLE MATERIALS OFF SITE IN A LEGAL MANNER. NO ON-SITE BURN OR BURY PITS ALLOWED.
30	90	ROUGH GRADE SITE. SEED AND MULCH BLANKETS MUST BE INSTALLED AS SHOWN WITHIN 5 DAYS OF FINAL GRADE. REPAIR AND/OR RE-INSTALL ANY TEMPORARY SOIL EROSION CONTROL MEASURES THAT WERE DAMAGED DURING GRADING OPERATIONS.
40	240	TEMPORARY SEEDING MUST BE PROVIDED IN AREAS NOT TO BE WORKED ON FOR 14 DAYS OR LONGER.
45	105	CONSTRUCT AND STABILIZE DETENTION FACILITIES
45	120	INSTALL SITE UTILITIES (STORM, SANITARY, WATER MAIN, ETC.) INSTALL INLET FILTERS AT NEW DRAINAGE STRUCTURES.
100	110	WATER MAIN FLUSHING
150	175	FINE GRADE SITE AND PREPARE FOR SITE PAVING OPERATIONS.
175	205	INSTALL FIRST COURSE OF PAVEMENT, SIDEWALKS, CURBING AS PROPOSED. IF PERMANENT LANDSCAPING IS NOT TO BE INSTALLED SOON AFTER PAVING IS COMPLETE, ALL AREAS WITHIN 20 FEET OF BACK OF CURB MUST BE TEMPORARILY SEEDED. REPAIR INLET FILTERS, SILT FENCE AND ANY OTHER DAMAGED SOIL EROSION CONTROL MEASURES AS NECESSARY.
205	270	CONSTRUCT PROPOSED BUILDINGS
270	280	INSTALL FINAL PAVEMENT COURSE
280	290	FINAL GRADE, REDISTRIBUTE STOCKPILED TOPSOIL, ESTABLISH VEGETATION AND INSTALL ALL PERMANENT LANDSCAPING IN ALL DISTURBED AREAS NOT BUILT.
290	295	CLEAN PAVEMENT AND REMOVE ALL TEMPORARY SOIL EROSION CONTROL MEASURES. RE-ESTABLISH VEGETATION AS REQUIRED.
300	300	REMOVE SEDIMENTATION CONTROLS ONCE ENTIRE SITE HAS BEEN PERMANENTLY STABILIZED AND THE CITY OF ANN ARBOR APPROVES THE FINAL GRADING

MAINTENANCE TASKS AND SCHEDULE DURING CONSTRUCTION

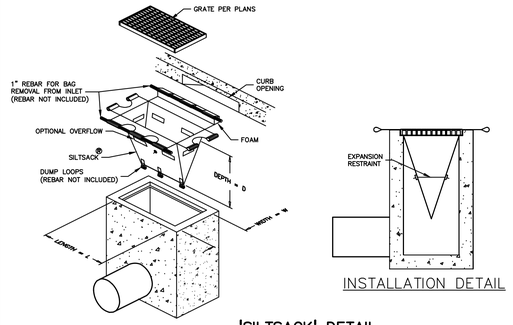
TASKS	COMPONENTS									SCHEDULE
	STORM SEWER SYSTEM	CATCH BASIN SUMPS	CATCH BASIN INLET CASTINGS	DITCHES AND SWALES	OUTFLOW CONTROL STRUCTURE	RIP-RAP	SEDIMENT BASINS	RAIN GARDENS	STORM DETENTION AREAS	
INSPECT FOR SEDIMENT ACCUMULATION	X	X		X	X		X	X	X	WEEKLY
REMOVAL OF SEDIMENT ACCUMULATION	X	X		X	X		X	X	X	AS NEEDED* & PRIOR TO TURNOVER
INSPECT FOR FLOATABLES AND DEBRIS			X	X	X		X	X	X	QUARTERLY
CLEANING OF FLOATABLES AND DEBRIS			X	X	X		X	X	X	QUARTERLY & AT TURNOVER
INSPECTION FOR EROSION				X	X		X	X	X	WEEKLY
RE-ESTABLISH PERMANENT VEGETATION ON ERODED SLOPES				X	X		X	X	X	AS NEEDED & PRIOR TO TURNOVER
REPLACEMENT OF STONE					X	X				AS NEEDED & PRIOR TO TURNOVER
MOWING				X	X		X	X	X	0-2 TIMES PER YEAR
INSPECT STORM WATER SYSTEM COMPONENTS DURING WET WEATHER AND COMPARE TO AS-BUILT PLANS			X	X	X	X	X	X	X	ANNUALLY AND AT TURNOVER
MAKE ADJUSTMENTS OR REPLACEMENTS AS DETERMINED BY ANNUAL WET WEATHER INSPECTION	X	X	X	X	X	X	X	X	X	AS NEEDED

* AS NEEDED MEANS WHEN SEDIMENT HAS ACCUMULATED TO A MAXIMUM DEPTH OF ONE FOOT

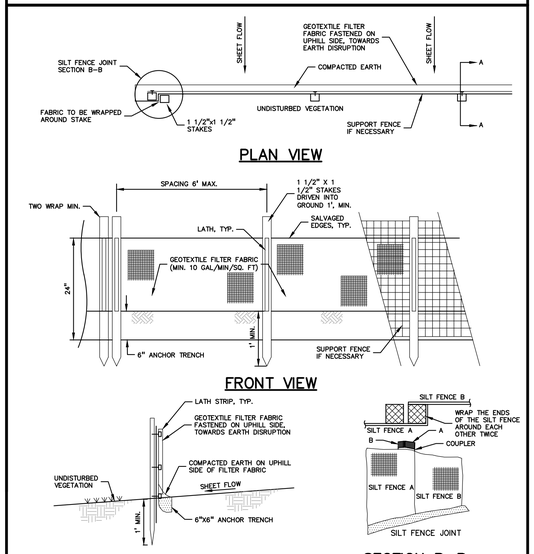
PERMANENT MAINTENANCE TASKS, SCHEDULE AND BUDGET

TASKS	CATCH BASIN INLET CASTINGS	DITCHES AND SWALES	OUTFLOW CONTROL STRUCTURE	RIP-RAP	SEDIMENT BASINS	RAIN GARDENS	STORM DETENTION AREAS	SCHEDULE	ESTIMATED ANNUAL BUDGET 1ST YEAR	2ND YEAR	3RD YEAR	SESC TASKS
INSPECT FOR SEDIMENT ACCUMULATION		X	X		X	X	X	ANNUALLY	$100	$100	$100	X
REMOVAL OF SEDIMENT ACCUMULATION		X	X		X	X	X	EVERY 2 YEARS AS NEEDED	$300	$100	$0	X
INSPECT FOR FLOATABLES AND DEBRIS	X	X	X		X	X	X	ANNUALLY	$75	$75	$75	
CLEANING OF FLOATABLES AND DEBRIS	X	X	X		X	X	X	ANNUALLY	$150	$50	$0	
INSPECTION FOR EROSION		X	X		X	X	X	ANNUALLY	$125	$100	$100	X
RE-ESTABLISH PERMANENT VEGETATION ON ERODED SLOPES		X	X		X	X	X	AS NEEDED	$250	$100	$100	X
REPLACEMENT OF STONE			X	X				EVERY 3-5 YEARS AS NEEDED	$150	$0	$250	X
MOWING		X	X		X	X	X	0-2 TIMES PER YEAR	$2,500	$1,750	$1,750	
INSPECT STORM WATER SYSTEM COMPONENTS DURING WET WEATHER AND COMPARE TO AS-BUILT PLANS	X	X	X	X	X	X	X	ANNUALLY	$75	$75	$75	
INSPECT INFILTRATION BASIN FOLLOWING STORMS OF 1-INCH OR MORE					X	X	X	AS NEEDED	$75	$75	$75	
MAKE ADJUSTMENTS OR REPLACEMENTS AS DETERMINED BY ANNUAL WET WEATHER INSPECTION	X	X	X	X	X	X	X	AS NEEDED	$300	$300	$300	
KEEP RECORDS OF ALL INSPECTIONS AND MAINTENANCE ACTIVITIES								ANNUALLY	$0	$0	$0	
KEEP RECORDS OF ALL COSTS FOR INSPECTIONS, MAINTENANCE, AND REPAIRS								ANNUALLY	$0	$0	$0	
								TOTAL BUDGET	$4,100	$2,725	$2,825	
								SESC BUDGET	925	400	550	

NOTE: LONG-TERM STORM WATER MAINTENANCE WILL BE PERFORMED BY THE CITY OF ANN ARBOR FIRE DEPARTMENT.



'SILTSACK' DETAIL
NOT TO SCALE



SILT FENCE DETAIL
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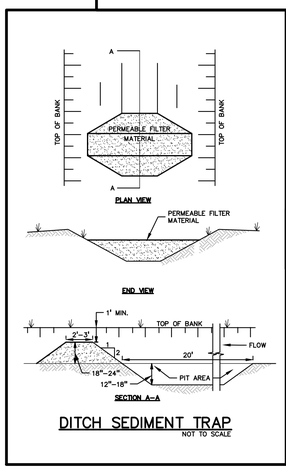
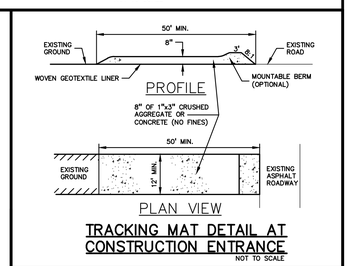


DITCH SEDIMENT TRAP
NOT TO SCALE



TRACKING MAT DETAIL AT CONSTRUCTION ENTRANCE
NOT TO SCALE

TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
JOSEPH B. WYWROT
ENGINEER
No. 6201040674
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

PROJECT NUMBER 21018

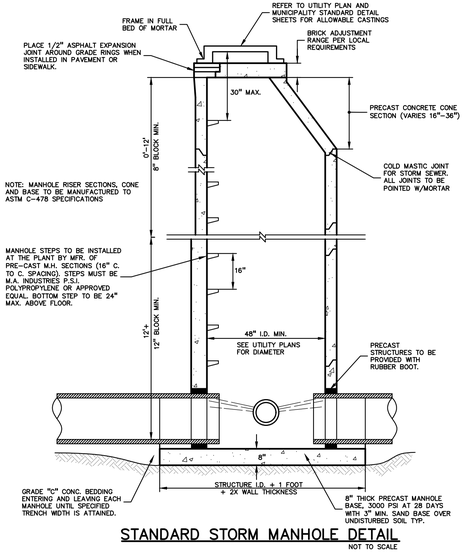
ISSUE		
	Bids/Permits	10.11.24
	Site Plan-Engineering	08.21.24
	Final Site Plan-Rev	11.08.23
	Final Site Plan	09.08.23
	Bids/Permits	08.04.23
	WCWRC Resubmittal	01.13.23
	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

SESC NOTES & DETAILS

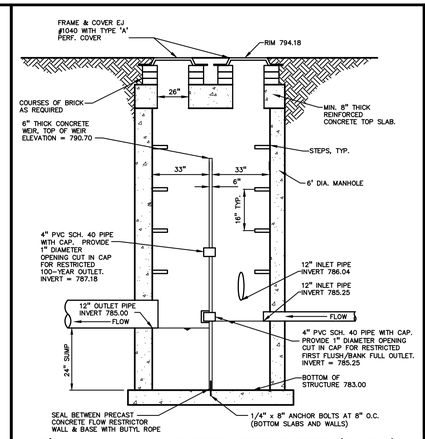
A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

SHEET C-8.1



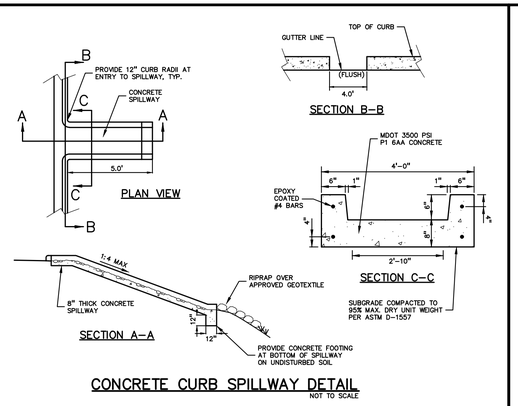
STANDARD STORM MANHOLE DETAIL

NOT TO SCALE



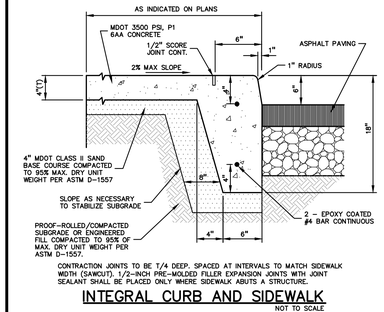
6' DIA. OUTLET CONTROL STRUCTURE (OC#41)

NOT TO SCALE



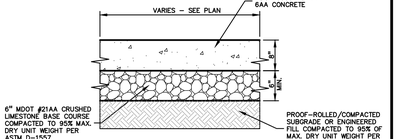
CONCRETE CURB SPILLWAY DETAIL

NOT TO SCALE



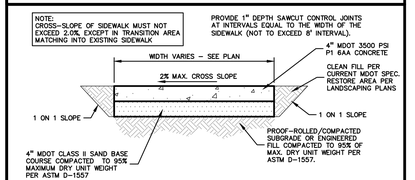
INTEGRAL CURB AND SIDEWALK

NOT TO SCALE



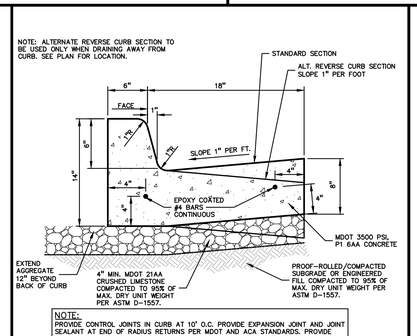
HEAVY DUTY CONCRETE DETAIL

NOT TO SCALE



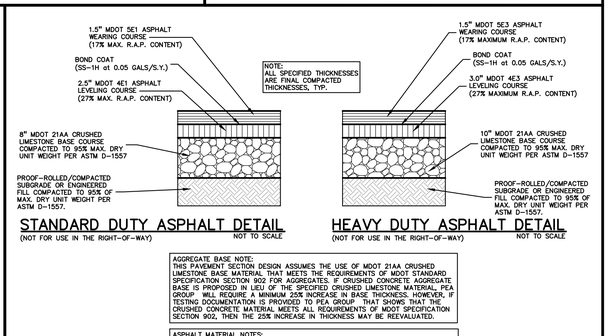
CONCRETE SIDEWALK

NOT TO SCALE



24"x6" STANDARD CONCRETE CURB AND GUTTER

NOT TO SCALE



STANDARD DUTY ASPHALT DETAIL

(NOT FOR USE IN THE RIGHT-OF-WAY)

NOT TO SCALE

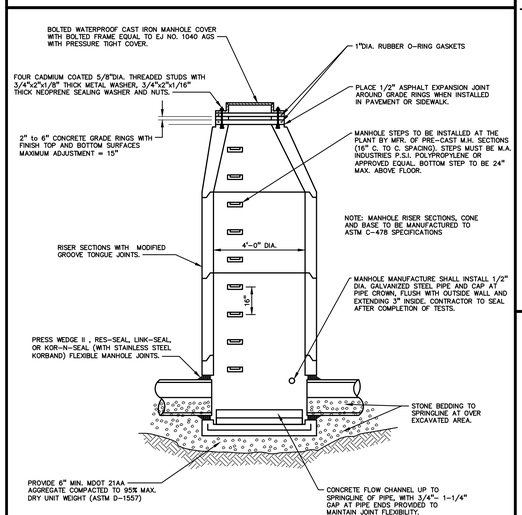
HEAVY DUTY ASPHALT DETAIL

(NOT FOR USE IN THE RIGHT-OF-WAY)

NOT TO SCALE

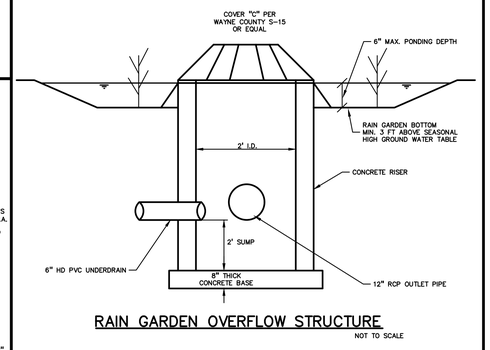
AGGREGATE BASE NOTE:
THIS PAVEMENT SECTION DESIGN ASSUMES THE USE OF MDOT 21AA CRUSHED LIMESTONE BASE MATERIAL THAT MEETS THE REQUIREMENTS OF MDOT STANDARD SPECIFICATION SECTION 902 FOR AGGREGATES. IF CRUSHED CONCRETE AGGREGATE BASE IS PROPOSED IN LIEU OF THE SPECIFIED CRUSHED LIMESTONE MATERIAL, PEA GROUP WILL REQUIRE A MINIMUM 25% INCREASE IN BASE THICKNESS. HOWEVER, IF TESTING DOCUMENTATION IS PROVIDED TO PEA GROUP THAT SHOWS THAT THE CRUSHED CONCRETE MATERIAL MEETS ALL REQUIREMENTS OF MDOT SPECIFICATION SECTION 902, THEN THE 25% INCREASE IN THICKNESS MAY BE REEVALUATED.

ASPHALT MATERIAL NOTES:
HOT-MIX ASPHALT MIXTURES UTILIZING RECYCLED ASPHALT PAVEMENT (RAP) MUST MEET MDOT SPECIAL PROVISION 125P501(E). THE BINDER GRADE FOR THIS WORK IS PG64-28. IF ASPHALT MIXES CONTAINING RAP ARE TO BE SUPPLIED FOR THIS PROJECT, THE ASPHALT BINDER MUST BE REVISED PER MDOT TIER 1' OR TIER 2' REQUIREMENTS (RAP CONTENT UP TO 27% MAXIMUM). TIER 3 MIXES ARE NOT ACCEPTABLE ON THIS PROJECT. AN ASPHALT MIX DESIGN FOR ALL SPECIFIED MIXES SHOULD BE FORWARDED TO PEA GROUP FOR REVIEW PRIOR TO CONSTRUCTION.



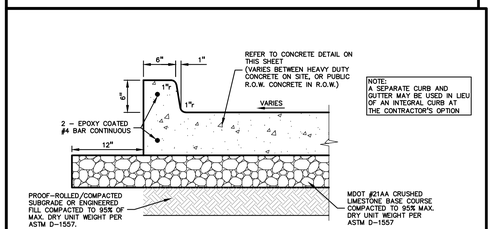
STANDARD SANITARY SEWER MANHOLE DETAIL (ON 8" THROUGH 24" DIAMETER)

NOT TO SCALE



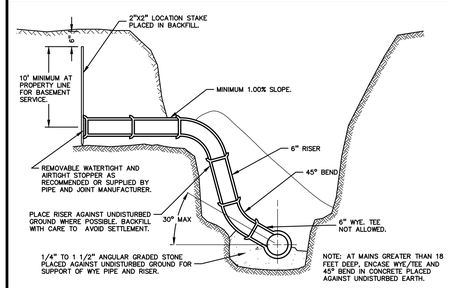
RAIN GARDEN OVERFLOW STRUCTURE

NOT TO SCALE



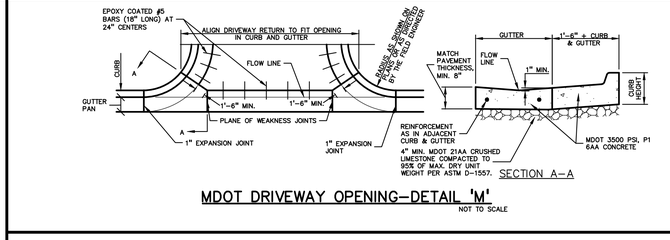
CONCRETE PAVEMENT WITH INTEGRAL CURB

NOT TO SCALE



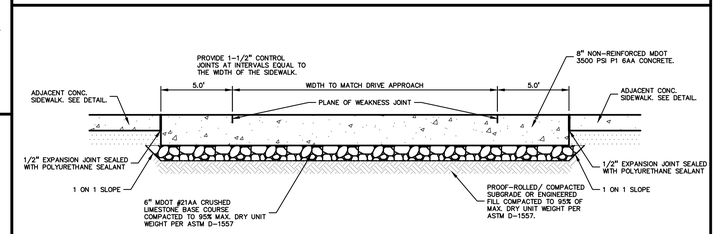
BUILDING LEAD RISER DETAIL

NOT TO SCALE



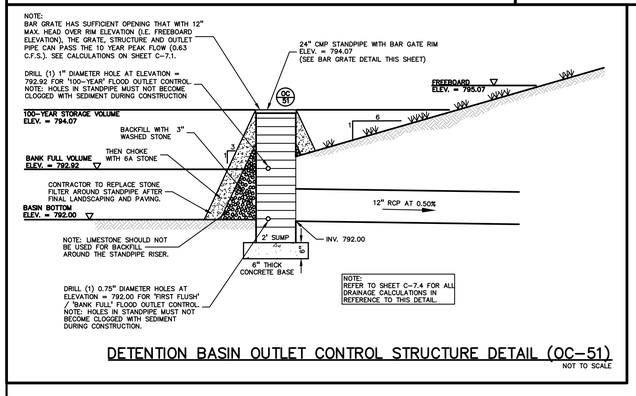
MDOT DRIVEWAY OPENING-DETAIL 'M'

NOT TO SCALE



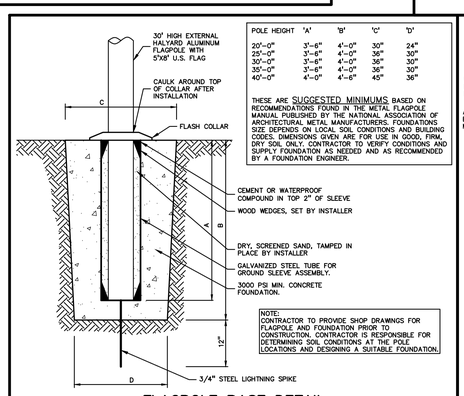
THICKENED SIDEWALK AT DRIVE APPROACH DETAIL

NOT TO SCALE



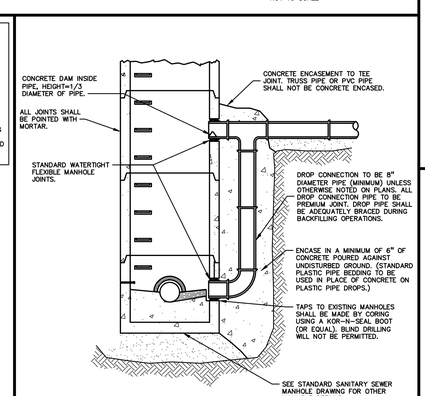
DETENTION BASIN OUTLET CONTROL STRUCTURE DETAIL (OC-51)

NOT TO SCALE



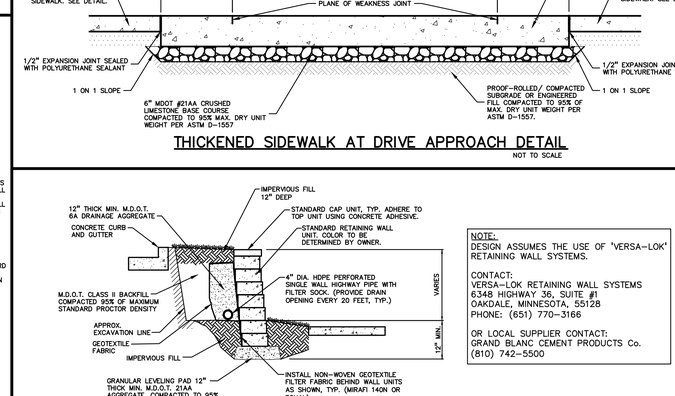
FLAGPOLE BASE DETAIL

NOT TO SCALE



EXTERNAL DROP MANHOLE CONNECTION

NOT TO SCALE



SEGMENTED RETAINING WALL

NOT TO SCALE

TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
JOSEPH B. WYWROT
ENGINEER
No. 6201040674
LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

PROJECT NUMBER 21018

ISSUE		
	Bids/Permits	10.11.24
	Site Plan-Engineering	08.21.24
	Final Site Plan-Rev	11.08.23
	Final Site Plan	09.08.23
	Bids/Permits	08.04.23
	WCWRC Resubmittal	01.13.23
	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

DETAILS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

SHEET C-8.2

Advanced Drainage Systems, Inc.

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

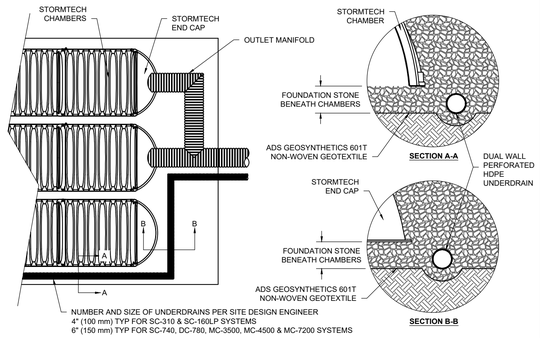
1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 6" (150 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

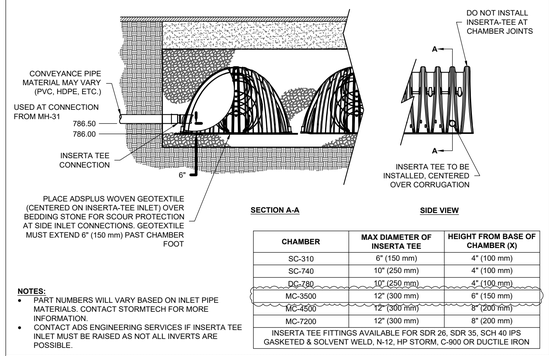
1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.



5 UNDERDRAIN DETAIL

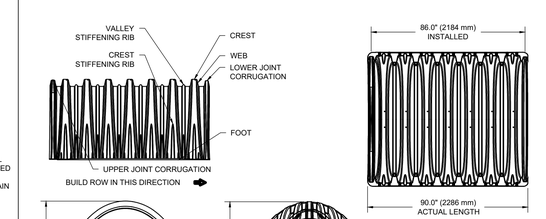


SECTION A-A **SIDE VIEW**

CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" (150 mm)	4" (100 mm)
SC-740	10" (250 mm)	4" (100 mm)
DC-780	10" (250 mm)	4" (100 mm)
MC-3500	12" (300 mm)	6" (150 mm)
MC-4500	12" (300 mm)	8" (200 mm)
MC-7200	12" (300 mm)	8" (200 mm)
INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SCH 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

NOTES:
- PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS. CONTACT STORMTECH FOR MORE INFORMATION.
- CONTACT ADS ENGINEERING SERVICES IF INSERTA TEE INLET MUST BE RAISED AS NOT ALL INVERTS ARE POSSIBLE.

6 INSERTA-TEE SIDE INLET DETAIL



NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

NOMINAL END CAP SPECIFICATIONS

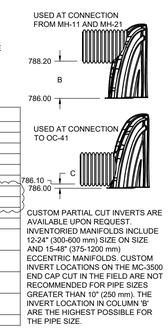
SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" (152 mm) STONE BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

PARTIAL CUT HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
PARTIAL CUT HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PARTIAL CUT INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

2 MC-3500 TECHNICAL SPECIFICATIONS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

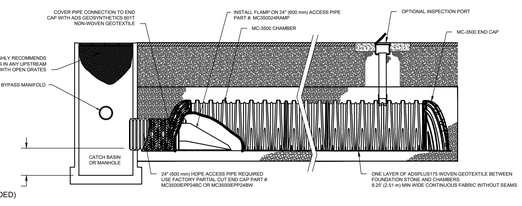
STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45° (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

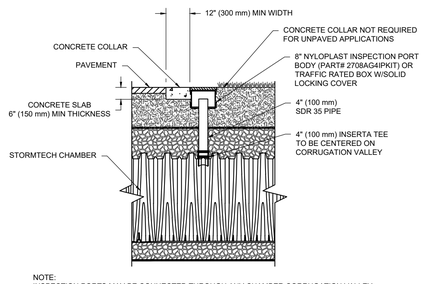
STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

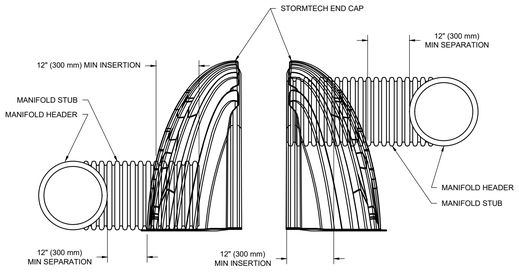


3 MC-3500 ISOLATOR ROW PLUS DETAIL



NOTE:
INSPECTION PORTS MAY BE CONNECTED THROUGH ANY CHAMBER CORRUGATION VALLEY.

4 4" PVC INSPECTION PORT DETAIL (MC SERIES CHAMBER)



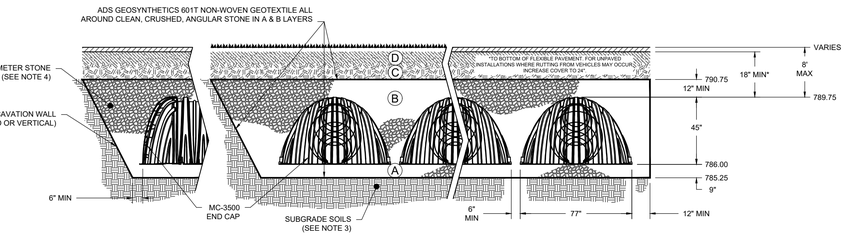
NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

7 MC-SERIES END CAP INSERTION DETAIL

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

	MATERIAL LOCATION	DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/FT/%. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

1 MC-3500 CROSS SECTION DETAIL

TCA ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN — JOSEPH B. WYWROT — ENGINEER — No. 6201046874 — LICENSED PROFESSIONAL ENGINEER

PEA GROUP
t: 844.813.2949
www.peagroup.com

PROJECT NUMBER 21018

ISSUE		
	Bids/Permits	10.11.24
	Site Plan-Engineering	08.21.24
	Final Site Plan-Rev	11.08.23
	Final Site Plan	09.08.23
	Bids/Permits	08.04.23
	WCWRC Resubmittal	01.13.23
	Site Plan Reapproval	11.21.22
	Site Plan Approval	09.22.22

DRN: JW CHK'D: JC

ADS DETENTION SYSTEM DETAILS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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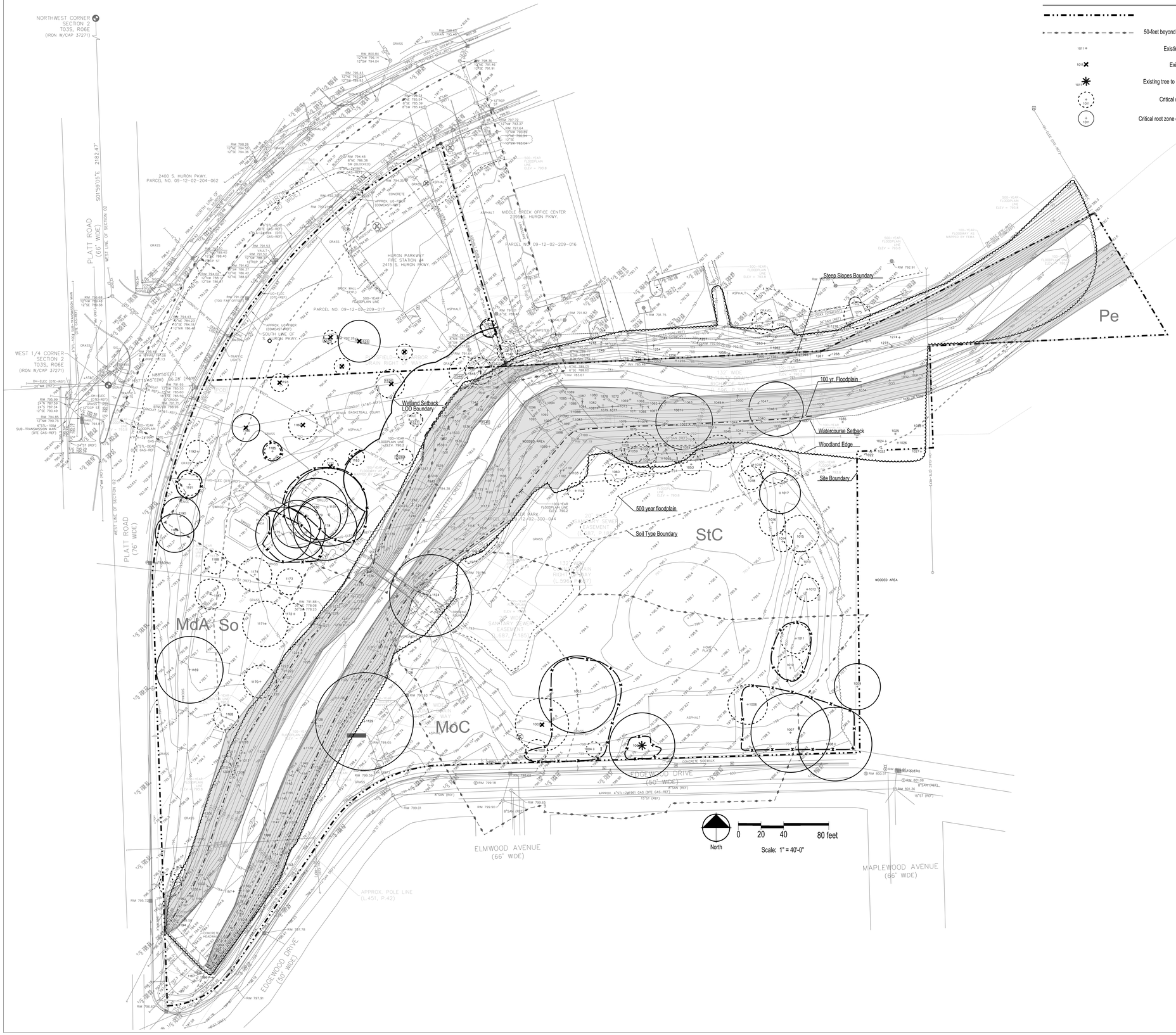
SHEET C-8.3



LEGEND

- Project boundary
- 50-feet beyond limits of soil disturbance
- Existing tree in woodland area
- Existing tree to be removed
- Existing tree to remain, but mitigated for
- Critical root zone of existing tree
- Critical root zone of existing landmark tree
- Tree protection fence
- Woodland edge
- Watercourse Setback
- Steep Slopes
- Wetland Setback
- 500 yr. Floodplain
- Soil type boundary
- 100 yr. floodplain

NOTE: Refer to civil plans for elements not listed above.

WOODLAND DESCRIPTION

The site consists of 6.7 acres of land situated east of Platt Road/S. Huron Parkway and north of Edgewood Drive. The site has remained mostly open for park use while maintaining 1.68 acres of medium-quality woodland along the creek consisting of a mix between native and invasive tree/shrub species with weedy understory growth. Trees within the woodland consist of box elders, maples, elms, black walnuts, cottonwoods, willows, and oaks along with invasive shrubs such as common buckthorn, glossy buckthorn, and others. See L-3 for full list. The quality of the woodland increases as it progresses towards Redbud Nature Area to the east. The woodland has a basal area of 29,660 sqft., or .68 acres. Thus the woodland basal area ratio is .40 acre/acre.

MITIGATION SUMMARY

All mitigation for landmark and woodland tree removal shall be in the form of tree replacement on the site. Refer to sheet L-4 for the proposed mitigation program, including location and species of proposed mitigation plantings.

SOILS

According to the NRCS soil survey, the soils on site include:

So - Sloan silt loam, 0 to 1 percent slopes
MdA - Matherton Sandy Loam, 0 to 4 percent slopes
Pe - Pewamo clay loam, 0 to 2 percent slopes
StC - St. Clair clay loam, 6 to 12 percent slopes
MoC - Morley loam, 6 to 12 percent slopes

STEEP SLOPES

Within the 6.7 acre site, 1.3 acres are classified as steep slopes, all of which fall within the woodland boundary and 100 yr. floodplain setbacks.

No proposed development is occuring within the steep slope boundary. A barrier fence will be installed at the limits of soil disturbance near steep sloped areas.

WATERCOURSES

According to the Huron Rivershed Water Council, "Malletts Creek is composed of 10 miles of opens streams, and it drains about 11 square miles of land. Several miles of the creek are disconnected from the main branch as they have been put underground into pipes. Malletts Creek flows into the 50 acre South Pond which then empties into the Huron River." This section of Mallets Creek is typical of an urban
stream with banks that are inclised and with bare soil from flashy rain events.

WETLAND REPORT

See the attached entire wetland report for more detailed information. From the report, "The existing wetland is a riparian forested and scrub-shrub wetland heavily influenced by the flow regime of Chalmers Drain (aka Malletts Creek), and by the poorly drained hydric soil complex that encompasses the Site.

Dominant vegetation found within the wetland include creeping bentgrass (agrostis stolonifera), glossy buckthorn (frangula alnus), green ash (fraxinus pennsylvanica), and eastern cottonwood (populus deltoides). Soils within the wetland were comprised of clayey silt loams considered hydric due to the presence of the hydric soil criteria of a sandy redox, and depleted matrix. Indicators of wetland hydrology observed within the wetland included water-stained leaves, oxidized rhizospheres in living roots, geomorphic position, the FAC-neutral test, and potential evidence of spring saturation from aerial imagery.

Dominant vegetation observed within the upland adjacent to the wetland include creeping bentgrass agrostis stolonifera), common blackberry (rubus allegheniensis), white oak (quercus alba), chinkapin oak (quercus muehlenbergii), red pine (pinus resinosa), and Japanese honeysuckle (lonicera japonica). Soils in the upland adjacent to the wetland were also comprised of clayey silt loams, but did not exhibit indicators of hydric soils. At the time of the visits, no indicators of wetland hydrology were observed."

811 MISS BEFORE YOU DIG CALL MISS DIG 800-482-7171 (TOLL FREE)

CONTRACTOR is responsible to field verify location of all underground utilities prior to any work.

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INSITE
InSite Design Studio, Inc.
412 Longshore Drive
Ann Arbor, Michigan
48105
Phone: 734.995.4194
Fax: 734.668.2525

STATE OF MICHIGAN
SHANNAN GIBB-RANDALL
LANDSCAPE ARCHITECT
NO. 3901001515
REGISTERED LANDSCAPE ARCHITECT

PROJECT NUMBER 21018

ISSUE		
	BIDS/PERMITS	10.11.24
	Final Site Plan	9.08.23
	BIDS/PERMITS	8.04.23
	Site Plan Resubmission	11.09.22
	Site Plan Approval	09.22.22

DRN: JLS CHK'D: DFB

Ann Arbor Fire Station 4

Natural Features Plan

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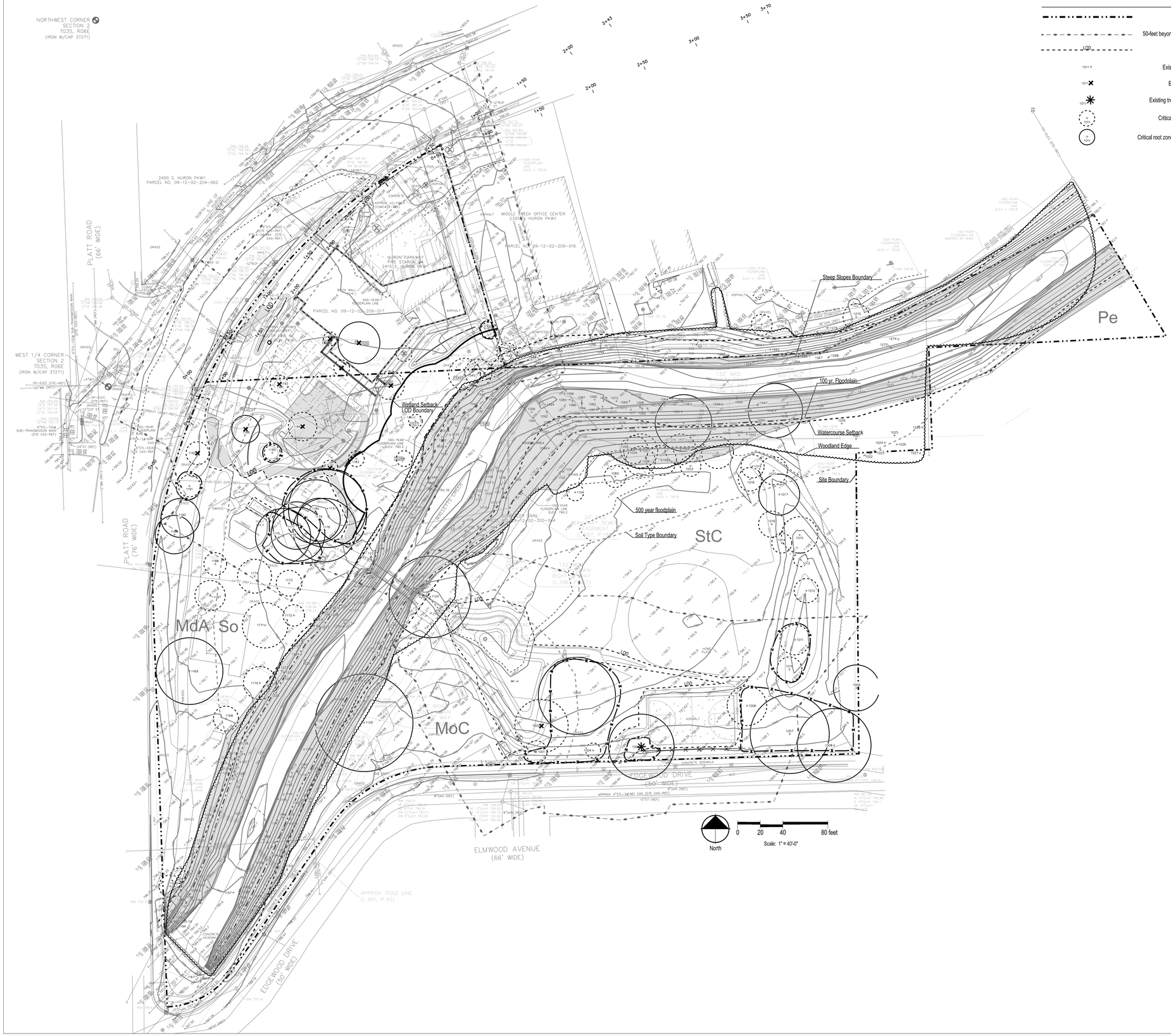
SHEET L.01



LEGEND

- Project boundary
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- Existing tree in woodland area
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- Critical root zone of existing tree
- Critical root zone of existing landmark tree
- Woodland edge
- Watercourse setback
- Steep slopes
- Wetland setback
- 500 yr. floodplain
- Soil type boundary
- Tree protection fence
- Proposed asphalt
- Proposed concrete
- Proposed bike hoop
- Proposed retaining wall
- Proposed fence
- 100 yr. floodplain

NOTE: Refer to civil plans for elements not listed above.

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DRN: JLS CHK'D: DFB

Ann Arbor Fire Station 4

Natural Features Overlay Plan

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SHEET L.02

72 HOURS BEFORE YOU DIG CALL MISS DIG 800-482-7171 (TOLL FREE)

CONTRACTOR is responsible to field verify location of all underground utilities prior to any work.

Key: *LM = Landmark Tree, WL = Woodland Tree, M = Mitigate, T= Trunk, G = Growth Rate, S = Structure, D = Diseases, C = Crown dev., L - Life expec.*

TAG NO.	CODE	DBH	COMMON NAME	LATIN NAME	T	G	S	D	C	L	SCORE	LM	WL	REMOVE	M
1001	SU	6	Sugar Maple	Acer saccharum	5	5	5	5	4	5	29				
1002	BW	17	Black Walnut	Juglans nigra	5	4	5	5	4	5	28			Remove	
1003	SM	34	Silver Maple	Acer saccharinum	4	5	4	5	5	5	28	LM			
1004	DR	6	Dawn redwood	Metasequoia	4	4	5	5	5	5	28				
1005	BC	25	Wild Black Cherry	Prunus serotina	5	5	5	5	4	5	29	LM			M
1006	SC	17	Scotch Pine	Pinus sylvestris	4	4	5	5	4	5	27				
1007	BW	34	Black Walnut	Juglans nigra	5	4	5	5	4	5	28	LM			
1008	BW	32	Black Walnut	Juglans nigra	4	5	4	5	4	5	27	LM			
1009	BW	18	Black Walnut	Juglans nigra	5	5	3	5	4	5	27	LM			
1010	BS	9	Blue Spruce	Picea pungens	4	4	4	4	4	5	25				
1011	BS	11	Blue Spruce	Picea pungens	4	4	4	4	4	5	25				
1012	SU	10	Sugar Maple	Acer saccharum	5	5	5	5	5	5	30				
1013	WS	6	White Spruce	Picea glauca	4	5	5	5	5	5	29				
1014	CA	7	Crab Apple	Malus caronaria	4	4	4	5	4	5	26				
1015	RO	16	Red Oak	Quercus rubra	5	5	4	4	4	5	27	LM			
1016	WP	11	(Eastern) White Pine	Pinus strobus	5	5	5	5	4	5	29				
1017	BO	18	Black Oak	Quercus velutina	5	5	5	5	5	5	30	LM			
1018	WP	10	(Eastern) White Pine	Pinus strobus	5	5	5	5	5	5	30				
1019	SU	9	Sugar Maple	Acer saccharum	5	5	5	5	5	5	30				
1020	RO	12	Red Oak	Quercus rubra	5	5	4	5	4	5	28		WL		
1021	BX	6	Box elder	Acer negundo	4	4	3	5	4	5	25		WL		
1022	BX	6	Box elder	Acer negundo	4	4	4	5	4	5	26		WL		
1023	BX	7	Box elder	Acer negundo	4	4	3	5	3	5	24		WL		
1024	WS	11	White Spruce	Picea glauca	5	4	3	5	4	5	26		WL		
1025	BX	12	Box elder	Acer negundo	4	3	3	4	3	4	21		WL		
1026	BX	9	Box elder	Acer negundo	4	3	3	4	3	4	21		WL		
1027	BX	8	Box elder	Acer negundo	4	3	2	4	3	4	20		WL		
1028	BX	17	Box elder	Acer negundo	5	3	4	5	4	4	25		WL		
1029	BX	19	Box elder	Acer negundo	4	3	2	3	2	4	18	LM	WL		
1030	BX	20	Box elder	Acer negundo	4	4	4	4	4	4	24	LM	WL		
1031	SM	8	Silver Maple	Acer saccharinum	4	3	3	4	2	5	21		WL		
1032	BX	12	Box elder	Acer negundo	4	4	3	4	3	4	22		WL		
1033	CT	17	Cottonwood	Populus deltoides	5	4	4	4	4	5	26		WL		
1034	SM	7	Silver Maple	Acer saccharinum	4	3	3	4	2	5	21		WL		
1035	BW	17	Black Walnut	Juglans nigra	5	4	4	4	5	5	27		WL		
1036	BX	13	Box elder	Acer negundo	4	4	4	5	4	5	26		WL		
1037	BX	8	Box elder	Acer negundo	4	4	3	4	3	4	22		WL		
1038	MW	7	White Mulberry	Morus alba	4	4	3	4	4	5	24		WL		
1039	BL	13	Black Locust	Robinia pseudoacacia	4	4	3	4	3	4	22		WL		
1040	BL	14	Black Locust	Robinia pseudoacacia	4	3	3	4	3	4	21		WL		
1041	BL	10	Black Locust	Robinia pseudoacacia	4	3	3	4	3	4	21		WL		
1042	BX	6	Box elder	Acer negundo	4	4	4	4	3	4	23		WL		
1043	BX	6	Box elder	Acer negundo	4	4	4	4	4	4	24		WL		
1044	BW	15	Black Walnut	Juglans nigra	5	5	4	5	4	5	28		WL		
1045	BX	6	Box elder	Acer negundo	4	4	3	4	3	4	22		WL		
1046	BX	24	Box elder	Acer negundo	4	3	3	4	3	4	21	LM	WL		
1047	SM	11	Silver Maple	Acer saccharinum	4	4	4	5	4	5	26		WL		
1048	SM	14	Silver Maple	Acer saccharinum	4	4	3	3	3	5	22		WL		
1049	BX	13	Box elder	Acer negundo	4	4	3	3	4	4	22		WL		
1050	SM	15	Silver Maple	Acer saccharinum	4	3	3	3	3	5	21		WL		
1051	BL	10	Black Locust	Robinia pseudoacacia	4	3	3	3	3	4	20		WL		
1052	BO	14	Black Oak	Quercus velutina	5	4	4	5	4	5	27				
1053	RO	9	Red Oak	Quercus rubra	5	5	4	5	4	5	28				
1054	RP	13	Red Pine	Pinus resinosa	4	4	3	4	2	5	22		WL		
1055	RO	13	Red Oak	Quercus rubra	5	4	5	5	4	5	28		WL		
1056	SC	13	Scotch Pine	Pinus sylvestris	4	4	4	4	4	5	25		WL		
1057	SC	15	Scotch Pine	Pinus sylvestris	4	4	4	4	4	5	25		WL		
1058	BC	6	Wild Black Cherry	Prunus serotina	4	4	3	5	3	5	24		WL		
1059	RO	12	Red Oak	Quercus rubra	5	4	4	5	4	5	27		WL		
1060	BP	9	Bradford Pear	Pyrus calleryanna	4	4	4	5	4	3	24				
1061	BX	6	Box elder	Acer negundo	3	4	3	4	3	4	21		WL		
1062	BL	25	Black Locust	Robinia pseudoacacia	4	3	3	4	4	4	22	LM	WL		
1063	SM	23	Silver Maple	Acer saccharinum	4	4	3	5	3	5	24	LM	WL		
1064	BX	6	Box elder	Acer negundo	3	3	3	3	3	4	19		WL		
1065	SM	11	Silver Maple	Acer saccharinum	5	4	4	5	4	5	27		WL		
1066	E	10	American Elm	Ulmus americana	4	4	3	5	4	5	25		WL		
1067	SM	6	Silver Maple	Acer saccharinum	5	4	4	5	3	5	26		WL		
1068	SM	10	Silver Maple	Acer saccharinum	4	3	4	5	3	5	24		WL		
1069	CT	13	Cottonwood	Populus deltoides	5	4	4	4	3	4	24		WL		
1070	SM	6	Silver Maple	Acer saccharinum	4	4	3	5	3	5	24		WL		
1071	SM	7	Silver Maple	Acer saccharinum	4	4	3	5	2	5	23		WL		
1072	CT	17	Cottonwood	Populus deltoides	4	4	3	5	3	4	23		WL		
1073	CT	6	Cottonwood	Populus deltoides	4	3	3	5	2	4	21		WL		
1074	BL	9	Black Locust	Robinia pseudoacacia	4	4	3	4	3	4	22		WL		
1075	BL	9	Black Locust	Robinia pseudoacacia	4	4	3	4	3	4	22		WL		
1076	BL	11	Black Locust	Robinia pseudoacacia	4	4	3	4	3	4	22		WL		
1077	CT	8	Cottonwood	Populus deltoides	4	3	3	4	2	4	20		WL		
1078	EE	9	Siberian Elm	Ulmus pumila	4	2	1	4	1	4	16		WL		
1079	SM	7	Silver Maple	Acer saccharinum	3	3	3	4	3	5	21		WL		
1080	SM	8	Silver Maple	Acer saccharinum	4	3	3	4	3	5	22		WL		
1081	CT	19	Cottonwood	Populus deltoides	4	4	4	5	4	4	25	LM	WL		
1082	BWW	12	Black Willow	Salix nigra	4	3	3	5	4	4	23		WL		
1083	SM	6	Silver Maple	Acer saccharinum	4	4	4	4	2	5	23		WL		
1084	BWW	13	Black Willow	Salix nigra	4	4	3	4	3	4	22		WL		
1085	BWW	10	Black Willow	Salix nigra	4	3	1	4	2	4	18		WL		
1086	BWW	11	Black Willow	Salix nigra	3	3	2	4	1	4	17		WL		
1087	CT	7	Cottonwood	Populus deltoides	4	4	3	4	2	4	21		WL		
1088	CT	7	Cottonwood	Populus deltoides	3	1	1	4	1	4	14		WL		
1089	BWW	16	Black Willow	Salix nigra	4	3	2	4	3	4	20		WL		
1090	CT	15	Cottonwood	Populus deltoides	4	4	4	5	3	4	24		WL		
1091	CT	19	Cottonwood	Populus deltoides	4	4	4	4	4	4	24	LM	WL		
1092	SM	6	Silver Maple	Acer saccharinum	4	3	3	4	2	5	21		WL		
1093	CT	10	Cottonwood	Populus deltoides	4	4	4	5	3	4	24		WL		
1094	BWW	6	Black Willow	Salix nigra	3	1	1	0	1	4	10		WL		
1095	SM	10	Silver Maple	Acer saccharinum	4	4	3	4	2	5	22		WL		
1096	SM	6	Silver Maple	Acer saccharinum	4	4	3	4	2	5	22		WL		
1097	CT	18	Cottonwood	Populus deltoides	4	4	4	5	3	4	24	LM	WL		
1098	BW	6	Black Walnut	Juglans nigra	5	4	4	5	4	5	27		WL		
1099	BW	8	Black Walnut	Juglans nigra	4	4	4	5	4	5	26		WL		
1100	BW	10	Black Walnut	Juglans nigra	4	4	4	5	4	5	26		WL		
1101	SC	10	Scotch Pine	Pinus sylvestris	3	3	2	4	2	4	18		WL		
1102	MW	7	White Mulberry	Morus alba	3	3	3	4	2	4	19		WL		
1103	SC	16	Scotch Pine	Pinus sylvestris	4	4	3	4	3	4	22		WL		
1104	BP	7	Bradford Pear	Pyrus calleryanna	3	3	3	4	3	3	19				
1105	SM	11	Silver Maple	Acer saccharinum	4	4	3	4	3	5	23		WL		
1106	CT	16	Cottonwood	Populus deltoides	5	4	4	5	4	4	26		WL		
1107	CT	17	Cottonwood	Populus deltoides	4	4	3	4	3	4	22		WL		
1108	SM	6	Silver Maple	Acer saccharinum	4	3	3	4	2	5	21		WL		
1109	E	9	American Elm	Ulmus americana	4	3	4	4	3	5	23		WL		
1110	BX	10	Box elder	Acer negundo	3	3	2	4	2	4	18		WL		
1111	BX	8	Box elder	Acer negundo	3	1	1	4	1	4	14		WL		
1112	BX	11	Box elder	Acer negundo	3	3	4	3	2	4	19		WL		

Key: *LM = Landmark Tree, WL = Woodland Tree, M = Mitigate, T= Trunk, G = Growth Rate, S = Structure, D = Diseases, C = Crown dev., L - Life expec.*

1113	BX	6	Box elder	Acer negundo	4	3	3	4	2	4	20		WL		
1114	BX	13	Box elder	Acer negundo	4	3	3	4	3	4	21		WL		
1115	E	11	American Elm	Ulmus americana	4	3	3	4	3	4	21		WL		
1116	BX	7	Box elder	Acer negundo	3	3	2	4	2	4	18		WL		
1117	BW	10	Black Walnut	Juglans nigra	4	4	3	4	3	5	23		WL		
1118	BWW	10	Black Willow	Salix nigra	4	3	3	4	3	4	21		WL		
1119	AS	16	Quaking Aspen	Populus tremuloides	3	1	1	5	1	4	15		WL		
1120	CT	12	Cottonwood	Populus deltoides	4	3	4	4	2	4	21		WL		
1121	BWW	14	Black Willow	Salix nigra	3	2	2	4	1	4	16		WL		
1122	BWW	14	Black Willow	Salix nigra	3	2	2	4	1	4	16		WL		
1123	SM	7	Silver Maple	Acer saccharinum	3	4	3	4	2	5	21		WL		
1124	WO	36	White Oak	Quercus alba	4	4	4	5	4	5	26	LM	WL		
1125	BR	6	Bur oak	Quercus macrocarpa	4	4	4	5	4	5	26		WL		
1126	BR	6	Bur oak	Quercus macrocarpa	4	4	4	5	4	5	26		WL		
1127	NM	6	Norway Maple	Acer platanoides	5	4	4	5	4	5	27		WL		
1128	ER	6	Eastern Rebud	Cercis canadensis	4	4	4	5	4	4	25				
1129	WO	29	White Oak	Quercus alba	4	3	4	4	3	5	23	LM			
1130	NM	10	Norway Maple	Acer platanoides	5	4	4	5	5	5	28		WL		
1131	E	6	American Elm	Ulmus americana	4	3	4	5	3	4	23				
1132	BC	6	Wild Black Cherry	Prunus serotina	4	4	4	5	4	4	25			Remove	
1133	NM	8	Norway Maple	Acer platanoides	5	4	4	5	4	5	27		WL		
1134	NM	9	Norway Maple	Acer platanoides	5	4	4	5	4	5	27		WL		
1135	SM	6	Silver Maple	Acer saccharinum	1	1	1	4	1	3	11		WL		
1136	E	9	American Elm	Ulmus americana	4	4	4	4	2	4	22		WL		
1137	CT	10	Cottonwood	Populus deltoides	4	3	4	4	3	4	22		WL		
1138	C	10	Catalpa	Catalpa speciosa	3	4	3	4	3	4	21		WL		
1139	BWW	10	Black Willow	Salix nigra	3	4	3	4	3	4	21		WL		
1140	CT	7	Cottonwood	Populus deltoides	4	4	3	3	4	4	22		WL		
1141	E	8	American Elm	Ulmus americana	3	4	3	3	3	4	20		WL		
1142	CT	12	Cottonwood	Populus deltoides	4	3	2	4	1	4	18		WL		
1143	CT	7	Cottonwood	Populus deltoides	3	3	3	4	2	4	19		WL		
1144	E	7	American Elm	Ulmus americana	4	3	3	4	3	4	21		WL		
1145	SM	6	Silver Maple	Acer saccharinum	4	4	5	4	3	5	25		WL		
1146	CT	9	Cottonwood	Populus deltoides	4	3	2	4	2	4	19		WL		
1147	E	8	American Elm	Ulmus americana	4	4	4	4	4	4	24		WL		
1148	BWW	16	Black Willow	Salix nigra	3	3	2	4	2	3	17		WL		
1149	BWW	6	Black Willow	Salix nigra	4	3	4	4	4	4	23		WL		
1150	BC	6	Wild Black Cherry	Prunus serotina	1	1	1	3	1	3	10		WL		
1151	BW	6	Black Walnut	Juglans nigra	4	4	4	4	4	5	25		WL		
1152	NM	8	Norway Maple	Acer platanoides	4	4	4	4	4	5	25		WL		
1153	EE	11	Siberian Elm	Ulmus pumila	4	3	3	4	3	4	21				
1154	SM	7	Silver Maple	Acer saccharinum	4	3	3	4	3	5	22		WL		
1155	E	6	American Elm	Ulmus americana	3	3	3	4	3	4	20		WL		
1156	BX	6	Box elder	Acer negundo	3	3	2	4	2	4	18		WL		
1157	BWW	14	Black Willow	Salix nigra	4	3	3	3	2	4	19		WL		
1158	CT	6	Cottonwood	Populus deltoides	3	3	3	3	3	4	19		WL		
1159	BWW	15	Black Willow	Salix nigra	3	3	2	2	3	3	16		WL		
1160	EE	7	Siberian Elm	Ulmus pumila	4	4	3	3	3	4	21		WL		
1161	BW	11	Black Walnut	Juglans nigra	4	4	4	5	3	5	25		WL		
1162	MW	14	White Mulberry	Morus alba	4	3	3	4	4	4	22		WL		
1163	E	6	American Elm	Ulmus americana	4	3	3	4	3	4	21		WL		
1164	BW	6	Black Walnut	Juglans nigra	4	3	3	4	3	5	22		WL		
1165	SM	8	Silver Maple	Acer saccharinum	3	3	2	4	2	4	18		WL		
1166	E	12	American Elm	Ulmus americana	4	3	4	3	3	4	21				
1167	BW	8	Black Walnut	Juglans nigra	4	4	4	4	4	5	25				
1168	RO	10	Red Oak	Quercus rubra	5	4	4	5	4	5	27				
1169	BW	29	Black Walnut	Juglans nigra	4	4	3	4	3	5	23	LM			
1170	BO	11	Black Oak	Quercus velutina	4	4	4	5	4	5	26				
1171	SU	13	Sugar Maple	Acer saccharum	4	4	4	4	4	5	25				
1172	RO	7	Red Oak	Quercus rubra	4	4	4	5	4	5	26				
1173	SU	10	Sugar Maple	Acer saccharum	4	4	4	4	4	5	25				
1174	BO	15	Black Oak	Quercus velutina	5	4	4	4	4	5	26				
1175	SM	24	Silver Maple	Acer saccharinum	4	4	4	4	3	5	24	LM			
1176	SM	23	Silver Maple	Acer saccharinum	4	4	3	4	3	5	23	LM			
1177	SM	21	Silver Maple	Acer saccharinum	4	4	4	4	3	5	24	LM			
1178	SM	28	Silver Maple	Acer saccharinum	4	4	4	4	3	5	24	LM			
1179	SM	19	Silver Maple	Acer saccharinum	4	4	4	4	3	5	24	LM			
1180	SM	28	Silver Maple	Acer saccharinum	4	4	4	4	4	5	25	LM			
1181	SM	34	Silver Maple	Acer saccharinum	4	4	4	4	4	5	25	LM	WL		
1182	SWO	7	Swamp White Oak	Quercus bicolor	4	4	4	4	4	5	25			Remove	
1183	SWO	7	Swamp White Oak	Quercus bicolor	4	4	4	4	3	5	24				
1184	S	13	Sycamore	Platanus occidentalis	3	4	4	4	4	5	24			Remove	
1185	SWO	7	Swamp White Oak	Quercus bicolor	4	4	4	4	4	5	25				
1186	FC	12	Flowering Cherry	Prunus spp.	4	4	4	5	4	5	26	LM		Remove	M
1187	SWO	7	Swamp White Oak	Quercus bicolor	4	4	4	4	4	5	25				
1188	SU	10	Sugar Maple	Acer saccharum	3	4	3	4	3	5	22				
1189	CA	15	Crab Apple	Malus caronaria	3	3	3	4	3	4	20	LM			
1190	CA	15	Crab Apple	Malus caronaria	3	3	3	3	3	4	19	LM			
1191	CA	9	Crab Apple	Malus caronaria	3	3	3	4	3	4	20				
1192	CA	10	Crab Apple	Malus caronaria	3	3	3	3	4	4	20			Remove	
1193	RM	8	Red Maple	Acer rubrum	4	4	4	4	5	5	26			Remove	
1194	E	7	American Elm	Ulmus americana	4	4	3	4	3	4	22		WL		
1195	EE	8	Siberian Elm	Ulmus pumila	3	3	3	4	3	4	20		WL		
1196	EE	11	Siberian Elm	Ulmus pumila	4	3	2	4	3	4	20		WL		
1197	E	6	American Elm	Ulmus americana	4	3	2	4	2	4	19		WL		
1198	E	6	American Elm	Ulmus americana	4	3	3	4	2	4	20		WL		
1199	CT	11	Cottonwood	Populus deltoides	4	3	3	4	3	4	21		WL		
1200	EE	7	Siberian Elm	Ulmus pumila	3	4	3	4	3	4	21		WL		
1201	CT	10	Cottonwood	Populus deltoides	3	4	3	4	3	4	21		WL		
1202	E	6	American Elm	Ulmus americana	4	4	4	4	3	4	23		WL		
1203	BW	9	Black Walnut	Juglans nigra	4	4	3	4	3	5	23				
1204	EE	6	Siberian Elm	Ulmus pumila	4	3	2	4	2	4	19				
1205	BW	8	Black Walnut	Juglans nigra	4	4	4	4	4	5	25		WL		
1206	EE	7	Siberian Elm	Ulmus pumila	4	4	3	4	3	4	22		WL		
1207	CT	10	Cottonwood	Populus deltoides	4	4	4	4	3	4	23		WL		
1208	BW	6	Black Walnut	Juglans nigra	4	3	3	4	3	5	22		WL		
1209	BW	6	Black Walnut	Juglans nigra	4	4	4	4	3	5	24		WL		
1210	BW	8	Black Walnut	Juglans nigra	4	4	4	3	4	5	24		WL		
1211	BW	7	Black Walnut	Juglans nigra	4	4	4	4	4	5	25		WL		
1212	EE	8	Siberian Elm	Ulmus pumila	4	4	3	4	3	4	22		WL		
1213	BW	6	Black Walnut	Juglans nigra	4	3	3	4	3	5	22		WL		
1214	BW	7	Black Walnut	Juglans nigra	4	3	3	4	3	5	22		WL		
1215	BW	8	Black Walnut	Juglans nigra	4	4	4	4	4	5	25		WL		
1216	EE	8	Siberian Elm	Ulmus pumila	2	3	2	4	2	4	17		WL		
1217	EE	7	Siberian Elm	Ulmus pumila	4	3	3	4	3	4	21		WL		
1218	EE	7	Siberian Elm	Ulmus pumila	4	3	3	4	3	4	21		WL		
1219	E	8	American Elm	Ulmus americana	4	3	2	4	2	4	19		WL		
1220	BW	7	Black Walnut	Juglans nigra	4	4	3	4	3	5	23		WL		
1221	EE	7	Siberian Elm	Ulmus pumila	4	4	3	4	3	4	22		WL		
1222	BW	6	Black Walnut	Juglans nigra	4	3	3	3	3	5	21		WL		
1223	BW	9	Black Walnut	Juglans nigra	4	4	4	5	4	5	26		WL		
1224	EE	19	Siberian Elm	Ulmus pumila	4	4	3	4	3	4	22	LM	WL		
1225	TH	7	Thornapple/Hawthorne	Cragaegus spp.	3	3	3	4	3	4	20		WL		
1226	BR	8	Bur oak	Quercus macrocarpa	4	4	3	4	4	5	24		WL		

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1227	NM	6	Norway Maple	Acer platanoides	4	4	4	4	4	5	25		WL		
1228	TH	10	Thornapple/Hawthorne	Cragaegus spp.	4	4	4	4	4	4	24		WL		
1229	BR	7	Bur oak	Quercus macrocarpa	4	4	4	4	4	5	25		WL		
1230	EE	10	Siberian Elm	Ulmus pumila	4	4	3	4	4	4	23		WL		
1231	E	7	American Elm	Ulmus americana	4	4	3	4	3	4	22		WL		
1232	NM	7	Norway Maple	Acer platanoides	4	4	4	4	4	5	25		WL		
1233	EE	11	Siberian Elm	Ulmus pumila	4	4	3	4	3	4	22		WL		
1234	TH	7	Thornapple/Hawthorne	Cragaegus spp.	4	3	3	4	3	4	21		WL		
1235	BW	6	Black Walnut	Juglans nigra	4	3	3	4	3	5	22		WL		
1236	BX	10	Box elder	Acer negundo	2	2	2	2	2	3	13		WL		
1237	EE	14	Siberian Elm	Ulmus pumila	4	4	4	4	4	4	24		WL		
1238	E	9	American Elm	Ulmus americana	4	4	4	4	4	4	24		WL		
1239	BR	11	Bur oak	Quercus macrocarpa	4	4	4	4	3	5	24		WL		
1240	EE	8	Siberian Elm	Ulmus pumila	4	4	3	3	2	4	20		WL		
1241	E	10	American Elm	Ulmus americana	4	4	3	4	3	4	22		WL		
1242	BX	4	Box elder	Acer negundo	4	3	3	3	4	4	21		WL		
1243	EE	15	Siberian Elm	Ulmus pumila	4	4	3	4	3	4	22		WL		
1244	BW	11	Black Walnut	Juglans nigra	4	4	4	4	4	5	25		WL		
1245	BX	6	Box elder	Acer negundo	4	3	3	4	3	4	21		WL		
1246	SM	8	Silver Maple	Acer saccharinum	4	4	3	4	3	5	23		WL		
1247	BX	8	Box elder	Acer negundo	4	4	4	4	3	4	23		WL		
1248	EE	7	Siberian Elm	Ulmus pumila	4	4	3	4	3	4	22		WL		
1249	EE	7	Siberian Elm	Ulmus pumila	4	4	3	4	3	4	22		WL		
1250	EE	6	Siberian Elm	Ulmus pumila	3	3	3	4	2	4	19		WL		
1251	EE	10	Siberian Elm	Ulmus pumila	4	3	3	4	3	4	21				
1252	EE	7	Siberian Elm	Ulmus pumila	4	3	3	4	2	4	20		WL		
1253	BX	3	Box elder	Acer negundo	4	4	3	3	3	4	21		WL		
1254	EE	15	Siberian Elm	Ulmus pumila	4	3	1	4	1	4	17		WL		
1255	E	10	American Elm	Ulmus americana	4	3	3	3	3	4	20		WL		
1256	HK	8	Hackberry	Celtis occidentalis	5	4	4	4	3	5	25		WL		
1257	BW	15	Black Walnut	Juglans nigra	4	4	4	4	3	5	24		WL		
1258	E	8	American Elm	Ulmus americana	4	4	4	4	3	4	23		WL		
1259	BWW	10	Black Willow	Salix nigra	3	3	3	4	3	3	19		WL		
1260	E	8	American Elm	Ulmus americana	4	4	4	4	4	4	24		WL		
1261	E	6	American Elm	Ulmus americana	4	4	4	4	4	4	24		WL		
1262	EE	6	Siberian Elm	Ulmus pumila	4	3	3	4	3	4	21		WL		
1263	BX	6	Box elder	Acer negundo	4	3	2	4	2	4	19		WL		
1264	CT	14	Cottonwood	Populus deltoides	3	3	3	4	3	4	20		WL		
1265	SM	9	Silver Maple	Acer saccharinum	4	4	4	4	3	5	24		WL		
1266	BX	15	Box elder	Acer negundo	4	3	3	4	3	4	21		WL		
1267	SM	8	Silver Maple	Acer saccharinum	4	2	1	4	1	5	17		WL		
1268	BX	8	Box elder	Acer negundo	3	3	2	4	2	3	17		WL		
1269	CT	14	Cottonwood	Populus deltoides	3	3	4	4	2	3	19		WL		
1270	SM	13	Silver Maple	Acer saccharinum	4	4	4	4	3	5	24		WL		
1271	CT	13	Cottonwood	Populus deltoides	4	3	3	4	3	4	21		WL		
1272	BW	7	Black Walnut	Juglans nigra	4	4	3	4	3	5	23		WL		
1273	SM	10	Silver Maple	Acer saccharinum	3	4	4	4	3	4	22		WL		
1274	CT	13	Cottonwood	Populus deltoides	3	3	3	4	3	3	19		WL		
1275	HL	11	Honeylocust	Gleditsia triacanthos	4	4	2	4	2	4	20				
1276	RP	12	Red Pine	Pinus resinosa	3	3	2	4	2	3	17				
1277	BL	8	Black Locust	Robinia pseudoacacia	4	3	3	4	2	4	20				
1278	BL	6	Black Locust	Robinia pseudoacacia	3	4	3	4	3	3	20		WL		
1279	T	7	Tamarack	Larix laricina	1	1	1	4	1	1	9		WL		
1280	T	9	Tamarack	Larix laricina	3	3	3	3	2	1	15				
1524	SWO	6	Swamp White Oak	Quercus bicolor	5	4	4	5	4	5	27			Remove	
1525	E	18	American Elm	Ulmus americana	4	4	4	5	3	4	24	LM		Remove	M
1526	S	11	Sycamore	Platanus occidentalis	4	4	4	5	4	5	26			Remove	
1527	RM	6	Red Maple	Acer rubrum	5	4	4	5	4	5	27				
1528	RM	6	Red Maple	Acer rubrum	5	4	4	5	3	5	26				
1529	BX	11	Box elder	Acer negundo	4	1	1	4	1	4	15		WL		
1530	BX	6	Box elder	Acer negundo	4	3	4	4	3	4	22		WL		
1531	SM	8	Silver Maple	Acer saccharinum	4	3	2	4	2	5	20		WL		
1532	PN	10	Pin Cherry	Prunus pennsylvanica	4	4	4	5	4	3	24		WL		
1533	BX	9	Box elder	Acer negundo	4	4	4	5	3	4	24		WL		
1534	EE	8	Siberian Elm	Ulmus pumila	4	3	3	4	2	4	20		WL		
1535	SM	10	Silver Maple	Acer saccharinum	4	4	4	5	3	5	25		WL		
1536	BX	6	Box elder	Acer negundo	4	2	2	4	1	4	17		WL		
1537	EE	11	Siberian Elm	Ulmus pumila	4	3	3	4	3	4	21		WL		
1538	PN	8	Pin Cherry	Prunus pennsylvanica	4	4	4	4	4	3	23		WL		
1539	SM	6	Silver Maple	Acer saccharinum	4	4	3	4	2	5	22		WL		
1540	BWW	11	Black Willow	Salix nigra	4	4	3	4	3	4	22		WL		
1541	BW	9	Black Walnut	Juglans nigra	4	4	4	5	4	5	26		WL		
1542	BX	8	Box elder	Acer negundo	4	4	3	5	3	4	23		WL		
1543	RP	14	Red Pine	Pinus resinosa	4	3	3	4	3	5	22		WL		
1544	RP	14	Red Pine	Pinus resinosa	4	3	3	5	3	5	23				
1545	RP	12	Red Pine	Pinus resinosa	4	3	3	4	3	5	22				
1546	EE	7	Siberian Elm	Ulmus pumila	4	4	4	4	3	4	23				
1547	E	9	American Elm	Ulmus americana	4	4	3	4	2	4	21				
1548	BW	8	Black Walnut	Juglans nigra	4	3	3	4	2	5	21		WL		
1549	E	6	American Elm	Ulmus americana	4	4	3	4	3	4	22		WL		
1550	EE	8	Siberian Elm	Ulmus pumila	4	3	3	4	2	4	20				
			JUMP IN SEQUENCE												

Summary Table	**Number of Trees**	**Number of Diameter Inches**
Landmark trees removed	2	30
Landmark trees to remain but mitigated as removals*	1	25
Landmark trees preserved	19	676
Woodland trees removed	0	0
Woodland trees preserved	235	2319
TOTAL number of trees removed & mitigated as removals	10	127
TOTAL number of trees preserved	299	3166
TOTAL mitigation required		27.5"

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STATE OF MICHIGAN
SHANNAN GIBB-RANDALL
LANDSCAPE ARCHITECT
NO. 3901001515
REGISTERED LANDSCAPE ARCHITECT

PROJECT NUMBER 21018

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Site Plan Approval	09.22.22

DRN: JLS CHK'D: DFB

Ann Arbor Fire Station 4

Natural Features: Tree Information

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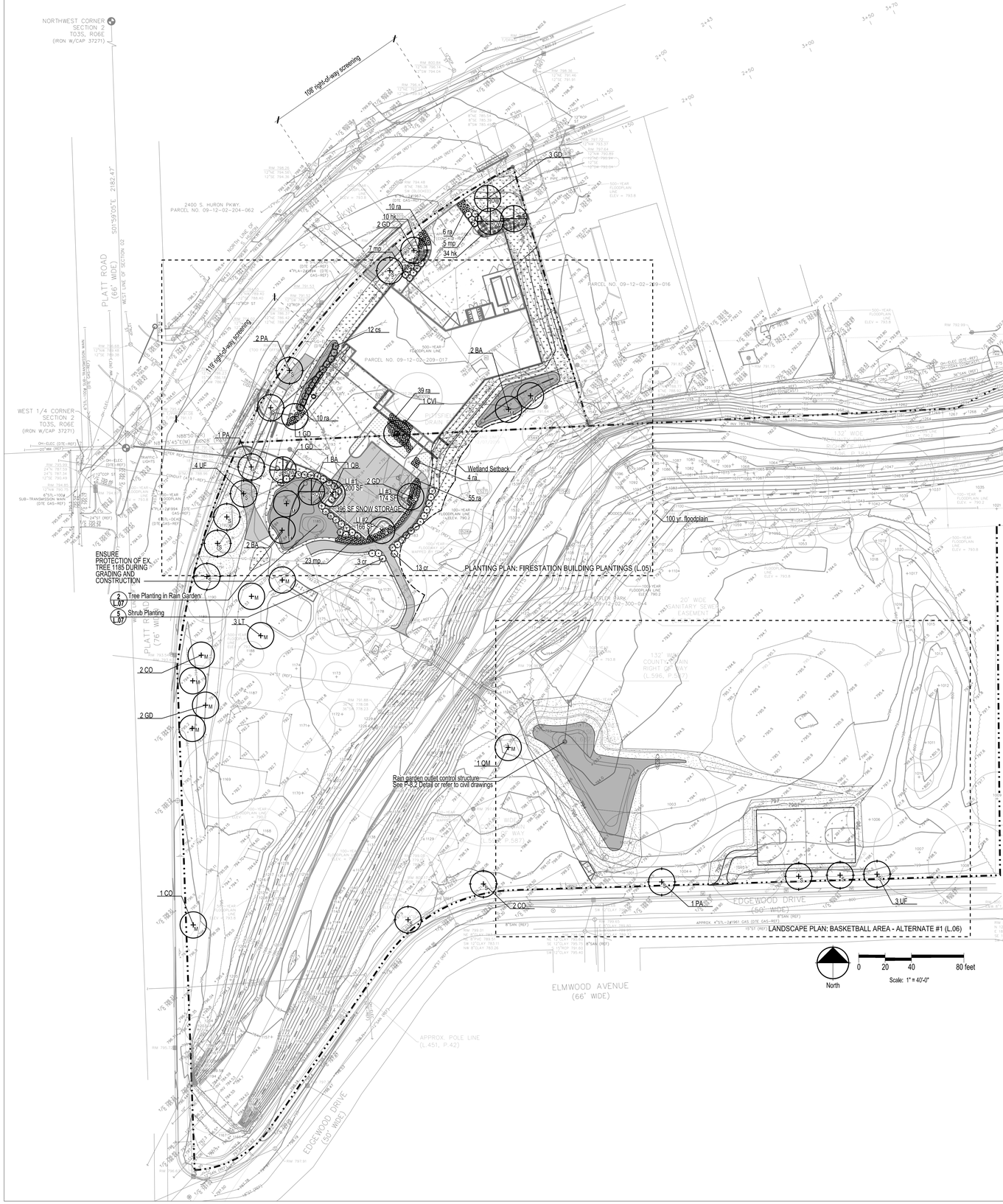
SHEET
L.03



LEGEND

- Proposed canopy tree: street tree
- Proposed canopy tree: mitigation
- Proposed canopy tree: right-of-way screening
- Proposed canopy tree: parking lot island
- Proposed shrub: right-of-way and conflicting land use buffer
- Existing Tree CRZ
- Proposed canopy tree
- Proposed Perennial Planting
- Proposed Rain Garden
- Proposed Lawn
- Microclover Seed Mix
- Snow Storage
- Proposed Fence
- Proposed Lightpole
- Proposed Bike Hoop
- Proposed Refuse Container
- Proposed Asphalt
- Steel Bed Edging

NOTE: See civil drawings for any items not listed in the legend above

NOTES

1. Refer to below table for size and species of existing trees.
2. All compacted soils in landscaped areas shall be tilled to a minimum 12-inch depth before placement of planting media.
3. Water outlets will be provided within 150-feet of all planting beds and rain gardens.
4. All proposed plantings that exceed a mature height greater than 6-inches shall be planted a minimum of 5 feet from fire hydrants.
5. All proposed trees shall be planted a minimum of 15 feet from fire hydrants.
7. Refer to 32 92 00 - FINE GRADING LAWN SEEDING specification for soil specifications.
8. All vegetation species deviations from the approved site plan must be approved ahead of time in writing by the City of Ann Arbor.
9. The City of Ann Arbor has adopted an ordinance limiting phosphorus in fertilizer. Applications of fertilizer beyond the initial topsoil and seeding shall be a fertilizer with no phosphorus.
10. Contact designer before changing any proposed plants on any landscape sheets
11. At the time of plant and seed delivery for the rain gardens, a WCWRC landscape reviewer must be present. The quantity and species delivered will be reviewed on site. Contact Catie Wytychak at wytychakc@ewashtenaw.org or 734.222.6813 to coordinate.
12. Water is only available from connection to existing fire hydrants through the City of Ann Arbor. Contractor must provide all necessary connections, hoses, and backflow prevention devices as required by local codes and ordinances. All water use shall be metered through the City of Ann Arbor. Coordination with City Fire Department as necessary.

LANDSCAPE MAINTENANCE PROGRAM

1. All diseased, damaged, or dead material shown on the Landscape Plan as proposed plantings shall be replaced by the end of the following planting season as a continuing obligation for the duration of the site plan.
2. Snow cannot be pushed into interior landscape islands unless they are designated on the Landscape Plan for snow storage.
3. No chemicals are allowed in the stormwater features or buffer zones with the following exception: invasive species may be treated with chemicals by a certified applicator. Mowing is only allowed twice per year.

** Type Legend*
L = Interior Landscape Island Tree
S = Street Tree
R = Right-of-way Screening Tree/ Refuse Screening
M = Mitigation Tree
C = Conflicting Land Use Buffer

PLANT LIST

Total #	Type* L	S	R	M	C	O	ID	Botanical Name	Common Name	Size	Spacing	Notes
TREES												
5			1	4			BA	*Betula allaghaniensis*	Yellow Birch	2" cal.	as shown	Multi-stem
5		2		3			CO	*Celtis occidentalis*	Hackberry	2" cal.	as shown	
0						1	CVI	*Crataegus viridis*	Winter King Hawthorn	2" cal.	as shown	
13	2	2	6	3			GD	*Gymnocladus dioicus*	Kentucky Coffeetree	2" cal.	as shown	
3				3			LT	*Liriodendron tulipifera*	Tulip Tree	2" cal.	as shown	
4		3	1				PA	*Platanus x. acerifolia*	London Planetree	2" cal.	as shown	
1	1						QB	*Quercus bicolor*	Swamp White Oak	2" cal.	as shown	
1				1			QM	*Quercus macrocarpa*	Bur Oak	2" cal.	as shown	
8		8					UF	*Ulmus 'Frontier'*	Frontier Hybrid Elm	2" cal.	as shown	
	3	15	8	14	0	1						

Total #	L	S	R	M	C	O	ID	Botanical Name	Common Name	Size	Spacing	Notes
SHRUBS												
16					16		cr	*Cornus racemosa*	Gray Dogwood	5 gal.	as shown	
12			12				cs	*Cornus sericea*	Redtwig Dogwood	5 gal.	as shown	
44			44				hk	*Hypericum kalmianum 'Blues Festival'*	Blues Festival Hypericum	2 gal.	as shown	
35			35				mp	*Morella pensylvanica*	Northern Bayberry	5 gal.	as shown	
124			26			98	ra	*Rhus aromatica 'Gro-Low'*	Gro-Low Fragrant Sumac	5 gal.	as shown	
	0	0	117	0	16	98						

See 32 92 00 - FINE GRADING LAWN SEEDING for specifications on lawn and Microclover seed.

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DRN: JLS CHK'D: DFB

Ann Arbor Fire Station 4

Overall Landscape: Tree, Shrub, and Seeding Plan

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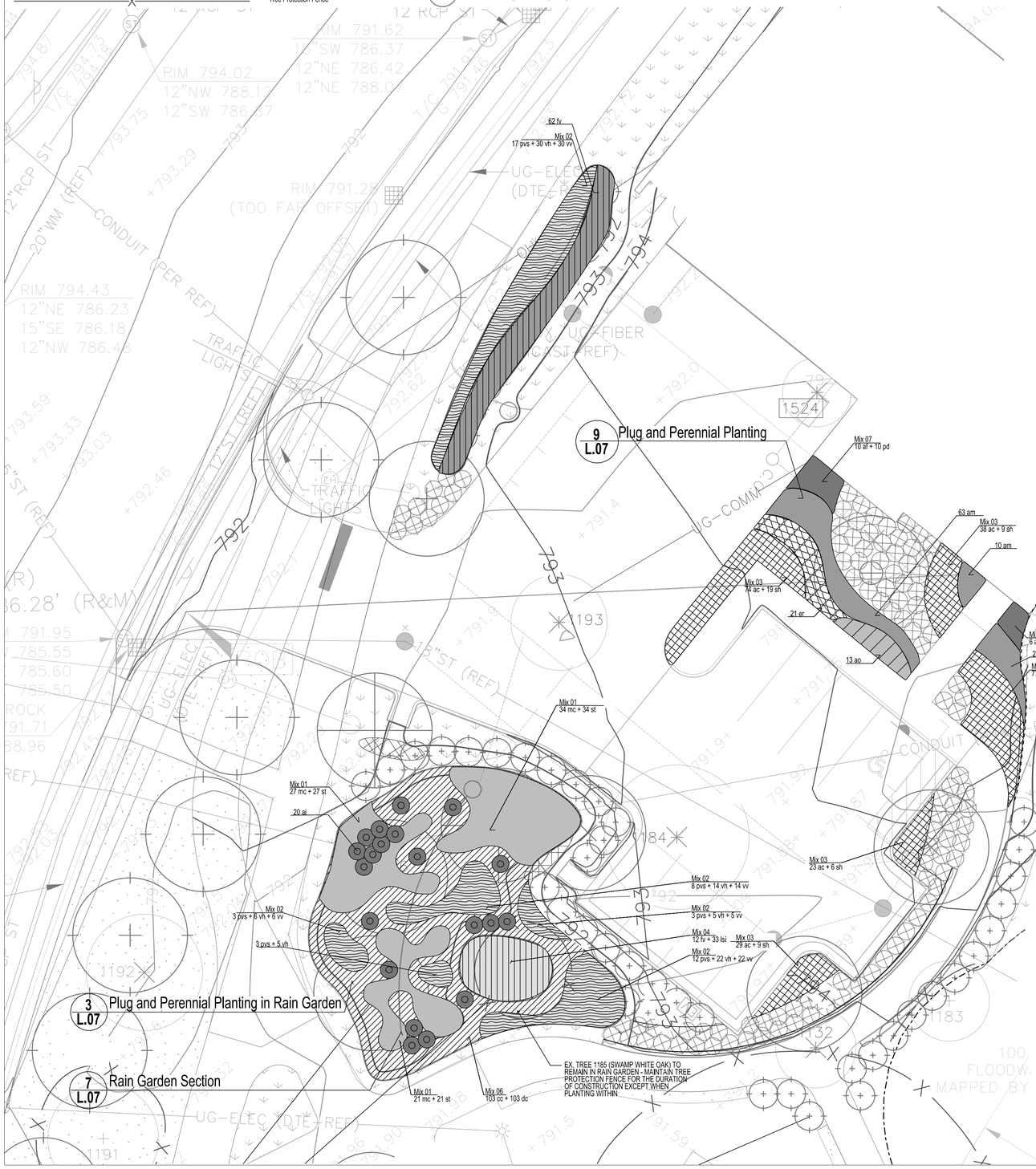
SHEET L.04

LEGEND

Proposed Perennials
Proposed Microclover
Proposed Lawn
Proposed Steel Edge
Tree Protection Fence
Proposed canopy tree: parking (See L-4 for species)
Proposed shrub: right-of-way and conflicting land use buffer (See L-4 for species)
Existing Tree CRZ (See L-3 for species)
Existing Tree to be removed
Proposed canopy tree: street tree (See L-4 for species)
Proposed canopy tree: mitigation (See L-4 for species)
Proposed canopy tree: right-of-way screening (See L-4 for species)
Proposed canopy tree (See L-4 for species)

See survey sheet (S-1) for any items not listed in the legend



LANDSCAPE NOTES

1. Refer to sheet L-4 for size and species of proposed trees.
2. All compacted soils in landscaped areas shall be tilled to a minimum 2-inch depth before placement of planting media.
3. Water outlets will be provided within 150-feet of all required plantings except those in detention basin one (L.06)
4. All proposed plantings that exceed a mature height greater than 6-inches shall be planted a minimum of 5 feet from fire hydrants.
5. All proposed trees shall be planted a minimum of 15 feet from fire hydrants.
6. Developer reserves the right to shift tree planting locations if water main connection is installed to the south.
7. Refer to 32 92 00 - FINE GRADING LAWN SEEDING specification for soil specifications.
8. All vegetation species deviation from the approved site plan must be approved ahead of time in writing by the City of Ann Arbor.
9. The City of Ann Arbor has adopted an ordinance limiting phosphorus in fertilizer. Applications of fertilizer beyond the initial topsoil and seeding shall be a fertilizer with no phosphorus.
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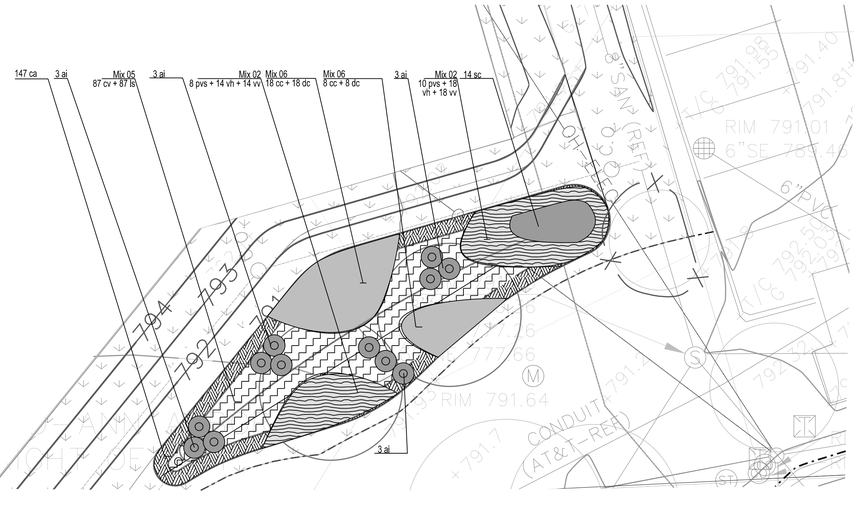

Plant Schedule - Firestation Building Area

Perennials and Bulbs (*Not included in mixes*)

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
ai	32	Asclepias incarnata	Swamp Milkweed	36" o.c.	#1 cont.	
am	97	Achillea millefolium '*Oertel's Rose*'	Oertel's Rose Yarrow	18" o.c.	#1 cont.	
ao	13	Aster oblongifolius '*October Skies* '	October Skies' Aromatic Aster	24" o.c.	#1 cont.	
ca	147	Carex albicans	Whitetinge Sedge	12" o.c.	plug	
er	21	Eupatorium rugosum '*Chocolate* '	Chocolate Joe-Pye	24" o.c.	#1 cont.	.
fv	62	Fragraria virginiana	Wild Strawberry	24" o.c.	plug	
sc	14	Scirpus cyperinus	Woolgrass	24" o.c.	plug	

Mix 01

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
mc	82	Molinia caerulea 'Poul Petersen'	Moor Grass 'Poul Petersen'	24" o.c.	#1 cont	Overall bed spacing 24" o.c.
sp	82	Silphium terebinthinaceum	Prairie Dock	24" o.c.	plug	

Mix 02

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
pvs	64	Panicum virgatum 'Shenandoah'	Switchgrass	24" o.c.	#1 cont	See L.07-8 for detail on spacing
vh	114	Verbena hastata	Blue Vervain	18" o.c.	plug	
vv	109	Veronicastrum virginicum	Culver's Root	18" o.c.	plug	

Mix 03

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
ac	303	Allium cernuum	Nodding Wild Onion	12" o.c.	plug	See L.07-8 for detail on spacing
sh	62	Sporobolis heterolepis	Prairie Dropseed	24" o.c.	plug	

Mix 04

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
fv	12	Fragraria virginiana	Wild Strawberry	30" o.c.	plug	See L.07-8 for detail on spacing
lsi	33	Lobelia siphilitica	Great Blue Lobelia	18" o.c.	plug	

Mix 05

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
cv	87	Carex vulpinoidea	Fox Sedge	18" o.c.	plug	Overall bed spacing 18" o.c.
ls	87	Liatris spicata	Dense Blazing Star	18" o.c.	plug	

Mix 06

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
cc	129	Conoclinium coelestinum	Blue Mistflower	24" o.c.	plug	Overall bed spacing 24" o.c.
dc	129	Deschampsia cespitosa 'Goldtau'	Golden Tuftgrass 'Goldtau'	24" o.c.	#1 cont.	

Mix 07

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
af	16	Agastache 'Blue Fortune'	Giant Hyssop	18" o.c.	#1 cont.	Overall bed spacing 18" o.c.
pd	16	Penstemon digitalis '*Husker Red* '	Husker Red Penstemon	18" o.c.	#1 cont.	

0 5' 10' 20'
Scale: 1" = 10'-0"

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Ann Arbor Fire Station 4

Landscape Plan: Fire Station Area

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SHEET L.05

LANDSCAPE NOTES

1.Refer to sheet L-4 for size and species of proposed trees.
2.All compacted soils in landscaped areas shall be tilled to a minimum 12-inch depth before placement of planting media.
3.Water outlets will be provided within 150-feet of all required plantings except those in detention basin 1 (L.06).
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5.All proposed trees shall be planted a minimum of 15 feet from fire hydrants.
6.Developer reserves the right to shift tree planting locations if water main connection is installed to the south.
7.Refer to 32 92 00 - FINE GRADING LAWN SEEDING specification for soil specifications.
8.All vegetation species deviations from the approved site plan must be approved ahead of time in writing by the City of Ann Arbor.
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2. Snow cannot be pushed into interior landscape islands unless they are designated on the Landscape Plan for snow storage.
3. No chemicals are allowed in the stormwater features or buffer zones with the following exception: invasive species may be treated with chemicals by a certified applicator. Mowing is only allowed twice per year.

Plant Schedule - Basketball Court Rain Garden

Perennials and Bulbs

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
ba	19	Baptisia australis	Blue False Indigo	36" o.c.	#1 cont	
ls	46	Liatris spicata	Dense Blazing Star	See drawing	plug	
hm	7	Heracleum maximum	Cow Parsnip	See drawing	plug	

Mix 01

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
ep	34	Echinacea purpurea	Purple Coneflower	24" o.c.	plug	Overall bed spacing 24" o.c.
mc	34	Molinia caerulea 'Poul Petersen'	Moor Grass 'Poul Petersen'	24" o.c.	#1 cont	
st	34	Silphium terebinthinaceum	Prairie Dock	24" o.c.	plug	

Mix 02

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
fv	82	Fragraria virginiana	Wild Strawberry	30" o.c.	plug	Plant Fragraria virginiana at 30" o.c. over entire area, then fill area with Monarda fitsulosa and Silphium terebinthinaceum at 24" o.c. spacing.
mf	65	Monarda fitsulosa	Wild Bergamot	24" o.c.	plug	
rh	65	Silphium terebinthinaceum	Prairie Dock	24" o.c.	plug	

Mix 03

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
mc	54	Molinia caerulea 'Poul Petersen'	Moor Grass 'Poul Petersen'	30" o.c.	#1 cont	Plant Molinia caerulea 'Poul Petersen' at 30" over entire area, then fill area with Melanthium virginicum and Verbena hastata at 18" o.c. spacing.
mv	75	Melanthium virginicum	Bunchflower Lily	18" o.c.	plug	
vh	75	Verbena hastata	Blue Vervain	18" o.c.	plug	

Mix 04

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
ag	26	Andropogon gerardii	Big Bluestem	24" o.c.	#1 cont	Overall bed spacing 24" o.c.
ey	26	Eryngium yuccifolium	Rattlesnake Master	24" o.c.	plug	
rs	26	Rudbeckia subtomentosa	Sweet Coneflower	24" o.c.	plug	

Mix 05

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
ca	691	Carex albicans	Whitetinge Sedge	12" o.c.	plug	Plant Eupatorium rugosum and Iris cristata at 24" o.c. spacing over entire area, then fill remaining area with Carex albicans at 12" o.c. spacing.
er	87	Eupatorium rugosum	White Snakeroot	24" o.c.	plug	
ic	87	Iris cristata	Crested Iris	24" o.c.	plug	

Mix 06

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
dc	106	Deschampsia cespitosa 'Goldtau'	Gold Dew Tufted Hair Grass	18" o.c.	#1 cont	Overall bed spacing 18" o.c.
li	106	Lobelia siphilitica	Great Blue Lobelia	18" o.c.	plug	

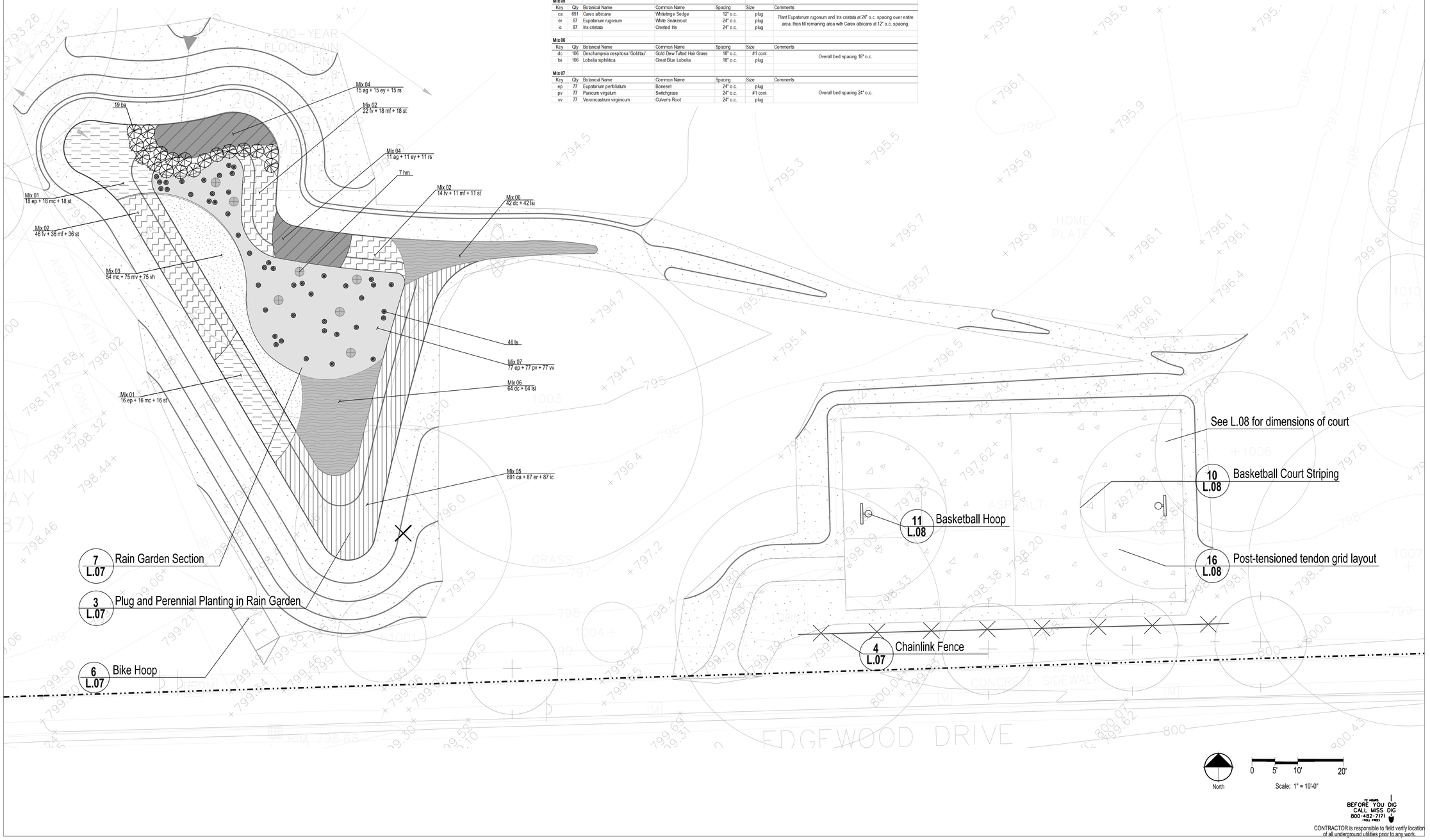
Mix 07

Key	Qty	Botanical Name	Common Name	Spacing	Size	Comments
ep	77	Eupatorium perfoliatum	Boneset	24" o.c.	plug	Overall bed spacing 24" o.c.
pv	77	Panicum virgatum	Switchgrass	24" o.c.	#1 cont	
vv	77	Veronicastrum virginicum	Culver's Root	24" o.c.	plug	

LEGEND

- Proposed Perennials
- Existing Tree CRZ
- Proposed canopy tree: street tree
- Proposed Lawn
- Chainlink Fence

NOTE: See survey sheets (P-1.0-1.4) for any items not listed in the legend above



72 HOURS BEFORE YOU DIG CALL MISS DIG 800-482-7171 TOLL FREE

CONTRACTOR is responsible to field verify location of all underground utilities prior to any work.

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Ann Arbor, Michigan
48105
Phone: 734.995.4194
Fax: 734.668.2525

STATE OF MICHIGAN
SHANNAN GIBB-RANDALL
LANDSCAPE ARCHITECT
NO. 3901001515
REGISTERED LANDSCAPE ARCHITECT

PROJECT NUMBER 21018

ISSUE		
	BIDS/PERMITS	10.11.24
	Final Site Plan	9.08.23
	BIDS/PERMITS	8.04.23
	Site Plan Resubmission	11.09.22
	Site Plan Approval	09.22.22

DRN: JLS CHK'D: DFB

Ann Arbor Fire Station 4

Landscape Plan: Basketball Area Alternate #1

A3C COLLABORATIVE ARCHITECTURE
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SHEET L.06

Planting Notes:

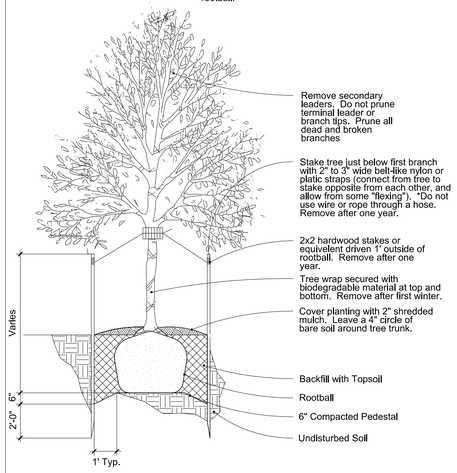
1. See specifications for all material requirements.

2. Taper planting hole 45° up from bottom of hole.

3. Set rootball plumb on 95% compacted soil pedestal so as top1/4 of rootball is above finished grade. Remove all binding and burlap from top 1/2 of rootball. Cut wires of basket and fold completely down into hole.

4. Remove all tags, strings, plastics, and any other materials wich are unsightly or could cause girdling.

5. Remove all non-biodegradeable materials from the rootball. Fold down all burlap from 1/3rd from the top of the rootball.



1 Deciduous Tree Planting

NOTES:
1. Rain garden soil mix to be composed of 50% existing topsoil, 25% 2NS sand, and 25% compost.
2. 2" undyed shredded hardwood mulch to be applied to all planting areas.

Planting Notes:

1. See specifications for all material requirements.

2. Taper planting hole 45° up from bottom of hole.

3. Set rootball plumb on 95% compacted soil pedestal so as top1/4 of rootball is above finished grade. Remove all binding and burlap from top 1/2 of rootball. Cut wires of basket and fold completely down into hole.

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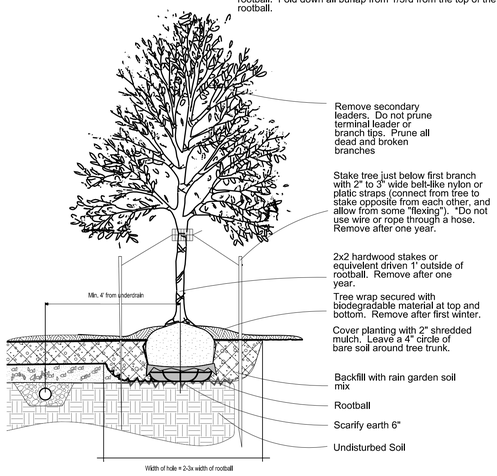
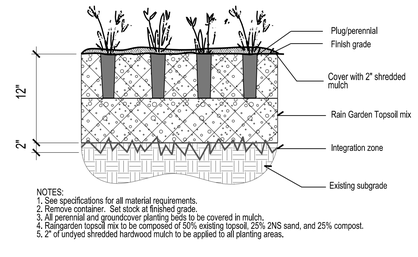
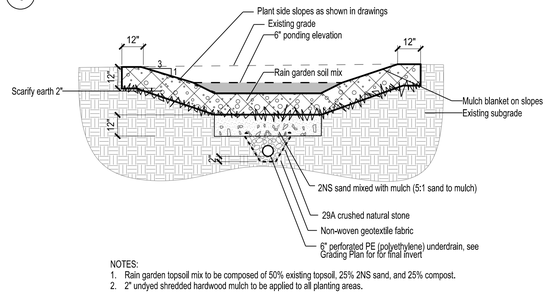


2 Tree Planting in Rain Garden



NOTES:
1. See specifications for all material requirements.
2. Remove container. Set stock at finished grade.
3. All perennial and groundcover planting beds to be covered in mulch.
4. Raingarden topsoil mix to be composed of 50% existing topsoil, 25% 2NS sand, and 25% compost.
5. 2" of undyed shredded hardwood mulch to be applied to all planting areas.

3 Plug and Perennial Planting in Rain Garden



NOTES:
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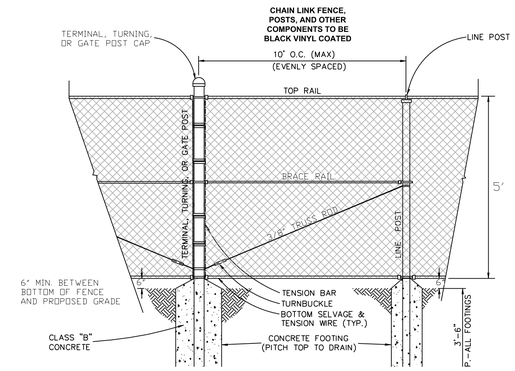
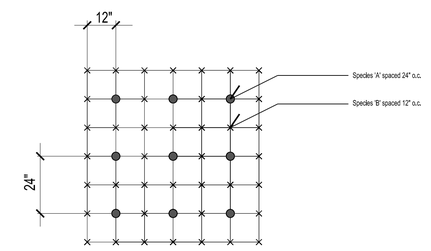
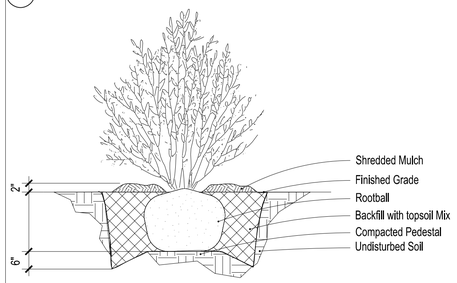
2. 2" undyed shredded hardwood mulch to be applied to all planting areas.



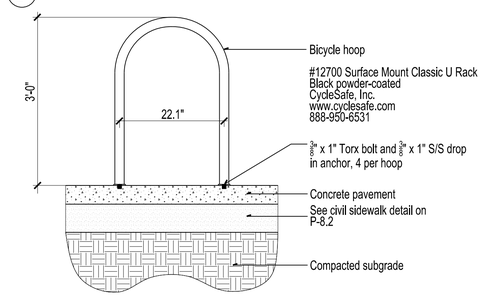
4 Chainlink Fence



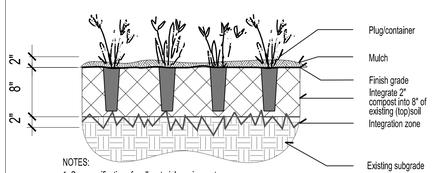
8 Plant Spacing at 12" and 24" o.c.



5 Shrub Planting



6 Bike Hoop



NOTES:
1. See specifications for all material requirements.
2. Remove container. Set stock at finished grade.
3. All perennial and groundcover planting beds to be covered in mulch.

9 Plug and Perennial Planting

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STATE OF MICHIGAN
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LANDSCAPE ARCHITECT
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DRN: JLS CHK'D: DFB

Ann Arbor Fire Station 4

Landscape Details

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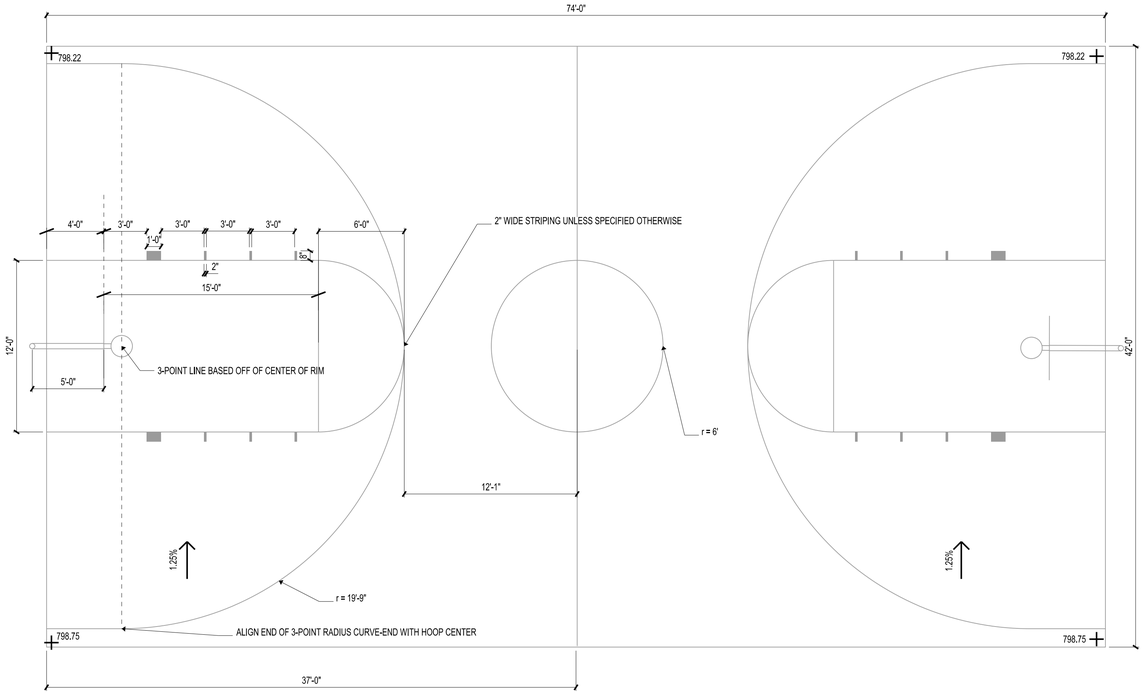
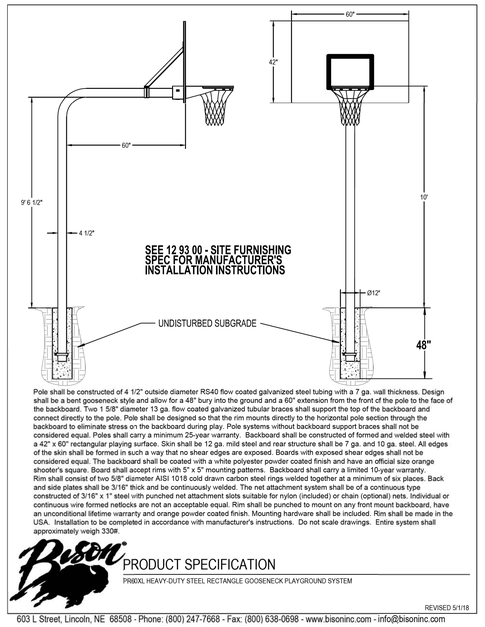
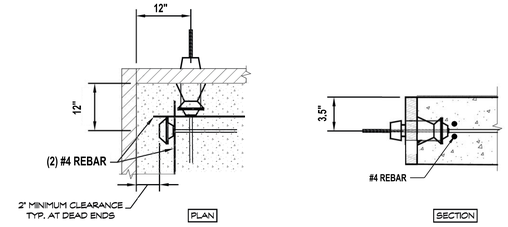
SHEET L.07



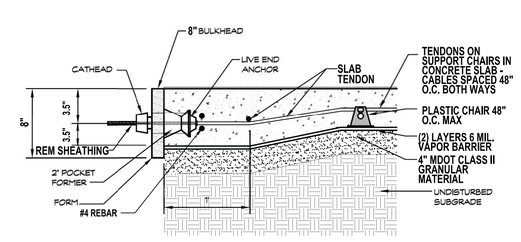
10 **Basketball court striping**



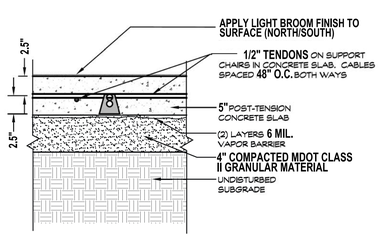
11 **Basketball Hoop**



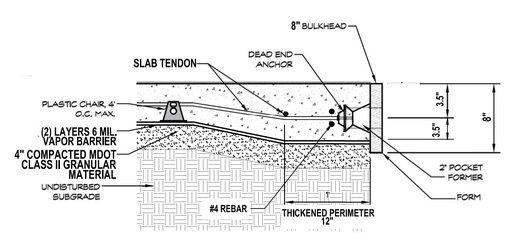
12 **Minimum anchor distance**



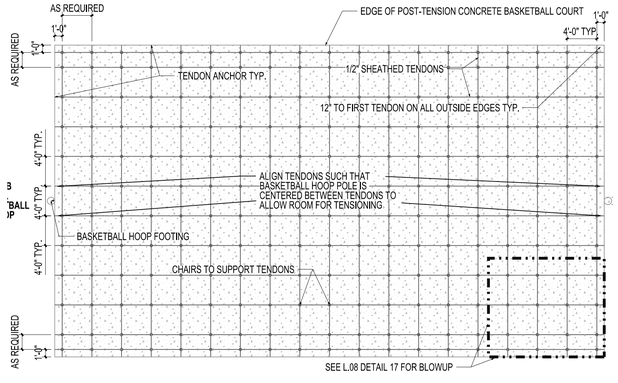
13 **Live end anchor**



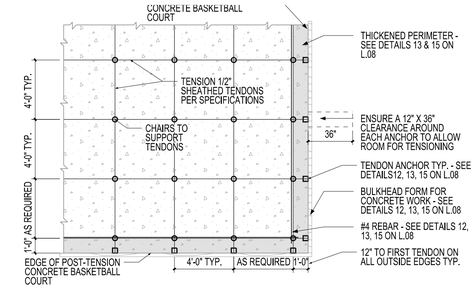
14 **Basketball court surface**



15 **Dead End Anchor**



16 **Post-tensioned tendon grid layout**



17 **Post-tensioned tendon grid layout**

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DRN: JLS CHK'D: DFB

Ann Arbor Fire Station 4

Basketball Court Details
Alternate #1

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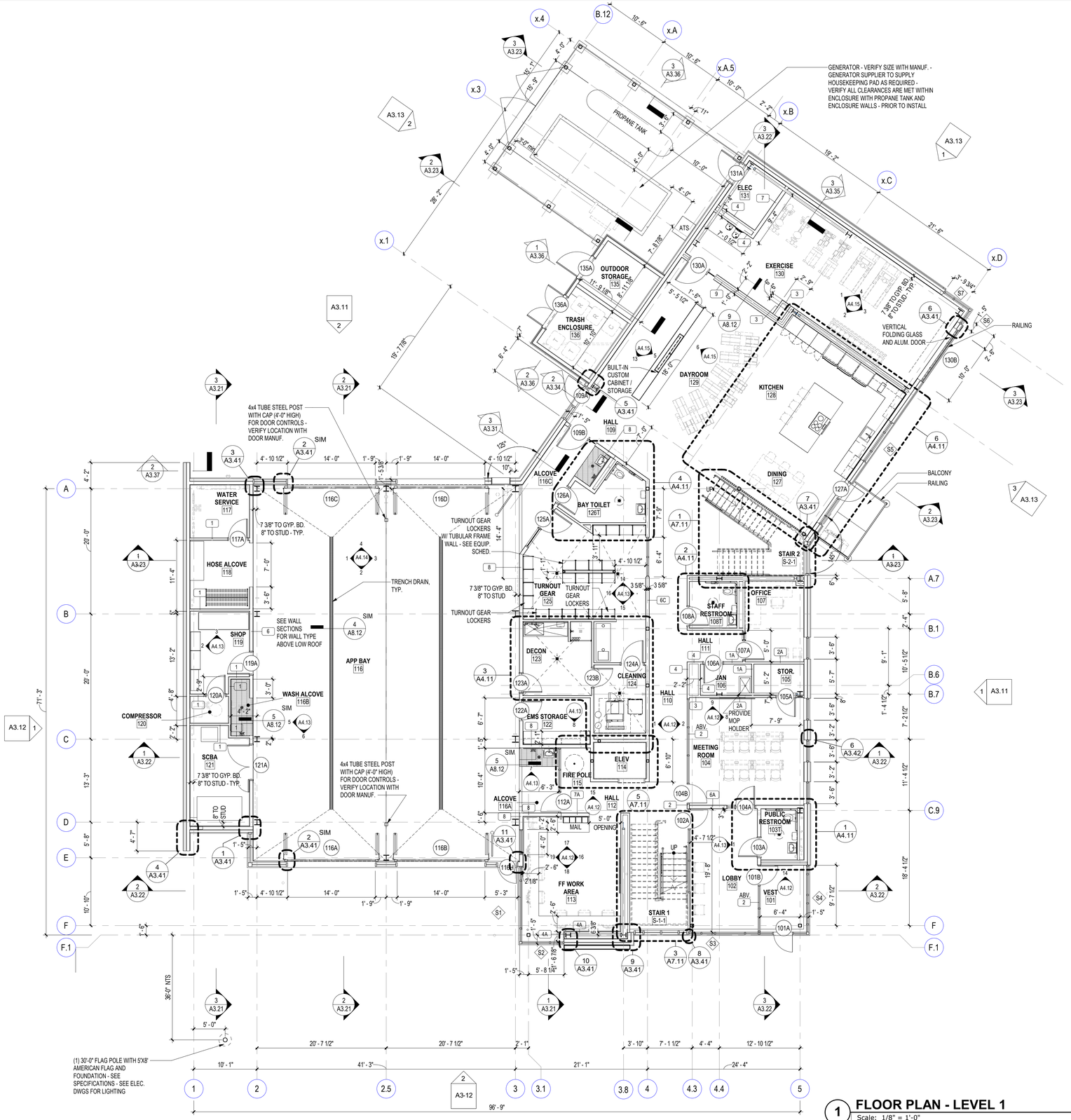
SHEET L.08



LEGEND

- 1/2 HR SEPARATION - CONT. TO UNDERSIDE OF FLOOR/ ROOF ASSEMBLY - SEE CODE COMPLIANCE SHEET G0.11
- ### — REFERENCED DOOR TYPE AND SCHEDULE
- # — REFERENCED WALL TYPES
- A — REFERENCED WINDOW TYPES

GENERAL NOTES - FLOOR PLANS

1. SEE G0.02 - SHEET INDEX FOR GENERAL PROJECT NOTES, LEGENDS AND ABBREVIATIONS.
2. SEE A5.11 - ADA CODE SHEET FOR TYPICAL ACCESSIBLE MOUNTING HEIGHTS.
3. SEE G0.04 FOR WALL PARTITION TYPES.
4. DIMENSIONS ARE FACE OF GYPSUM BOARD, UNLESS NOTED OTHERWISE.
5. DOOR JAMBS (HINGE SIDE) SHALL BE 6" FROM CORNER IN STUD PARTITIONS UNLESS NOTED OTHERWISE.
6. REFER TO DETAILS FOR ADDITIONAL DIMENSIONING INFORMATION.
7. REFER TO ENLARGED PLANS FOR PARTITION TYPES AND DIMENSION IN AREAS WHICH ARE DETAILED AT A LARGER SCALE.
8. CONTRACTOR IS RESPONSIBLE FOR THE COORDINATION OF OWNER PROVIDED EQUIPMENT INCLUDED BUT NOT LIMITED TO DIMENSIONAL INFORMATION, AND MECHANICAL, ELECTRICAL AND PLUMING REQUIREMENTS.
9. SEE INTERIOR ELEV. FOR GROMMETS IN CASEWORK.
10. PROVIDE DEPRESSED SLAB AT WASH ALCOVE AND SHOWERS TYP. (SEE STRUCT. FOUNDATION PLAN FOR SLAB THICKNESS).
11. COORDINATE AND PROVIDE BACKING AND BLK'G REQ'D FOR CABINETS, GRAB BARS, HANDRAILS, MARKER BOARDS, TACK BOARDS, SHELVING AND OTHER EQUIPMENT AND HARDWARE PRIOR TO INSTALLING G.W.B. - CONT. X 6" 16 GA. FLAT STRAP W/ 2X6 MIN WOOD BLK'G REQUIRED AT ALL GRAB BARS AND HANDRAIL LOCATIONS. CONT. X 8" 16 GA. FLAT STRAP BACKING OK AT ALL OTHER LOCATIONS.
12. PROVIDE WALL TO WALL SLOPED FLOORS AT TRENCH DRAINS AT APPARATUS BAYS
13. PROVIDE BLOCK OUTS AT EXTERIOR DOORS AND APPARATUS BAY DOORS TO POUR SLAB THROUGH OPENING WITH A SINGLE EXPANSION JOINT AS INDICATED
14. WHERE CONTROL JOINTS TERMINATE AT AN INTERSECTING JOINT, HOLD SHORT AND FINISH WITH HAND SAW. OVERLAPPING SAW CUTS ARE NOT ALLOWED. CONTRACTOR TO PROVIDE A JOINT LAYOUT PLAN PRIOR TO PROCEEDING WITH THE WORK.
15. COORDINATE AND PROVIDE BACKING & BLK'G REQ'D FOR CABINETS AND HARDWARE PRIOR TO INSTALLING G.W.B.
16. SEE G0.04 FOR WALL TYPES.
17. SEE ENLARGED PLANS FOR WALL TYPES IN THOSE AREAS
18. REFER TO CODE COMPLIANCE PLANS FOR FIRE EXTINGUISHER CABINETS AND RATED WALL LOCATIONS.

1 **FLOOR PLAN - LEVEL 1**
Scale: 1/8" = 1'-0"

0 4' 8' 16'

PROJECT TRUE 35°

TCA
ARCHITECTURE + PLANNING + DESIGN

DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT
STATE OF MICHIGAN

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23
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Site Plan Approval	11/22/22
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Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

FIRST LEVEL FLOOR PLAN

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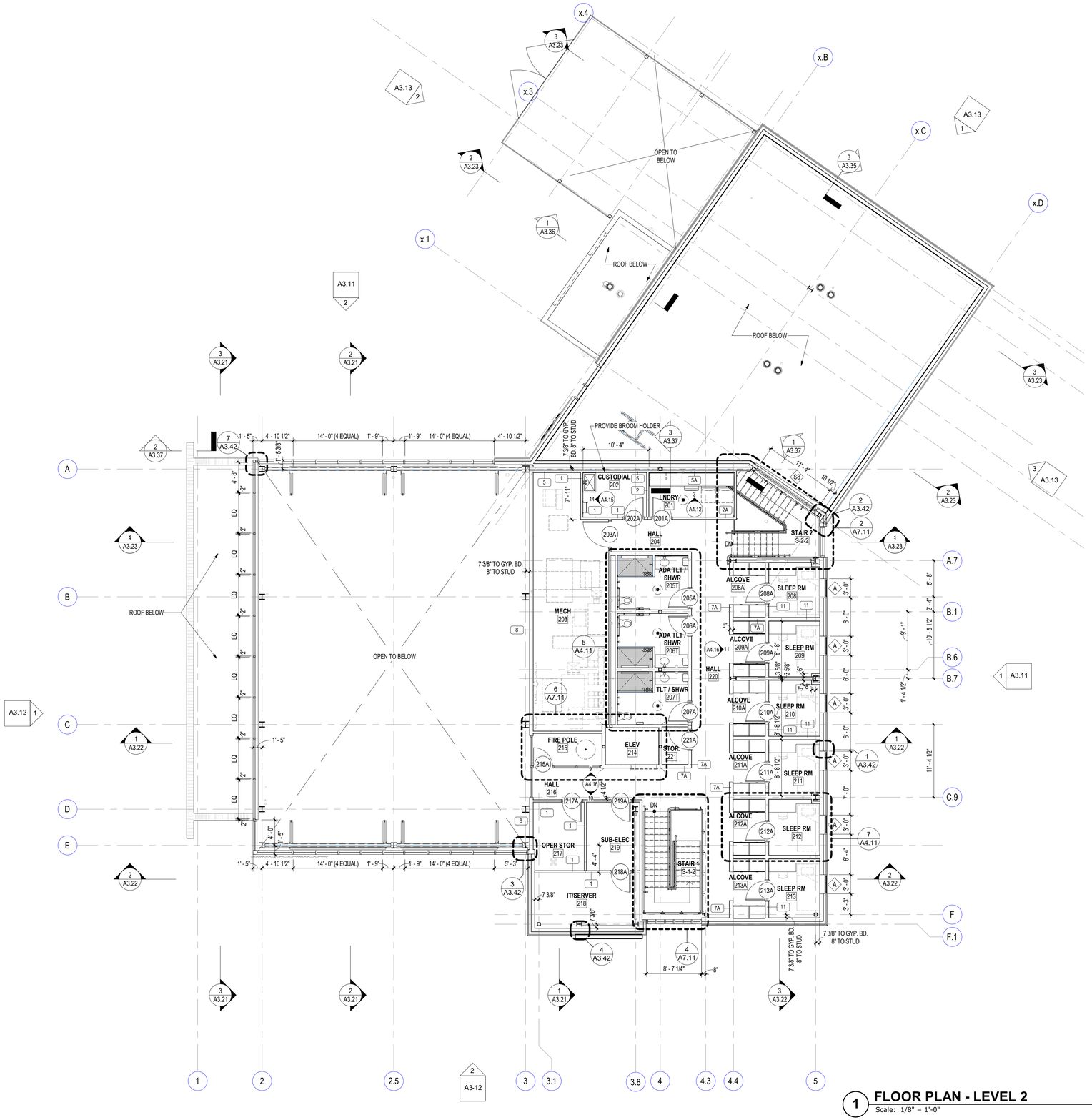

LEGEND

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GENERAL NOTES - FLOOR PLANS

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17. SEE ENLARGED PLANS FOR WALL TYPES IN THOSE AREAS
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1 FLOOR PLAN - LEVEL 2
Scale: 1/8" = 1'-0"

0 4' 8' 16'

PROJECT TRUE 30°

TCA
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STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
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Site Plan Approval	11/22/22
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Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
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SECOND LEVEL FLOOR PLAN

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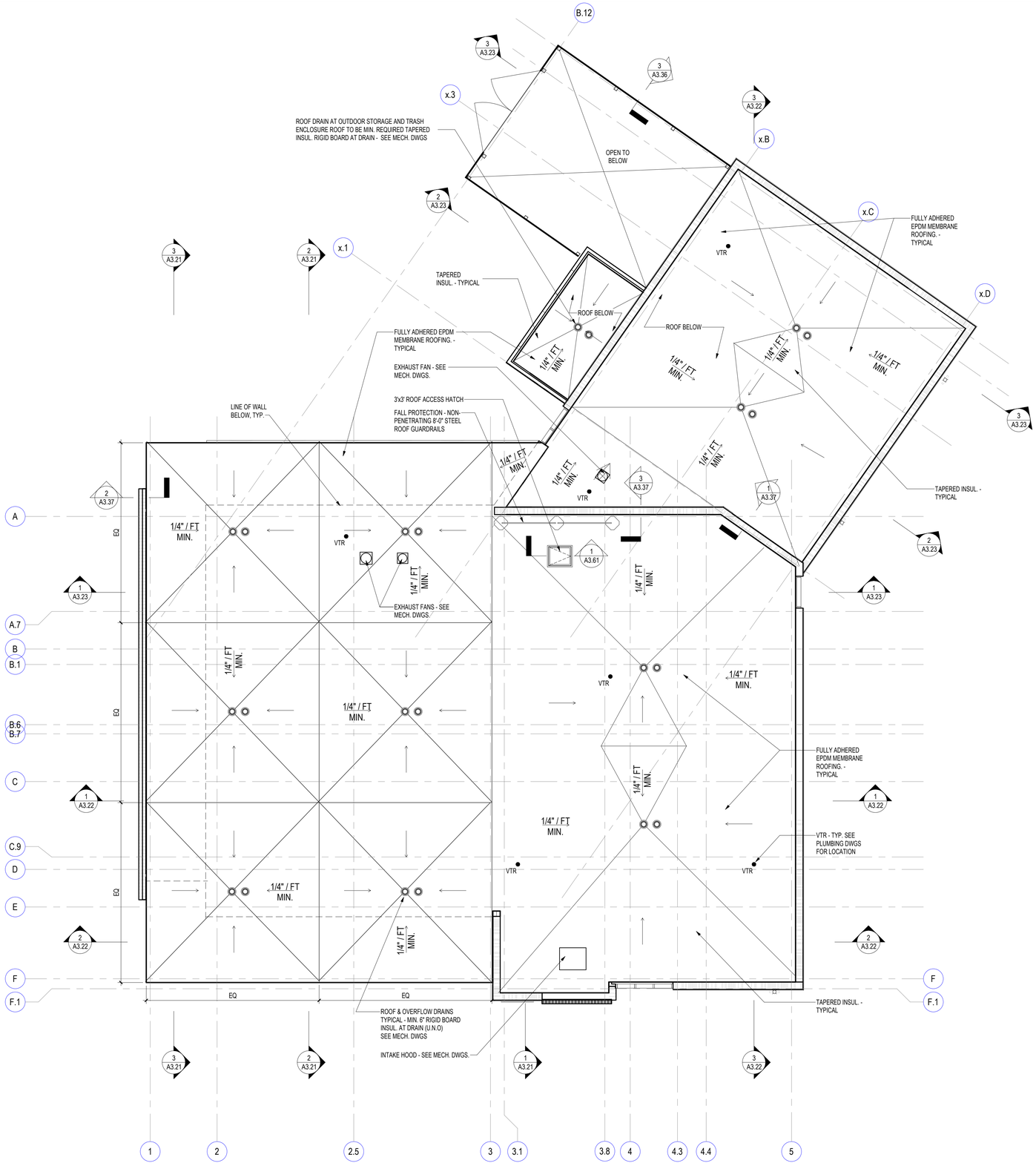
Sheet A2.12

10/14/2024 4:07:47 PM

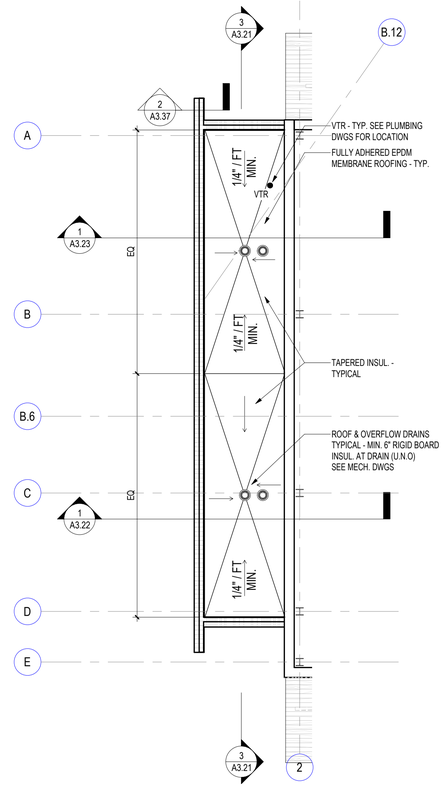
GENERAL NOTES - ROOF

1. VERIFY LOCATION OF ROOF PENETRATION W/ MECHANICAL & PLUMBING DRAWINGS.
2. ALL AREAS TO BE FLAT STEEL DECK WITH TAPERED INSULATION
3. ALL TAPERED INSULATION SHALL HAVE MIN. 1/4" PER FOOT
4. SOLAR PANELS NOT SHOWN FOR CLARITY
5. SEE G0.02 - SHEET INDEX FOR GENERAL PROJECT NOTES, LEGENDS AND ABBREVIATIONS.



2 ROOF PLAN

Scale: 1/8" = 1'-0"



1 ROOF PLAN - LOW ROOF

Scale: 1/8" = 1'-0"

0 4' 8' 16'

PROJECT TRUE 30°

T C A
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
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LICENSED ARCHITECT

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Design Development	05/26/23

Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

ROOF PLAN

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Sheet A2.13

10/14/2024 4:24:27 PM

DOOR SCHEDULE

	DOOR								FRAME				DETAILS				
MARK	WIDTH	HEIGHT	THICKNESS	TYPE	MATERIAL	FINISH	GLAZING	LABEL	TYPE	MATERIAL	FINISH	GLAZING	HEAD	JAMB	SILL	REMARKS	HARDWARE SET
101A	3' - 0"	7' - 0"	1 3/4"	E	ALUM	FAC	(T/I)		--	ALUM	FAC	(T/I)	5/A3.43	---	9/A2.22	3, 4	AL1
101B	3' - 0"	7' - 0"	1 3/4"	E	ALUM	FAC	(T)		5	ALUM	FAC	(T)	7/A2.22	8/A2.22	1/A2.22		AL2
102A	3' - 0"	7' - 0"	1 3/4"	E	ALUM	FAC	(T)		7	ALUM	FAC	(T)	7/A2.22	8/A2.22	---	3	AL3
103A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		01
104A	3' - 0"	7' - 0"	1 3/4"	D	WD	FAC	(T)		2	HM	PAINT	(T)	4/A2.22	2/A2.22	1/A2.22		02
104B	3' - 0"	7' - 0"	1 3/4"	E	ALUM	FAC	(T)		--	ALUM	FAC	(T)	7/A2.22	8/A2.22	1/A2.22	3, 5, 6	AL4
105A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	1/A2.22		03
106A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		04
107A	3' - 0"	7' - 0"	1 3/4"	D	WD	FAC	(T)		2	HM	PAINT	(T)	4/A2.22	2/A2.22	1/A2.22		05
108A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		06
109A	3' - 6"	7' - 0"	1 3/4"	E	ALUM	FAC	(T/I/TR)		--	ALUM	FAC	(T/I/TR/ISP)	---	5/A3.41	9/A2.22	3, 4	AL1
109B	3' - 6"	7' - 0"	1 3/4"	D	HM	PAINT	(T/I)		2	HM	PAINT	(T/I)	4/A2.22	2/A2.22	---	7	07
112A	3' - 0"	7' - 0"	1 3/4"	E	ALUM	FAC	(T/I)		6	ALUM	FAC	(T/I)	7/A2.22	8/A2.22	---	7	AL5
116A	14' - 0"	14' - 0"	2"	F	STL	FAC	(T/I)		-	STL	PAINT	-	3/A3.43	2/A3.41	5/A2.22		-
116B	14' - 0"	14' - 0"	2"	F	STL	FAC	(T/I)		-	STL	PAINT	-	3/A3.43	2/A3.41	5/A2.22		-
116C	14' - 0"	14' - 0"	2"	F	STL	FAC	(T/I)	-	-	STL	PAINT	-	3/A3.43	2/A3.41	5/A2.22		-
116D	14' - 0"	14' - 0"	2"	F	STL	FAC	(T/I)	-	-	STL	PAINT	-	3/A3.43	2/A3.41	5/A2.22		-
116H	3' - 0"	7' - 0"	1 3/4"	E	ALUM	FAC	(T/I)		--	ALUM	FAC	(T/I)	---	---	9/A2.22	3, 4	AL1
117A	3' - 0"	7' - 0"	1 3/4"	A	HM	PAINT	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		04
119A	3' - 6"	7' - 0"	1 3/4"	A	HM	PAINT	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		08
120A	3' - 0"	7' - 0"	1 3/4"	A	HM	PAINT	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		04
121A	3' - 6"	7' - 0"	1 3/4"	B	HM	PAINT	-		3	HM	PAINT	-	4/A2.22	2/A2.22	---	1, 2	09
122A	3' - 0"	7' - 0"	1 3/4"	C	HM	PAINT	(T)		1	HM	PAINT	(T)	4/A2.22	2/A2.22	---		04
123A	3' - 0"	7' - 0"	1 3/4"	C	HM	PAINT	(T)		1	HM	PAINT	(T)	4/A2.22	2/A2.22	---		10
123B	3' - 0"	7' - 0"	1 3/4"	D	HM	PAINT	(T)		1	HM	PAINT	-	4/A2.22	2/A2.22	---		10
124A	3' - 6"	7' - 0"	1 3/4"	D	HM	PAINT	(T)		1	HM	PAINT	-	4/A2.22	2/A2.22	---		10
125A	3' - 6"	7' - 0"	1 3/4"	D	HM	PAINT	(T)		4	HM	PAINT	(T)	4/A2.22	2/A2.22	---		08
126A	3' - 0"	7' - 0"	1 3/4"	A	HM	PAINT	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		06
127A	3' - 0"	7' - 0"	1 3/4"	E	ALUM	FAC	(T/I)		--	ALUM	FAC	(T/I)	5/A3.43 SIM	16/A2.22	9/A2.22 SIM	4	AL6
130A	3' - 6"	7' - 0"	1 3/4"	D	HM	PAINT	(T/I)		2	HM	PAINT	(T/I)	14/A2.22	15/A2.22	3/A2.22		11
130B	10' - 0"	10' - 0"	1 3/4"	G	ALUM	FAC	(T/I)		--	ALUM	FAC	(T/I)	2/A3.43	6/A3.41	1/A3.34		-
131A	3' - 6"	7' - 0"	1 3/4"	A	HM	PAINT	-		1	HM	PAINT	-	10/A2.22	11/A2.22	9/A2.22 SIM		12
135A	4' - 0"	7' - 0"	1 3/4"	A	HM	PAINT	-		1	HM	PAINT	-	12/A2.22	13/A2.22	9/A2.22 SIM		13
136A	3' - 0"	7' - 0"	1 3/4"	A1	HM	PAINT	-		3	HM	PAINT	-	12/A2.22	13/A2.22	9/A2.22 SIM	1	14
201A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		10
202A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		04
203A	4' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		15
205A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		16
206A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		16
207A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		16
208A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-	20 MIN.	1	HM	PAINT	-	4/A2.22	2/A2.22	---		17
209A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-	20 MIN.	1	HM	PAINT	-	4/A2.22	2/A2.22	---		17
210A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-	20 MIN.	1	HM	PAINT	-	4/A2.22	2/A2.22	---		17
211A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-	20 MIN.	1	HM	PAINT	-	4/A2.22	2/A2.22	---		17
212A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-	20 MIN.	1	HM	PAINT	-	4/A2.22	2/A2.22	---		17
213A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-	20 MIN.	1	HM	PAINT	-	4/A2.22	2/A2.22	---		17
215A	3' - 0"	7' - 0"	1 3/4"	E	ALUM	FAC	(T)		5	ALUM	FAC	(T)	7/A2.22	8/A2.22	---		AL2
217A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		08
218A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---	3	18
219A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---	3	18
221A	3' - 0"	7' - 0"	1 3/4"	A	WD	FAC	-		1	HM	PAINT	-	4/A2.22	2/A2.22	---		08

DOOR SCHEDULE KEY

DOOR & FRAME DESIGNATIONS	
WD	SOLID CORE WOOD
HM	HOLLOW METAL
MTL	METAL
STL	STEEL
ALUM	ALUMINUM
FAC	FACTORY FINISH
PAINT	PAINTED
-	-
-	-

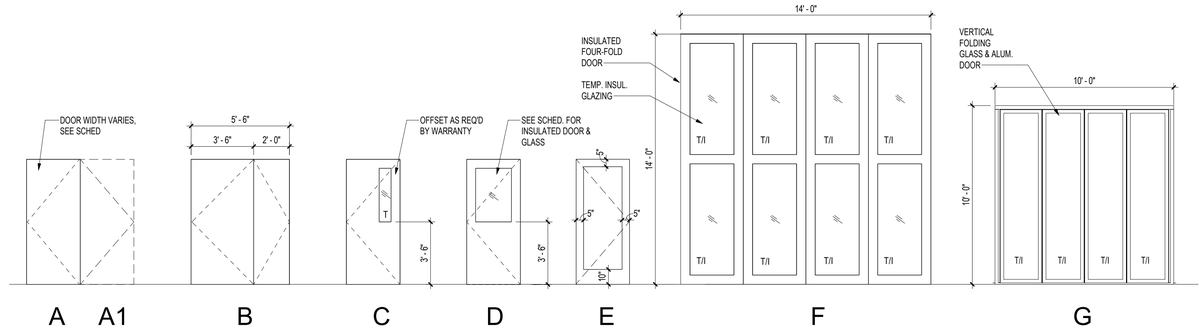
GLAZING DESIGNATIONS	
T	TEMPERED
I	INSULATED
F	FIRE RATED
TR	TRANSLUCENT
SP	SPANDREL PANEL
-	-
-	-
-	-
-	-

DOOR SCHEDULE REMARKS
1. PAIR OF DOORS
2. SMALL LEAF 2'-0"
3. CARD READER
4. SEE EXTERIOR ELEVATIONS FOR FRAME
5. SEE INTERIOR ELEVATIONS FOR FRAME
6. APPLY FROSTED FILM TO WINDOW AND DOOR - SEE INTERIOR ELEVATIONS
7. INSULATED DOOR AND GLASS

DOOR SCHEDULE GENERAL NOTES:
-FILL ALL FRAMES WITH MINERAL WOOL
-REFER TO PROJECT MANUAL FOR HARDWARE SPECIFICATIONS AND SCHEDULE

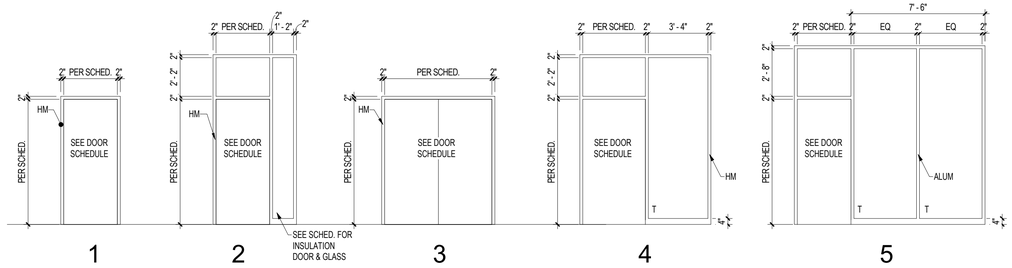
GENERAL NOTES - DOORS

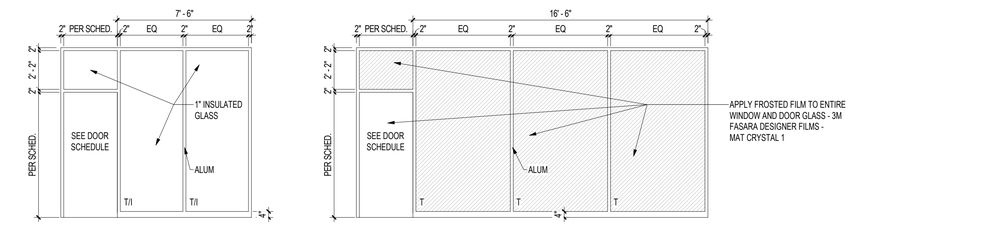
1. ALL SWING DOORS TO BE 1 3/4" THICK UNLESS NOTED OTHERWISE.
2. ALL DOORS SHALL BE 3/4" UNDERCUT (TYPICAL) EXCEPT WHERE THERE IS A BOTTOM FRAME/THRESHOLD OR SPECIALLY NOTED OTHERWISE.
3. GLAZING NOTES ON DOOR SCHEDULE IS FOR THE DOOR AND BORROWED LIGHT IN THE FRAME TYPICAL.
4. SEE SPECIFICATIONS FOR GLAZING TYPES AND INFORMATION.
5. GLAZING TO BE FREE OF STAMPS, MARKINGS, ETC. UNLESS REQUIRED BY CODE TO IDENTIFY A RATING.
6. GLAZING STOPS ON BORROWED LIGHTS SHALL BE LOCATED ON THE ROOM SIDE OF THE FRAME. BUTT JOINT ALL GLAZING STOP TIGHT TO FRAME FOR A CLEAN, FINISHED APPEARANCE.
7. CAULK PERIMETER OF DOOR AND WINDOW FRAMES TO THE WALL. MATCH FRAME COLOR.
8. CAULK EDGES AND VOIDS ALONG WINDOW STOPS OF HOLLOW MENTAL FRAMES PRIOR TO PAINTING TO PROVIDE A CLEAN FINISHED APPEARANCE.
9. ALL LABELS ON RATED DOORS TO BE FREE OF PAINT AND CLEARLY VISIBLE UPON INSPECTION.
10. SEE ELECTRICAL DRAWING FOR OPENINGS THAT REQUIRE POWER AND / OR DATA CONNECTIONS.



1 DOOR TYPES LEGEND

Scale: 1/4" = 1'-0"





2 FRAME TYPES

Scale: 1/4" = 1'-0"

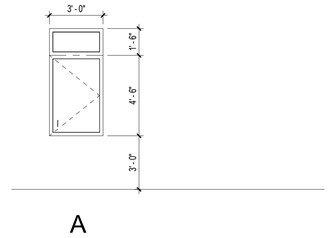
OPENING COVERING SCHEDULE KEY

TYPE 1	BLACK-OUT SOLAR SHADE
TYPE 2	SOLAR SHADE 1% OPENNESS
TYPE 3	SOLAR SHADE 3% OPENNESS

OPENING COVERING SCHEDULE GENERAL NOTES:
1. INTERIOR WINDOW COVERINGS REQUIRED AT ALL EXTERIOR GLAZING ASSOCIATED WITH DOOR AND FRAME TYPES U.N.O. INCLUDING: DOORS, TRANSOMS, WINDOWS AND SIDELITES.
2. SEE EXTERIOR AND INTERIOR ELEVATIONS FOR WINDOW AND FRAME TYPES AND FOR FURTHER NOTES.
3. NO MOTORIZED, ALL MANUAL.

OPENING COVERING SCHEDULE:

ROOM NUMBER	OPENING COVERING TYPE	NUMBER OF WINDOWS
104	2	3
107	3	1
127/128	3	WHOLE WINDOW SYSTEM & DOOR
208	1	1
209	1	1
210	1	1
211	1	1
212	1	1
213	1	1



3 WINDOW TYPES

Scale: 1/4" = 1'-0"

TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23
Design Development	05/26/23

Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

DOOR SCHEDULE, DOOR & FRAME TYPES

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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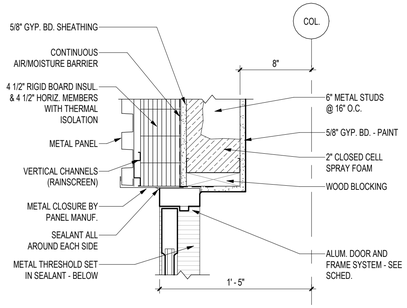
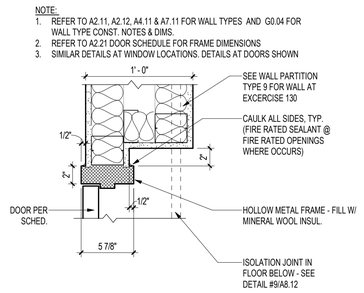
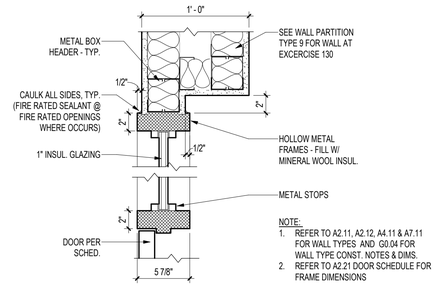


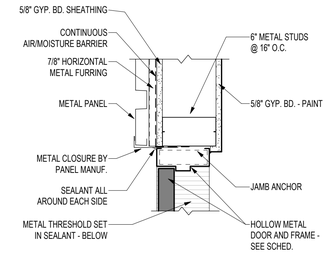
16 JAMB DETAIL
Scale: 1 1/2" = 1'-0"



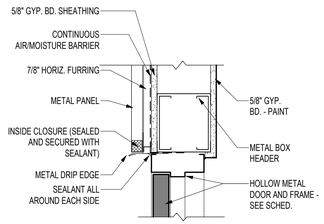
15 JAMB DETAIL
Scale: 1 1/2" = 1'-0"



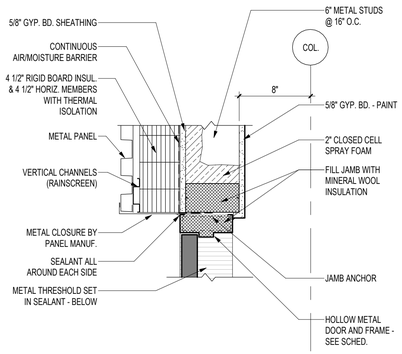
14 HEAD DETAIL
Scale: 1 1/2" = 1'-0"



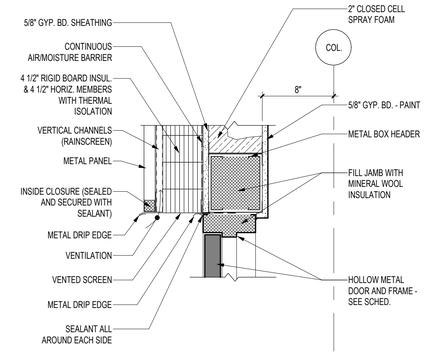
13 JAMB DETAIL
Scale: 1 1/2" = 1'-0"



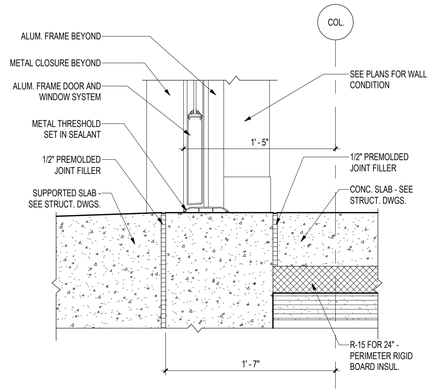
12 HEAD DETAIL
Scale: 1 1/2" = 1'-0"



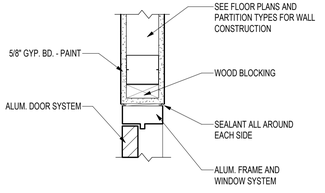
11 JAMB DETAIL
Scale: 1 1/2" = 1'-0"



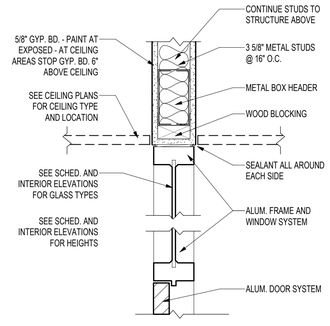
10 HEAD DETAIL
Scale: 1 1/2" = 1'-0"



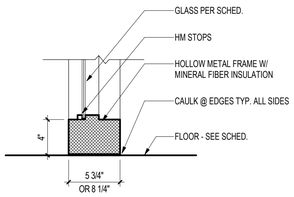
9 SILL DETAIL
Scale: 1 1/2" = 1'-0"



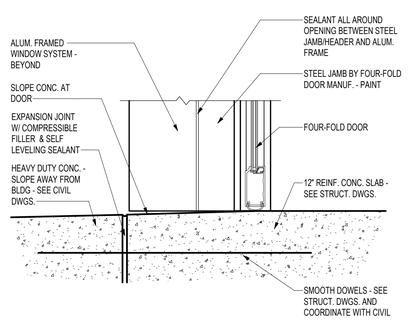
8 INT. ALUM. JAMB
Scale: 1 1/2" = 1'-0"



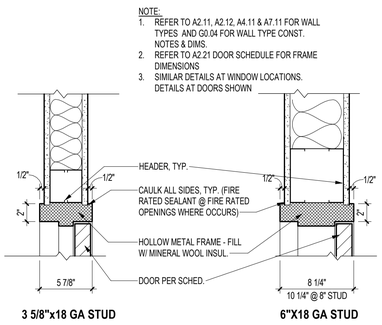
7 INT. ALUM. HEAD
Scale: 1 1/2" = 1'-0"



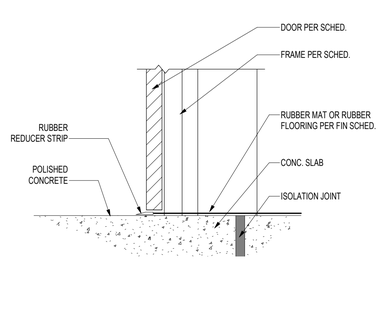
6 INT. HM. SILL
Scale: 1 1/2" = 1'-0"



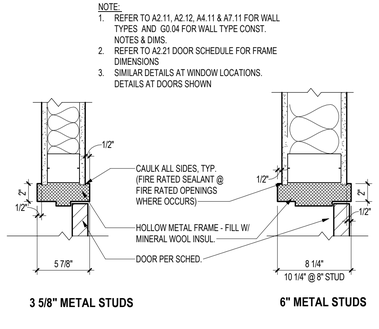
5 BAY DOOR THRESHOLD
Scale: 1 1/2" = 1'-0"



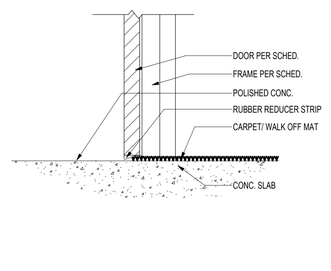
4 INT. HM HEAD
Scale: 1 1/2" = 1'-0"



3 THRESHOLD TRANSITION DETAIL
Scale: 1 1/2" = 1'-0"



2 INT. HM JAMB
Scale: 1 1/2" = 1'-0"



1 THRESHOLD DETAIL
Scale: 1 1/2" = 1'-0"

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TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23

Drawn: KJ/FEA Checked: FEA

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

INTERIOR DOOR & WINDOW DETAILS

A3C
COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
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T: (734) 663 - 1910
F: (866) 732 - 2168
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Sheet A2.22

FINISH SCHEDULE

ROOM		FLOOR		NORTH/NE WALL		EAST/SE WALL		SOUTH/SW WALL		WEST/NW WALL		CEILING		
NUMBER	NAME	TYPE	BASE	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	REMARKS
101	VEST	CPT2	RUB4	GWB & WPS2	PT & FF	SF	FF	SF	FF	SF	FF	WPS1	FF	6
102	LOBBY	PC	---	GWB	PT2	GWB & WPS2 / SF	PT & FF	SF	FF	SF	FF	WPS1	FF	6
103T	PUBLIC RESTROOM	PC	CTB1	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	GWB	PT3	
104	MEETING ROOM	CPT1	RUB4	GWB	PT	GWB	WPS2	GWB	PT2	SF	FF	ACT	FF	6
105	STOR.	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	ACT	FF	
106	JAN	PC	RUB4	GWB	PT	WRGWB	PT	WRGWB	PT	GWB	PT	GWB	PT3	
107	OFFICE	CPT1	RUB4	GWB	PT2	GWB	PT	GWB	PT	GWB	PT	ACT	FF	
108T	STAFF RESTROOM	PC	CTB1	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	GWB	PT3	
109	HALL	PC	RUB4	--	--	--	--	GWB	PT	SF	FF	WPS1	FF	
110	HALL	PC	RUB4	--	--	GWB	PT	--	--	GWB	PT	WPS1	FF	
111	HALL	PC	RUB4	GWB	PT	GWB	PT	GWB	PT			WPS1	FF	
112	HALL	PC	RUB4	GWB	PT			GWB	PT	SF	FF	WPS1	FF	
113	FF WORK AREA	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	ACT	FF	
114	ELEV	-	-	-	-	-	-	-	-	-	-	-	-	
115	FIRE POLE	PC	RUB4	GWB	PT	GWB	PT	--	--	SF	FF	WPS1	FF	
116	APP BAY	PC-2	CTB2	WRGWB/CT4	PT/FF	WRGWB/CT4	PT/FF	WRGWB/CT4	PT/FF	WRGWB/CT4	PT/FF	EXP	PT3	8
116A	ALCOVE	PC	CTB2	CT4	FF	CT4	FF	CT4	FF			GWB	PT3	
116B	WASH ALCOVE	PC	CTB2	CT4	FF	--	--	CT4	FF	CT4	FF	BB	EP	
116C	ALCOVE	PC	CTB2	CT4	FF	CT4	FF	--	--	CT4	FF	GWB	PT3	
117	WATER SERVICE	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	EXP	--	
118	HOSE ALCOVE	PC	CTB2	CT4	FF	CT4	FF	CT4	FF	CT4	FF	GWB	PT3	5
119	SHOP	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	GWB	PT3	
120	COMPRESSOR	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	GWB	PT3	
121	SCBA	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	GWB	PT3	
122	EMS STORAGE	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	GWB	PT3	
123	DECON	PC	CB4	FRWC	FF	FRWC	FF	FRWC	FF	FRWC	FF	BB	EP	
124	CLEANING	PC	CB4	FRWC	FF	FRWC	FF	FRWC	FF	FRWC	FF	BB	EP	
125	TURNOUT GEAR	PC	CB4	FRWC	FF	FRWC	FF	FRWC	FF	FRWC	FF	BB	EP	
126T	BAY TOILET	PC	CB4	FRWC	FF	FRWC	FF	FRWC	FF	FRWC	FF	BB	EP	
127	DINING	PC	RUB4	--	--	GWB	PT	WPS4	FF	--	--	GWB	PT3	4
128	KITCHEN	PC	RUB4	GWB/CT1	PT/FF	GWB/CT1	PT/FF	--	--	--	--	GWB/WPS2	PT3/FF	
129	DAYROOM	PC	RUB4	GWB	PT2	GWB	PT	GWB	PT	GWB	PT	GWB/WPS3	PT3/FF	
130	EXERCISE	ATH	RUB4	HGWB	PT2	HGWB	PT	HGWB	PT	HGWB	PT	EXP	PT3	8
131	ELEC	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	EXP	--	
135	OUTDOOR STORAGE	PC	RUB4	HGWB	PT	HGWB	PT	HGWB	PT	HGWB	PT	EXP	-	
136	TRASH ENCLOSURE	PC	RUB4	HGWB	PT	HGWB	PT	HGWB	PT	HGWB	PT	EXP	-	
201	LNDRY	PC	RUB4	WRGWB	PT	WRGWB	PT	WRGWB	PT	WRGWB	PT	GWB	PT3	
202	CUSTODIAL	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	GWB	PT3	
203	MECH	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	EXP	--	
204	HALL	PC	RUB4	GWB	PT2	--	--	GWB	PT	GWB	PT	GWB	PT3	
205T	ADA TLT / SHWR	PC/CT3	CTB1	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	GWB	PT3	
206T	ADA TLT / SHWR	PC/CT3	CTB1	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	GWB	PT3	
207T	TLT / SHWR	PC/CT3	CTB1	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	WRGWB/CT2	PT/FF	GWB	PT3	
208	SLEEP RM	PC	RUB4	GWB	PT2	GWB	PT2	GWB	PT	GWB	PT	ACT	FF	
208A	ALCOVE	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	WPS1	FF	
209	SLEEP RM	PC	RUB4	GWB	PT2	GWB	PT	GWB	PT	GWB	PT	ACT	FF	
209A	ALCOVE	PC	RUB4	GWB	PT	GWB	PT2	GWB	PT	GWB	PT	WPS1	FF	
210	SLEEP RM	PC	RUB4	GWB	PT2	GWB	PT	GWB	PT	GWB	PT	ACT	FF	
210A	ALCOVE	PC	RUB4	GWB	PT	GWB	PT2	GWB	PT	GWB	PT	WPS1	FF	
211	SLEEP RM	PC	RUB4	GWB	PT2	GWB	PT	GWB	PT	GWB	PT	ACT	FF	
211A	ALCOVE	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	WPS1	FF	
212	SLEEP RM	PC	RUB4	GWB	PT2	GWB	PT	GWB	PT	GWB	PT	ACT	FF	
212A	ALCOVE	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	WPS1	FF	
213	SLEEP RM	PC	RUB4	GWB	PT2	GWB	PT	GWB	PT	GWB	PT	ACT	FF	
213A	ALCOVE	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	WPS1	FF	
214	ELEV	-	-	-	-	-	-	-	-	-	-	-	-	
215	FIRE POLE	PC	RUB4	GWB	PT2	GWB	PT	GWB	PT	GWB	PT	WPS1	FF	
216	HALL	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	WPS1	FF	
217	OPER STOR	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	GWB	PT3	
218	IT/SERVER	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	GWB	PT3	
219	SUB-ELEC	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	GWB	PT3	
220	HALL	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	WD	FF	
221	STOR.	PC	RUB4	GWB	PT	GWB	PT	GWB	PT	GWB	PT	GWB	PT3	
S-1-1	STAIR 1	-	-	-	-	-	-	-	-	PP1	FF	-	-	7
S-1-2	STAIR 1	-	-	-	-	-	-	-	-	PP1	FF	WPS1	FF	7
S-2-1	STAIR 2	-	-	WPS4	FF	-	-	GWB	PT	-	-	-	-	4
S-2-2	STAIR 2	-	-	GWB	PT2	-	-	GWB	PT	GWB	PT	WPS1	FF	

FINISH SCHEDULE KEY

FLOOR		WALL/ WAINSCOT		CEILING	
PC	POLISHED CONC.	GWB	GYPSUM WALL BD.	GWB	GYPSUM WALL BD.
PC2	POLISHED CONC. W/ PETROTEX	HGWB	IMPACT RESISTANT GYPSUM WALL BD.	ACT	SUSPENDED ACOUSTIC CEILING TILE
		WRGWB	WATER RESISTANT GYPSUM WALL BD	EXP	EXPOSED TO STRUCTURE
				BB	BACKER BOARD
				FINISHES	
BASE				PT	PAINT
RUB4	4" RUBBER BASE			FF	FACTORY FINISH
CTB	CERAMIC TILE	CT	CERAMIC TILE WAINSCOT (VERIFY HEIGHT W/ INT. ELEV. & SECTIONS)	EP	EPOXY PAINT
CB4	FIBER REINFORCED BASE				
		SF	STOREFRONT	CASEWORK	
				SLDS	SOLID SURFACE
		FRWC	FIBERGLASS FABRIC-REINFORCED RESINOUS WALL SYSTEM	PL	PLASTIC LAMINATE

FINISH SCHEDULE REMARKS:

1. SEE INTERIOR ELEVATIONS AND PLANS FOR EXTENT OF CERAMIC TILE
2. SEE INTERIOR ELEVATIONS AND PLANS FOR TACK AND MARKERBOARD LOCATIONS, TYP.
3. INCLUDES W.R. GWB. REFER TO INT. ELEV. & SECTIONS FOR EXTENT.
4. WOOD SLAT ACCENT WALL SYSTEM (SIMILAR TO WOOD CEILING AND WALL SYSTEMS) - SEE INTERIOR ELEVATIONS
5. CERAMIC TILE TO 10'-0" FROM F.F.
6. WOOD WALL SYSTEM (SIMILAR TO WOOD CEILING SYSTEM) - PAINT GWB BLACK BEHIND WOOD SYSTEM.
7. PHENOLIC RESIN VERTICAL WALL PANEL ON INTERIOR - SAME PANEL USED ON EXTERIOR.
8. PAINT ALL EXPOSED STEEL - EXPOSED COLUMNS AND EXPOSED CEILING AREAS.

FINISH SCHEDULE GENERAL NOTES:

1. SEE REFLECTED CEILING PLANS FOR CEILING HEIGHTS
2. SEE DETAILS FOR BACKER BOARD LOCATIONS
3. SEE SHEET A2.42 FINISH PLANS FOR FURTHER INFORMATION

APPLIANCE SCHEDULE

CONTRACTOR FURNISHED / CONTRACTOR INSTALLED

CLEANING 124

WASHER-EXTRACTOR -
UNIMAC UWT045N2, 45 LB CAPACITY
(VERIFY THICKENED SLAB LOCATION & POSITION OF WASHER)
(45.3" d. x 64.7" h. x 34.1" w.)

WASHER (STACKABLE) -
WHIRLPOOL WHD5605MW, 4.5 CU. FT., FRONT LOAD, WHITE
(31.5625" d. x 38.625" h. x 27" w.)

DRYER (STACKABLE) -
WHIRLPOOL WHD560CHW, 7.4 CU. FT., VENTLESS, FRONT LOAD, WHITE
(31" d. x 38.8125" h. x 27" w.)

KITCHEN 128

REFRIGERATOR (PROVIDE 3) -
LG BOTTOM FREEZER LRDCS2603S, 26 CU. FT., STAINLESS STEEL FINISH
NO WATER LINE PROVIDED. NO ICE MACHINE REQUIRED. KIT TO REMOVE ICE MAKER.
(34.88 d. (W/HANDLES) x 69.88" h. x 32.75" w.)

RANGE (IN ISLAND) -
BOSCH HIS8655U, 800 SERIES INDUCTION, 36" SLIDE-IN, STAINLESS STEEL FINISH
(24.875" d. x 35.9375" h. x 36" w.)

RANGE HOOD -
GREENHECK QRRS, 36" WIDE, FIRE READY RANGE HOOD
(SEE MECHANICAL DRAWINGS FOR MORE INFORMATION)
(23.5" d. x 12.5" h. x 36" w.)

ICE MACHINE -
EDGESTAR IB250SSOD, 15 INCH WIDE, UNDERCOUNTER, STAINLESS STEEL FINISH
(20.06" d. x 33.31" h. x 14.88" w.)

COFFEE MAKER -
BUNN 38700.0011, AXIOM DV-TC, PROVIDE (2) 64oz THERMAL CARAFE PORTABLE SERVERS
(22.5" d. x 17.8" h. x 9" w.)

DISHWASHER -
BOSCH SHXN8U55UC, 24" WIDE, UNDERCOUNTER, STAINLESS STEEL FINISH
(23.75" d. x 33.875"-35" h. x 23.5625" w.)

MICROWAVE (ON COUNTER) -
GE PROFILE PES7227SLSS, 2.2 CU. FT., STAINLESS STEEL
(19.75" d. x 14" h. x 24.125" w.)

LAUNDRY 201

WASHER -
WHIRLPOOL WHD5605MW, 4.5 CU. FT., FRONT LOAD, WHITE
(31.5625" d. x 38.625" h. x 27" w.)

DRYER (PROVIDE 2) -
WHIRLPOOL WHD560CHW, 7.4 CU. FT., VENTLESS, FRONT LOAD, WHITE
(31" d. x 38.8125" h. x 27" w.)

EQUIPMENT SCHEDULE

HOSE ALCOVE 118

MOBILE HOSE DRYER – READY RACK, MHD-80 (80"X33"X88"), CF/CI
HEAVY DUTY MOBILE HOSE & CYLINDER SYSTEM – GEAR GRID CORP, (75" W. X 26.5" D. X 82" H.), CF/CI

SHOP 119

METAL SHELVING UNITS (2) – BURROUGHS - SKU: RCO6-36187-065 - CF/CI
WORK BENCH – HUSKY 8FT ADJUSTABLE HEIGHT SOLID WOOD TOP WORKBENCH - 96" W. X 24" D X 42" H - CF/CI
FLAMMABLE LIQUIDS CABINET – OF/OI

SCBA 121

MODULAR BREATHING AIR CENTER – MAKO, BAM06H WITH SCFS3-4HP, (45.5" D. X 86" W. X70" H.)

TURNOUT GEAR 125

LOCKERS – GEAR GRID, FIRE STATION WALL MOUNT, TOP SIDE STORAGE, (24" W. X 20" D. X 72"H.) – CF/CI
LOCKERS – GEAR GRID, FIRE STATION TUBULAR FRAME WALL WITH 4 LOCKERS - (24" W. X 20" D. X 72" H.) EACH SIDE, TOP SIDE STORAGE – CF/CI
AIR GEAR DRYER – RAM AIR TG-4 (72.2" W. X 28" D. X 77.8" H.)

FINISH KEY

CODE	MATERIAL	MANUFACTURER	STYLE	COLOR	SIZE	MANF. CODE	NOTES
ACT	ACOUSTICAL CEILING TILE	ARMSTRONG	ULTIMA	WHITE	24"X24"X3/4"	1911	WHITE, PRELUDE 15/16" BEVELED TEGULAR
ATH	ATHLETIC FLOORING	TARKETT	INTERIA	LUNAR EXPLORER	24"X24"X3/8	LD7	
CPT1	CARPET TILE	SHAW CONTRACT	REVERSE TILE 5T069	VISTA	24"X24"	69481	MONOLITHIC PATTERN
CPT2	CARPET TILE	MANNINGTON	RUFFIAN II	EBONY EARTH	24"X24"	1506	ENTRY MAT
CT1	CERAMIC TILE	DALTILE	MESMERIST	CHARM	3"X12"	MM32	
CT2	CERAMIC TILE	DALTILE	MESMERIST	SPIRIT	3"X12"	MM30	
CT3	CERAMIC TILE	DALTILE	COLORWHEEL	MATTE DESERT GRAY	2"X2"	X714	SHOWER FLOOR
CT4	CERAMIC TILE	DALTILE	PORTFOLIO	DOVE GREY	12"X24"	PF04	STAGGERED PATTERN
CTB1	CERAMIC TILE BASE	DALTILE	MESMERIST	SPIRIT	3"X6"	MM30	SOLDIER COURSE
CTB2	CERAMIC TILE BASE	DALTILE	PORTFOLIO	DOVE GREY	6"X12"	PF04/P36C9	
FRWC	FIBER REIN. WALL SYSTEM	TNEMEC		ACROPOLIS		08WH	
PL1	PLASTIC LAMINATE	WILSONART		BEIGEWOOD		7850	
PL2	PLASTIC LAMINATE	WILSONART		WHITE TIGRIS		4783-60	
PT1	PAINT	SHERWIN WILLIAMS	EGG SHELL	NATURAL WHITE		SW9542	
PT2	PAINT	SHERWIM WILLIAMS	EGG SHELL	BEDROCK		SW9563	
PT3	PAINT	SHERWIM WILLIAMS	LATEX,FLAT	CEILING WHITE		SW7007	
PP1	PHENOLIC PANELS	TRESPA PURA NFC		CLASSIC OAK		PU02	
RUB4	RUBBER BASE	ROPPE	700 SERIES, COVED	GALACTIC	4"	667	
SS1	SOLID SURFACE	WILSONART		MOON GEYSER		9209CM	
SS2	SOLID SURFACE	WILSONART		WHISPER WHITE		9237SS	
WPS1	WOOD PANEL SYSTEM	9WOOD LINEAR	WESTERN HEMLOCK	MAPLE STAIN	5 1/4" W	2116-2	SEE CLG. PLANS & CLG. DETAILS
WPS2	WOOD PANEL SYSTEM	9WOOD LINEAR	WESTERN HEMLOCK	MAPLE STAIN	1 3/8" W	2112-6	SEE CLG. PLANS, CLG. DETAILS & INT. ELEV.
WPS3	WOOD PANEL SYSTEM	9WOOD GRILLE	WESTERN HEMLOCK	MAPLE STAIN	1 3/8"WX3.5"D	1124-4	SEE CLG. PLANS & CLG. DETAILS
WPS4	WOOD PANEL SYSTEM	9WOOD SLAT WALL	WESTERN HEMLOCK	MAPLE STAIN	1 3/8"WX3.5"D		SEE WALL SECTIONS

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ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23
Design Development	05/26/23

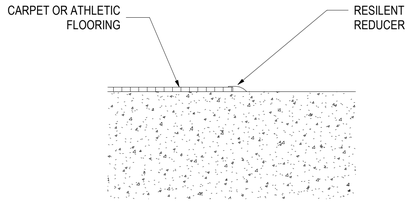
Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

INTERIOR FINISH SCHEDULE & KEY

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet A2.41



3 T1 FLOOR TRANSITION

Scale: 3" = 1'-0"

LEGEND

- PAINTED AREA
- PT# — PAINT TAG
- T# — FLOOR TRANSITION

GENERAL NOTES

1. REFER TO INTERIOR ELEVATIONS FOR PT1 & PT2
2. IF A PAINT COLOR IS NOT SPECIFIED FOR A WALL THEN THE WALL IS PT1, REFER TO FINISH SCHEDULE

2 LEVEL 2 FINISH PLAN

Scale: 3/32" = 1'-0"

1 LEVEL 1 FINISH PLAN

Scale: 3/32" = 1'-0"

TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date

Drawn: KLJ Checked: FEA

City of Ann Arbor
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ANN ARBOR, MI 48104

FINISH PLANS

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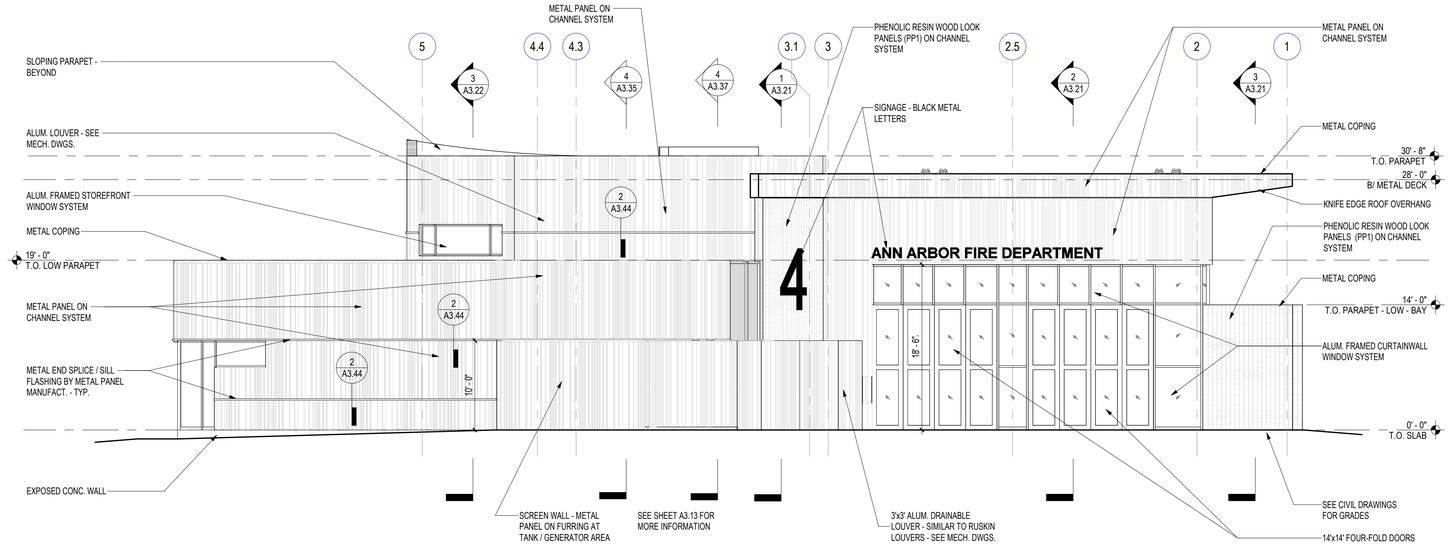
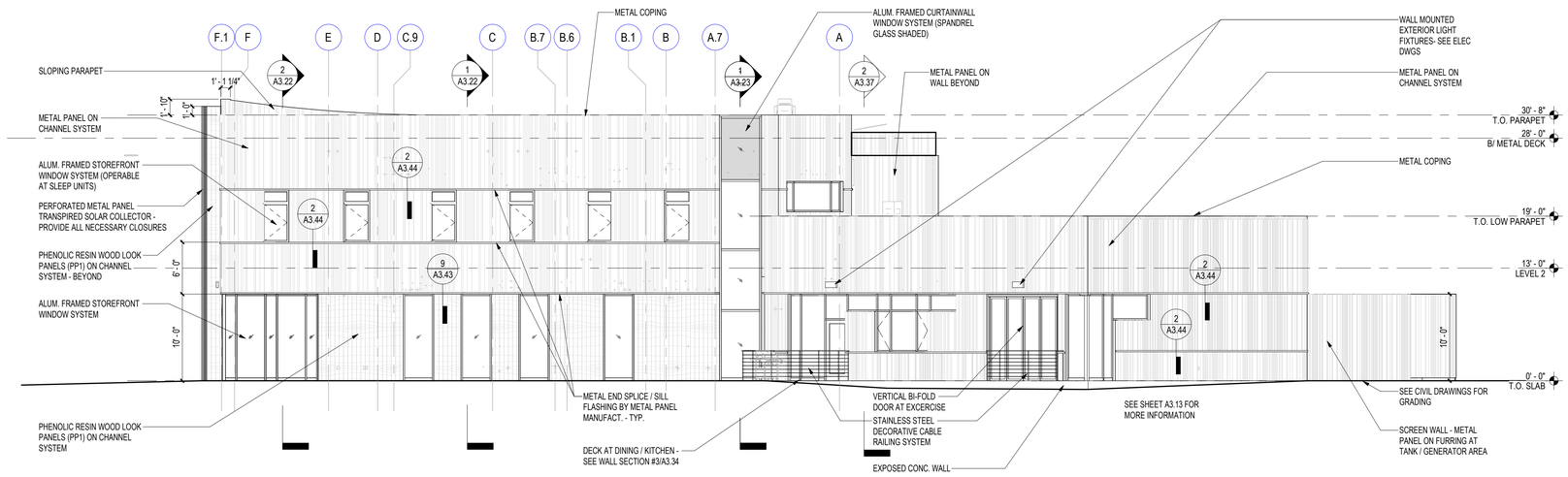


2 NORTH ELEVATION
Scale: 1/8" = 1'-0"



1 EAST ELEVATION
Scale: 1/8" = 1'-0"

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Site Plan Approval	11/22/22
Site Plan Approval	09/22/22

Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
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EXTERIOR ELEVATIONS

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Sheet A3.11

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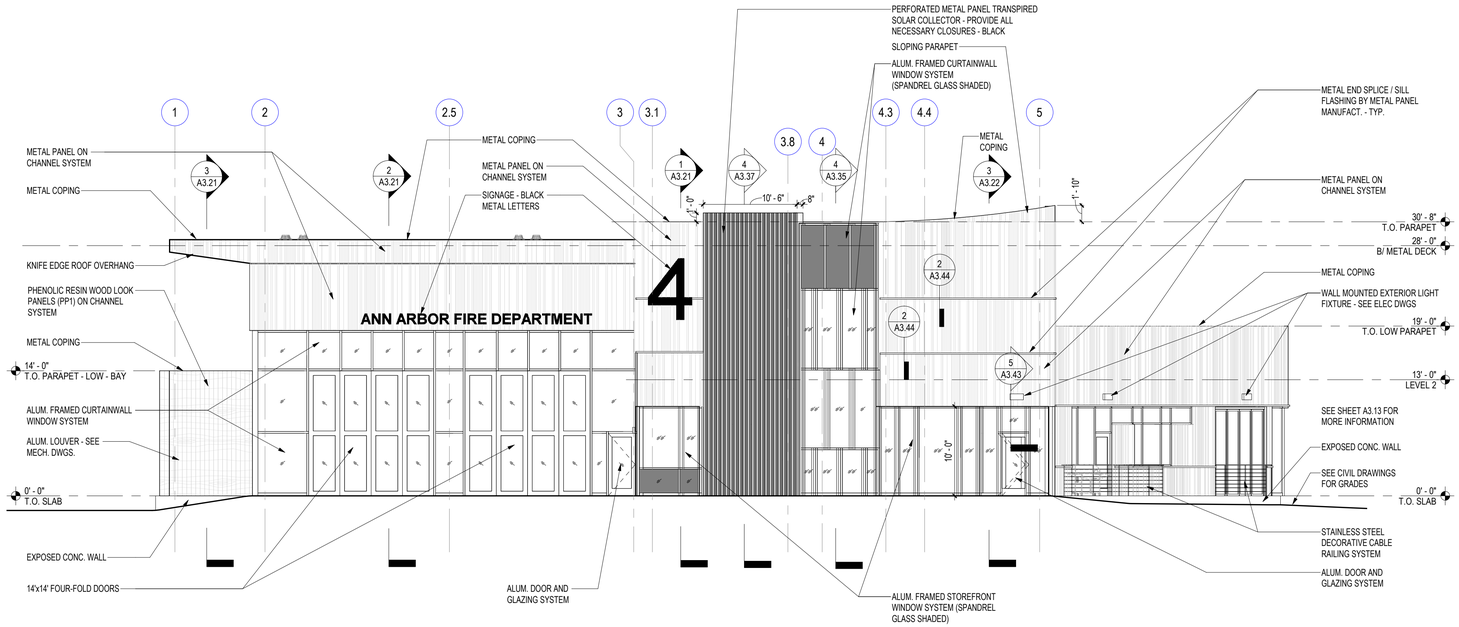
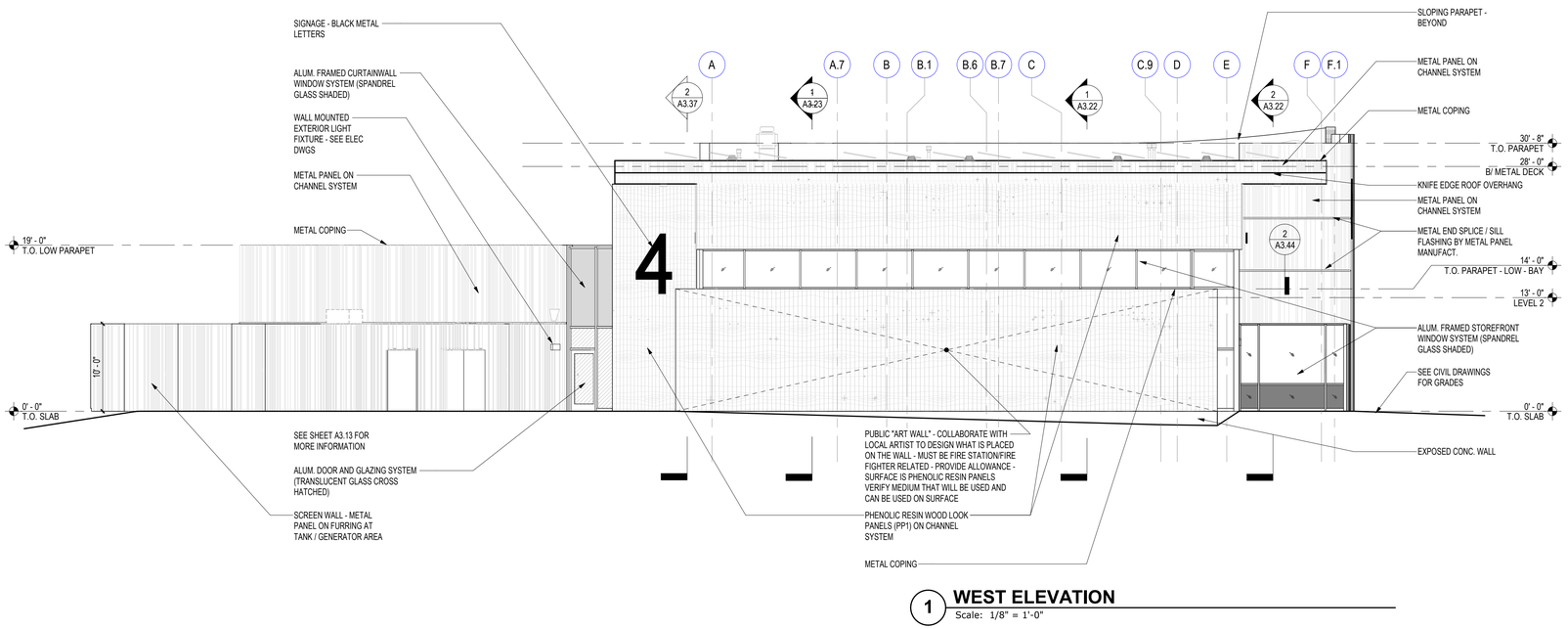


2 SOUTH ELEVATION
Scale: 1/8" = 1'-0"



1 WEST ELEVATION
Scale: 1/8" = 1'-0"

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Drawn TCA/A3C Checked TCA/A3C

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Sheet A3.12

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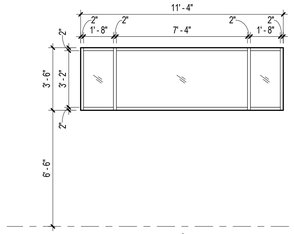
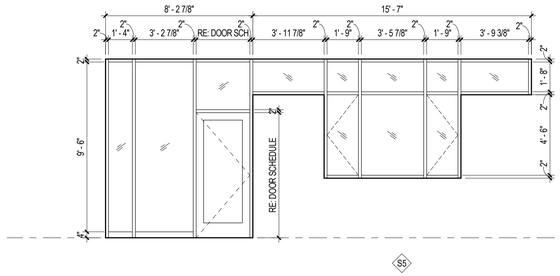


S8



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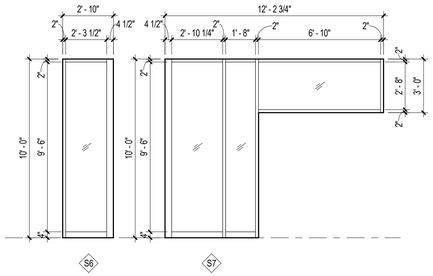
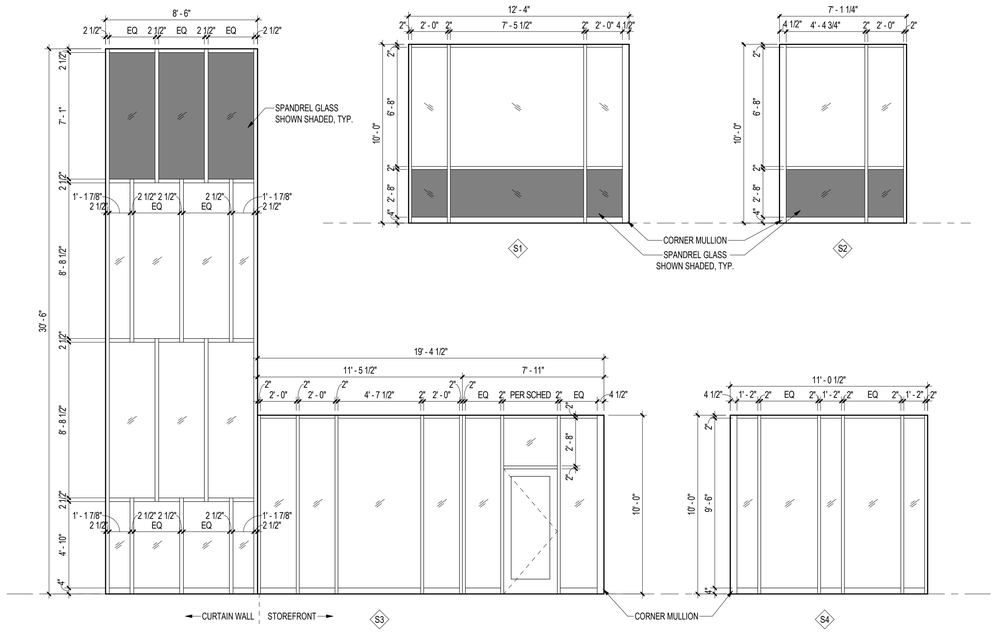
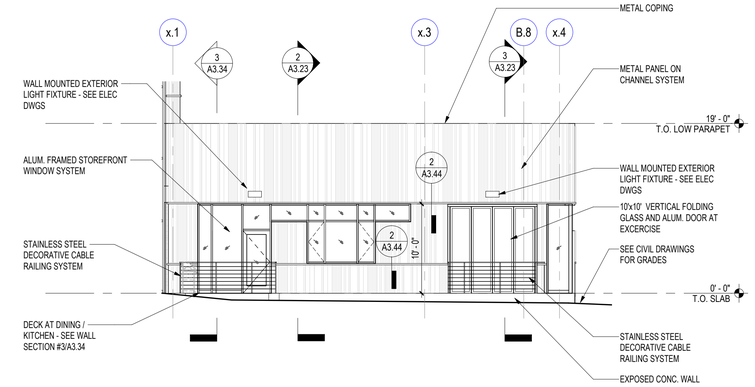


S6 S7

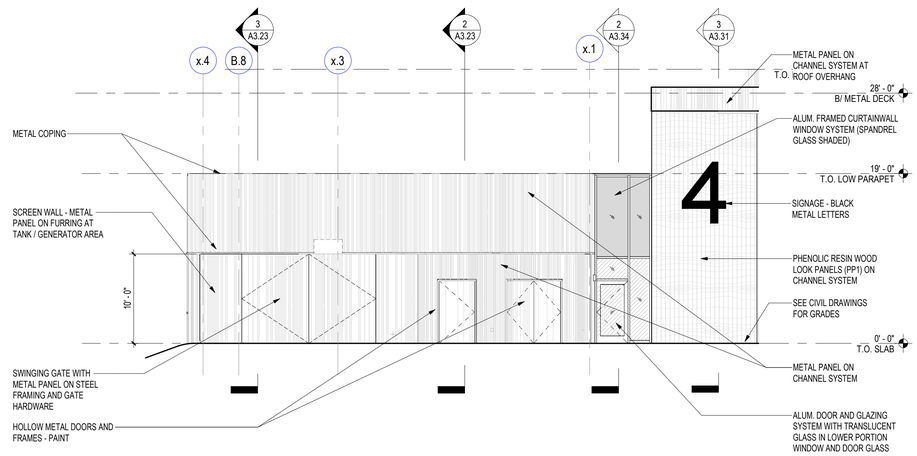


S1 S2 S3 S4

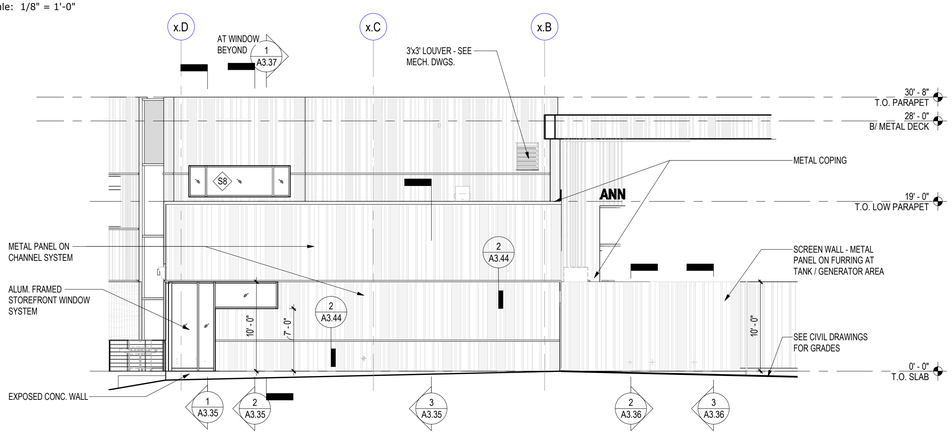
4 EXTERIOR WINDOW ELEVATIONS
Scale: 1/4" = 1'-0"



3 PARTIAL EAST ELEVATION
Scale: 1/8" = 1'-0"



2 PARTIAL WEST ELEVATION
Scale: 1/8" = 1'-0"



1 PARTIAL NORTH ELEVATION
Scale: 1/8" = 1'-0"

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Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23
Design Development	05/26/23

Drawn: KJ/SAD Checked: FEA

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

EXTERIOR ELEVATIONS

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Sheet A3.13

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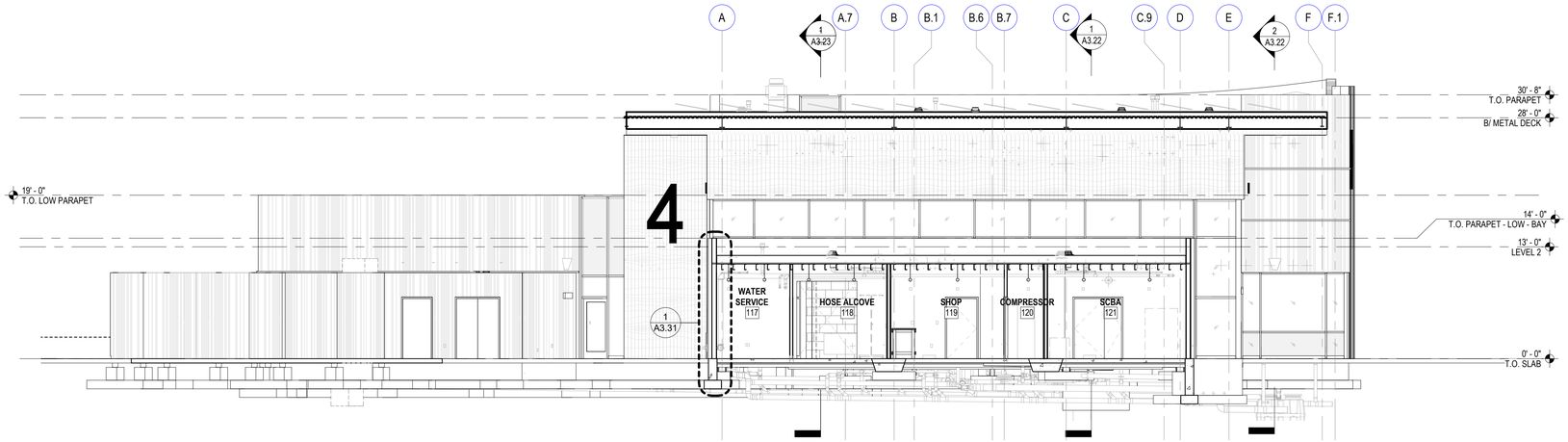

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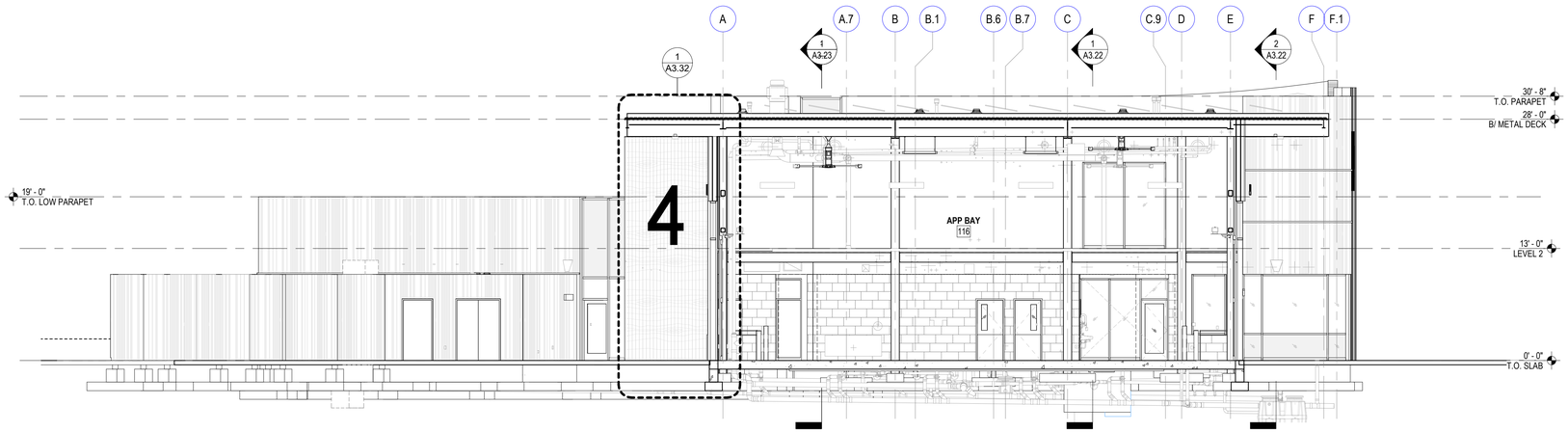

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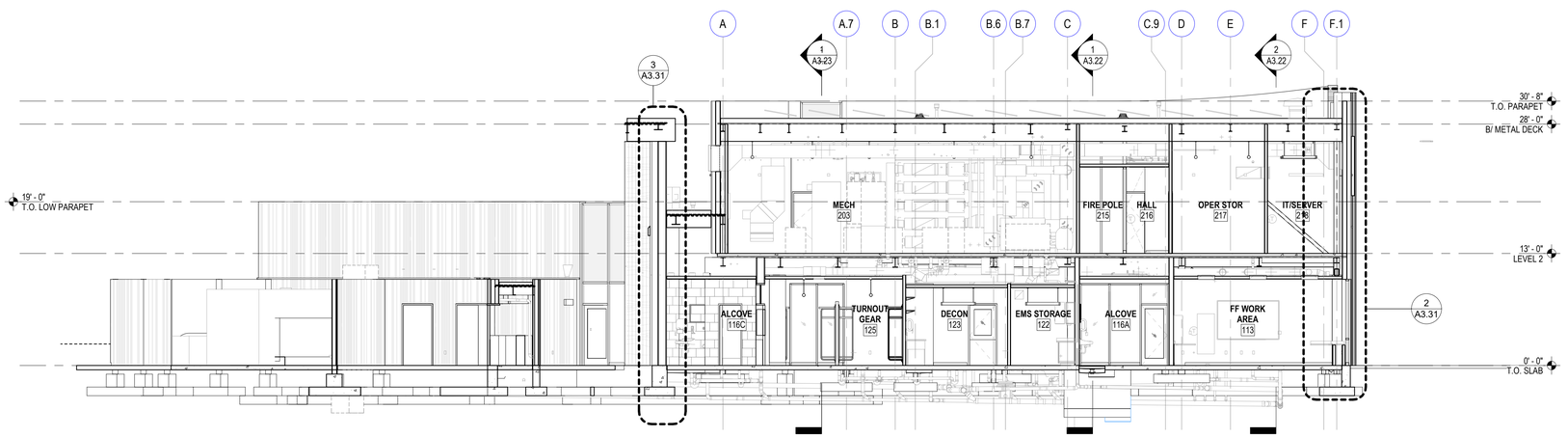

1 BUILDING SECTION

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10/11/2024 12:26:28 PM

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ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23
Final Site Plan	09/08/23
Design Development	05/26/23
Site Plan Approval	11/21/22
Site Plan Approval	09/22/22

Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
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BUILDING SECTIONS

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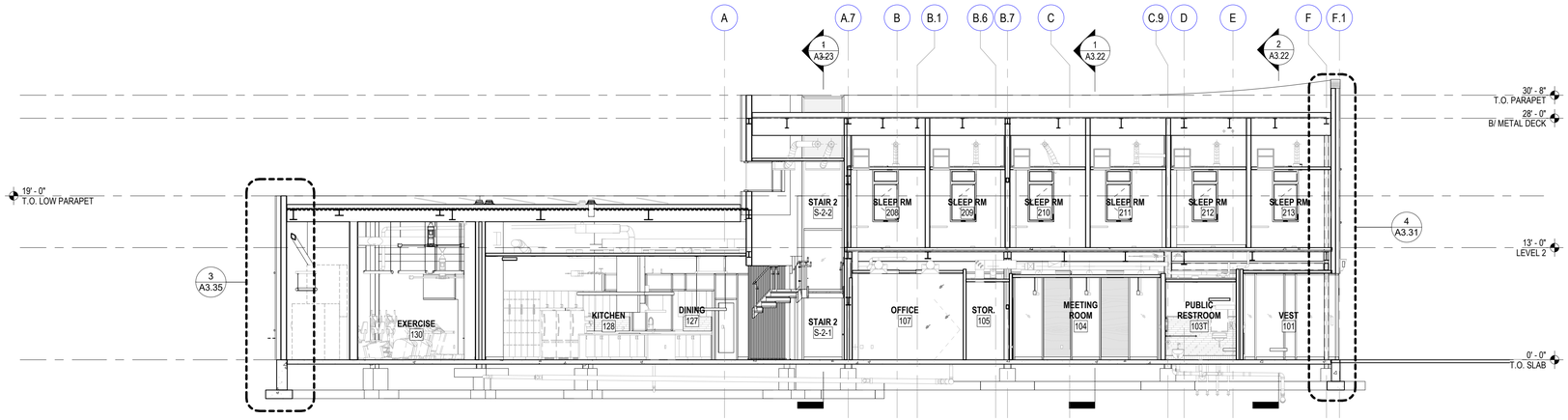

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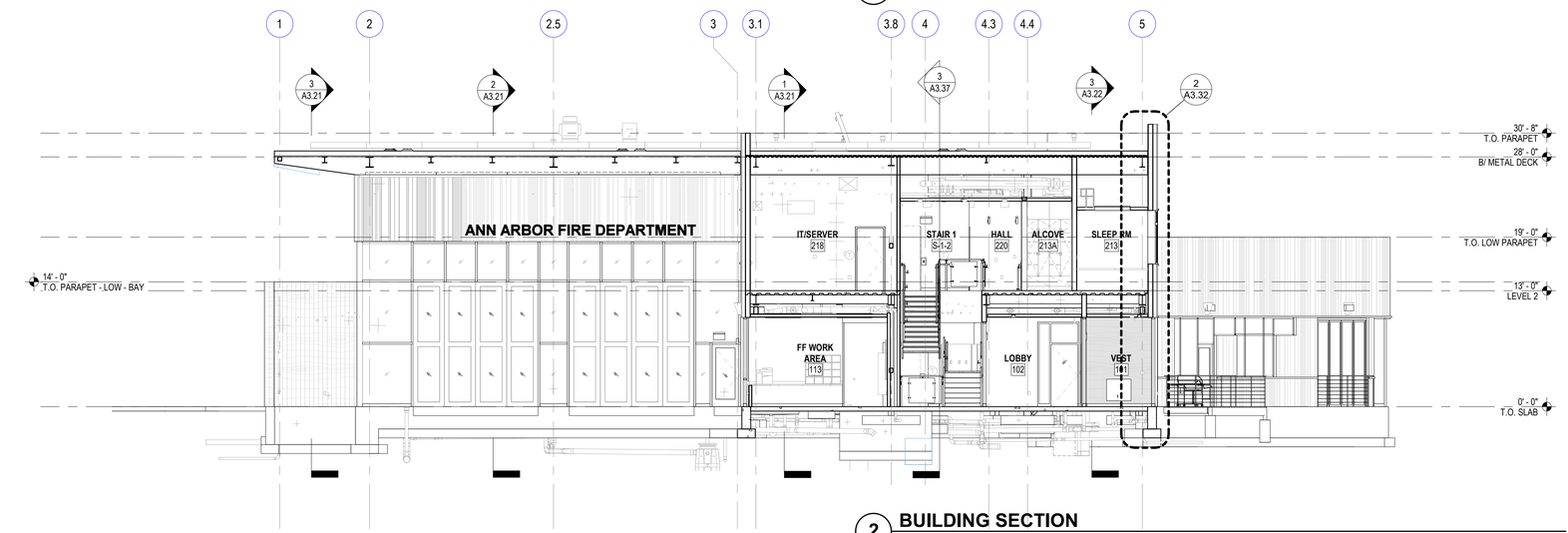

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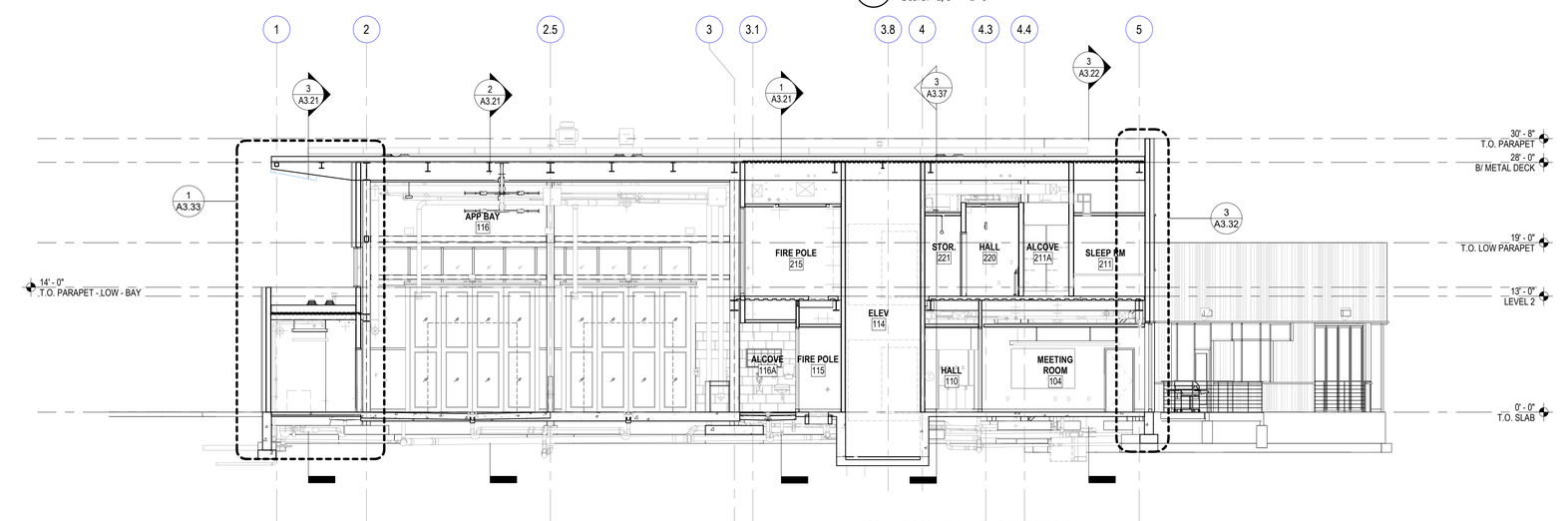

1 BUILDING SECTION

Scale: 1/8" = 1'-0"

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Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
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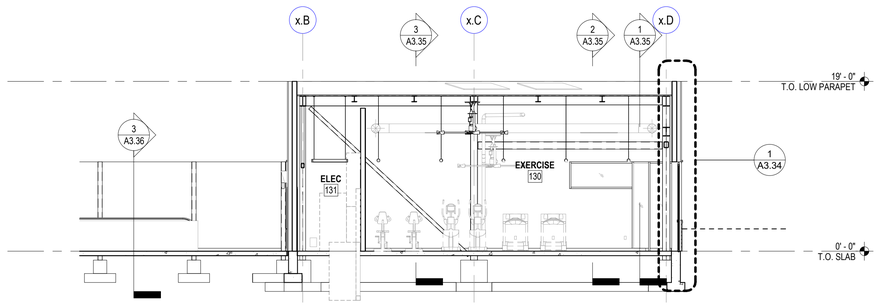
GENERAL NOTES



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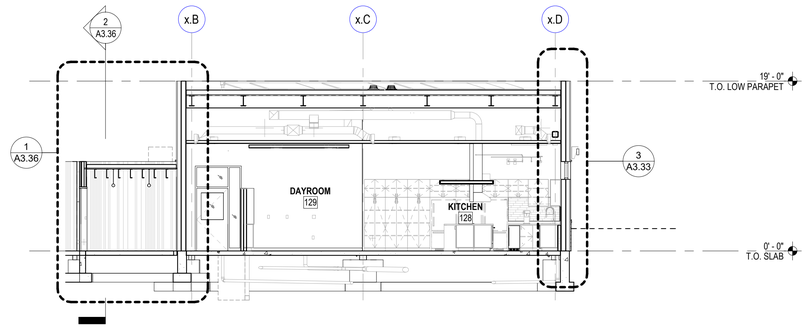

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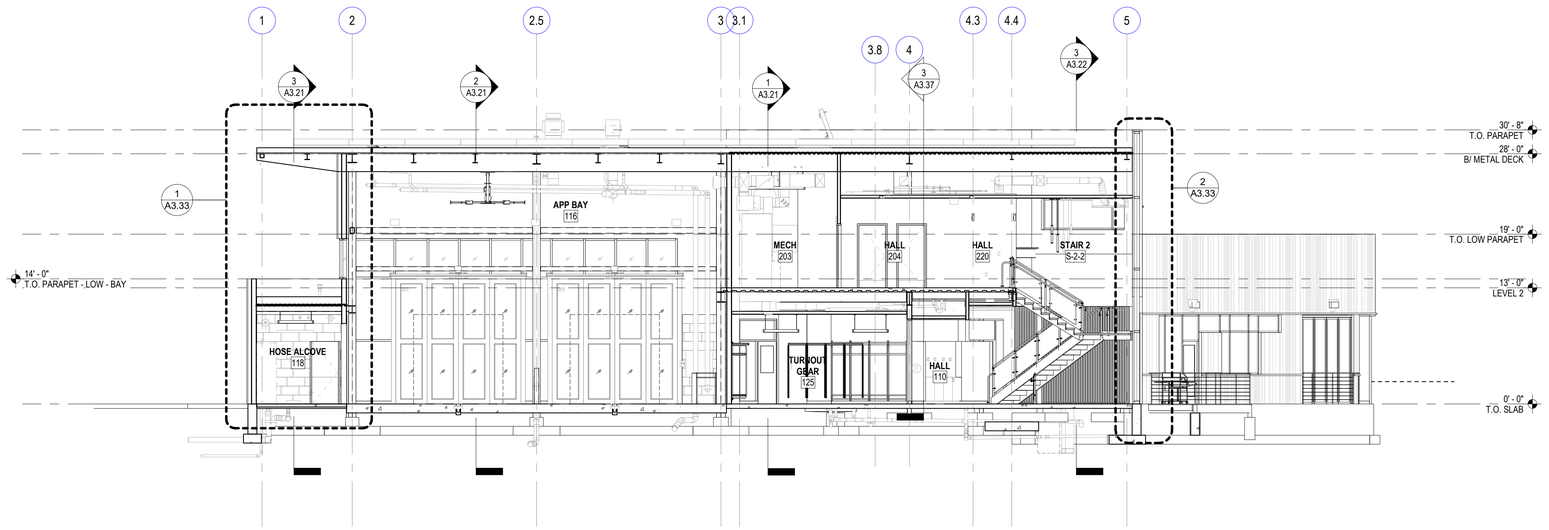

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10/11/2024 12:26:55 PM

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STATE OF MICHIGAN
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Drawn TCA/A3C	Checked TCA/A3C

City of Ann Arbor
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BUILDING SECTIONS

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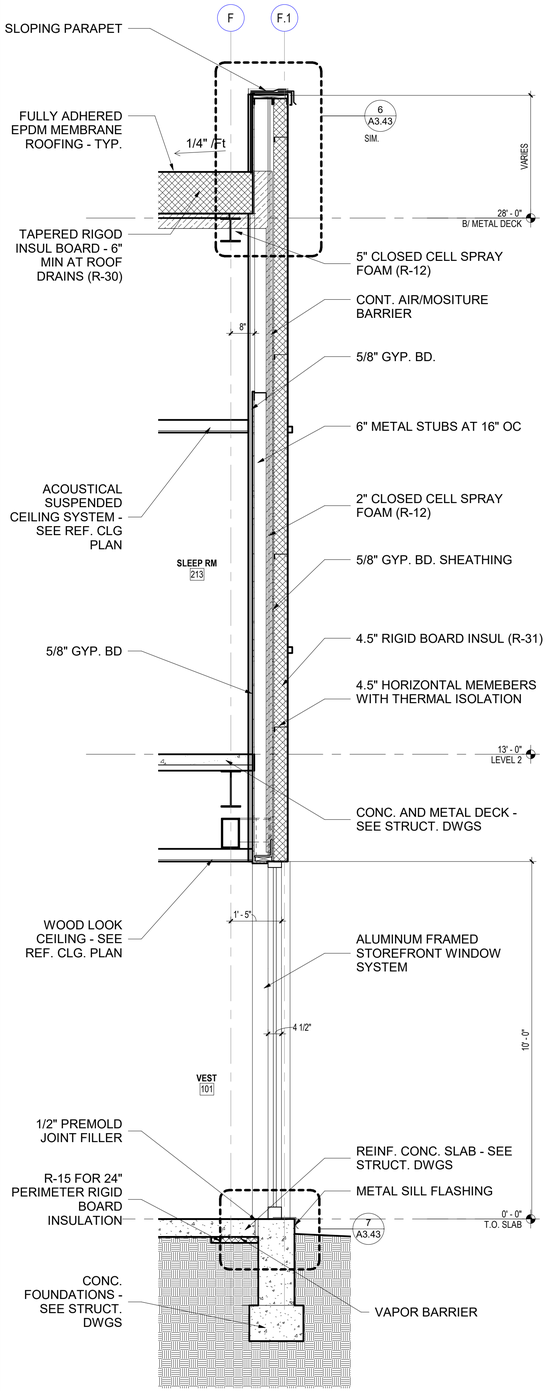

4 WALL SECTION
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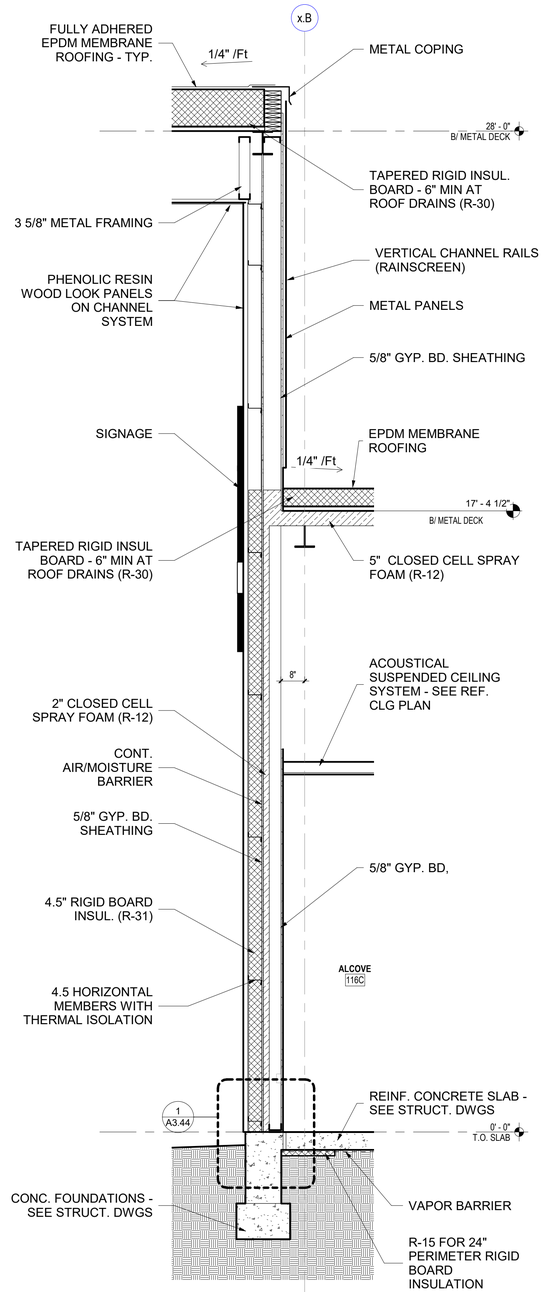
A3.22



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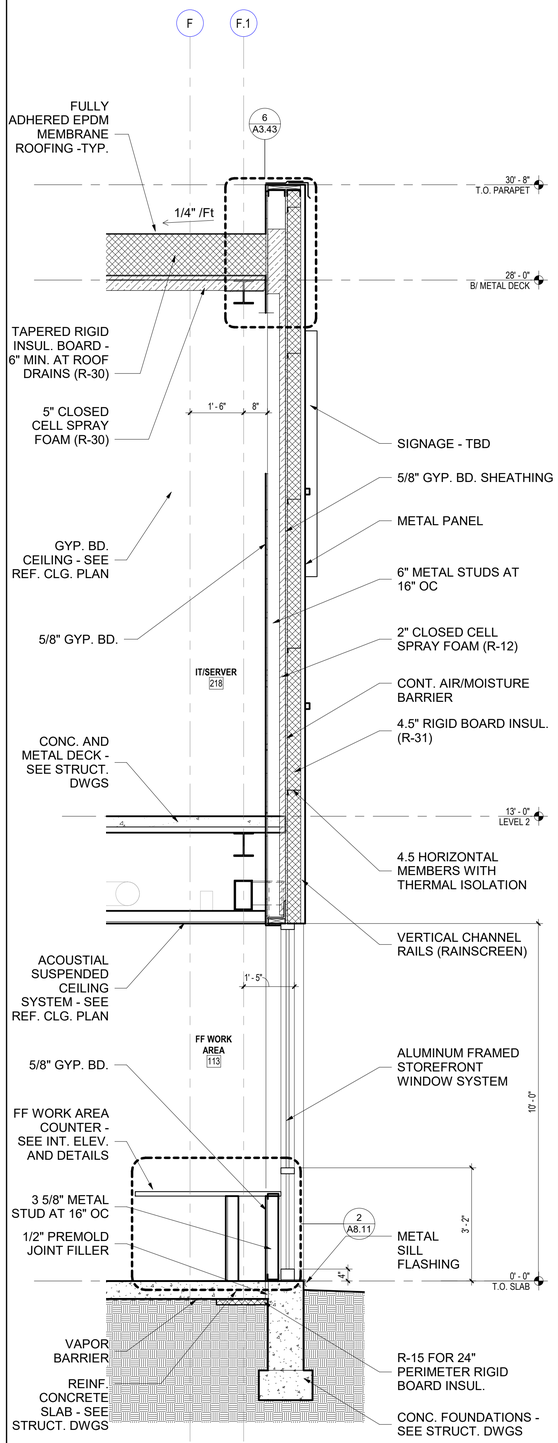
A2.11, A3.21



2 WALL SECTION
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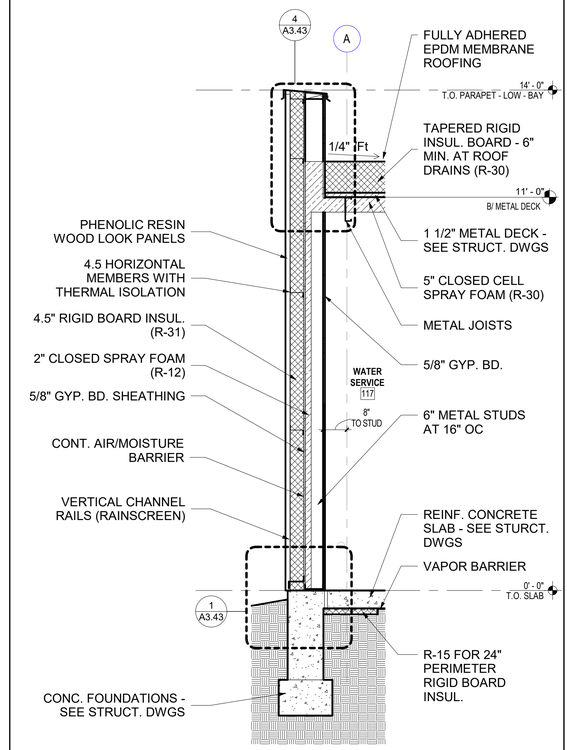
A3.21



1 WALL SECTION
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A3.21

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City of Ann Arbor
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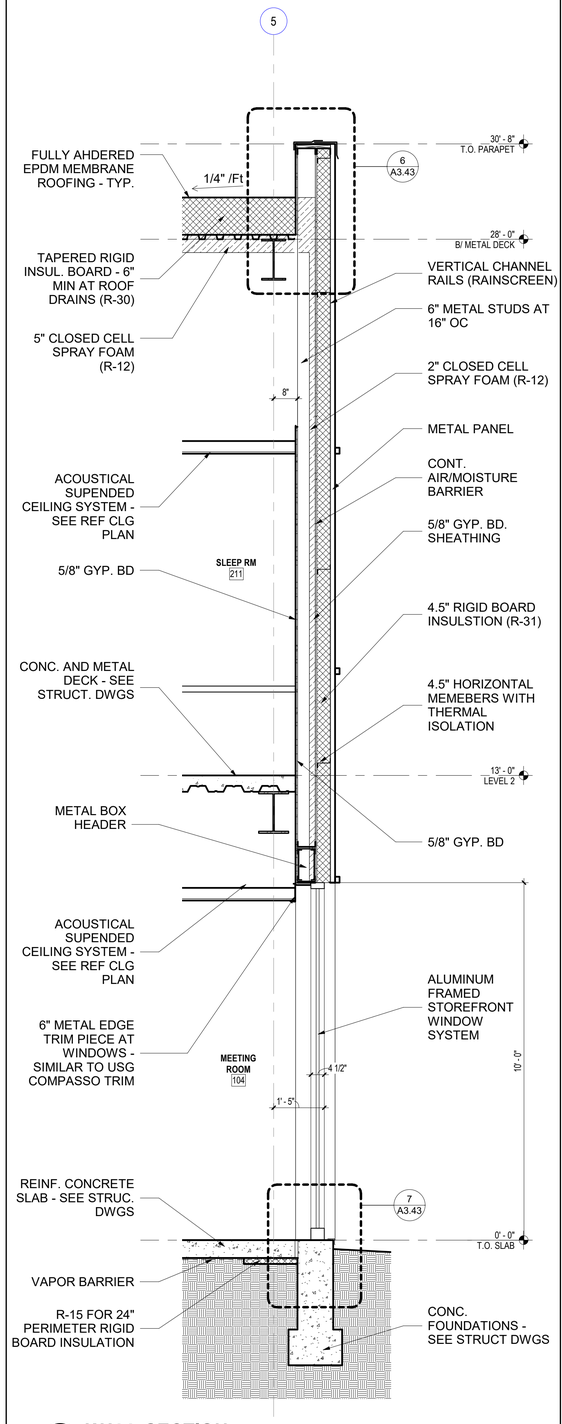
A3.31



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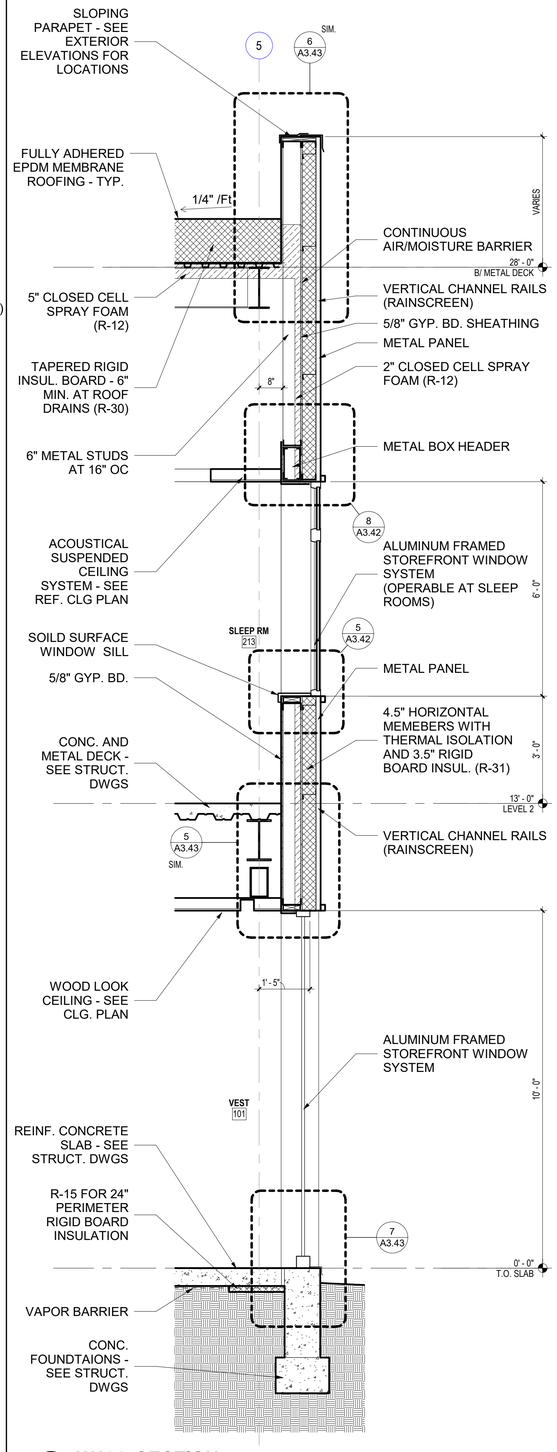
A3.22



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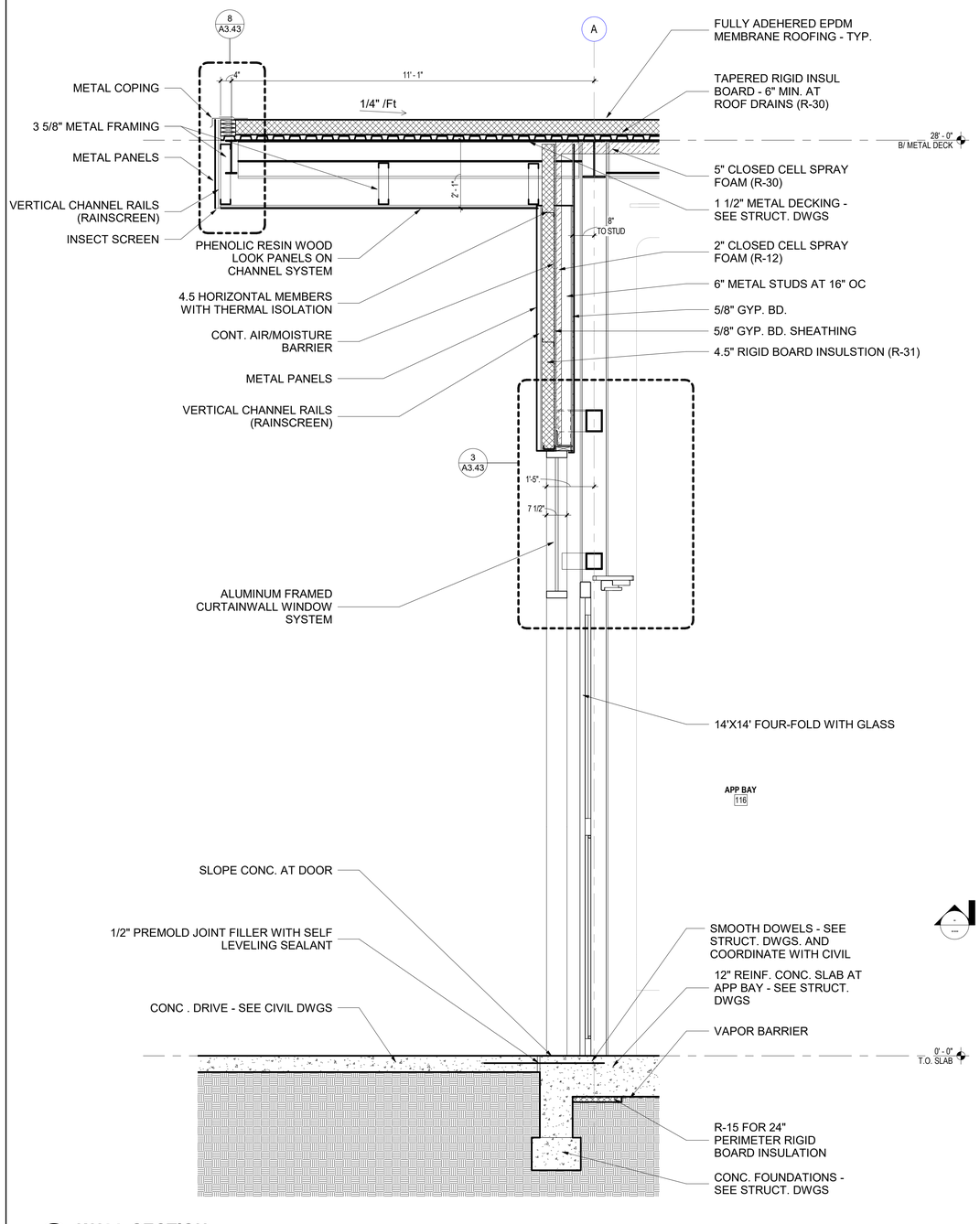
A3.22



1 WALL SECTION
Scale: 1/2" = 1'-0"

A3.21

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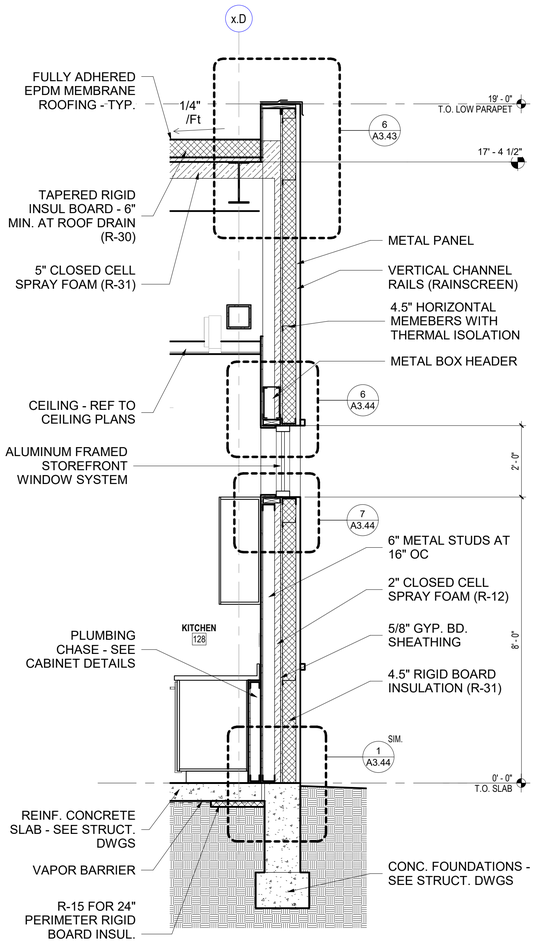

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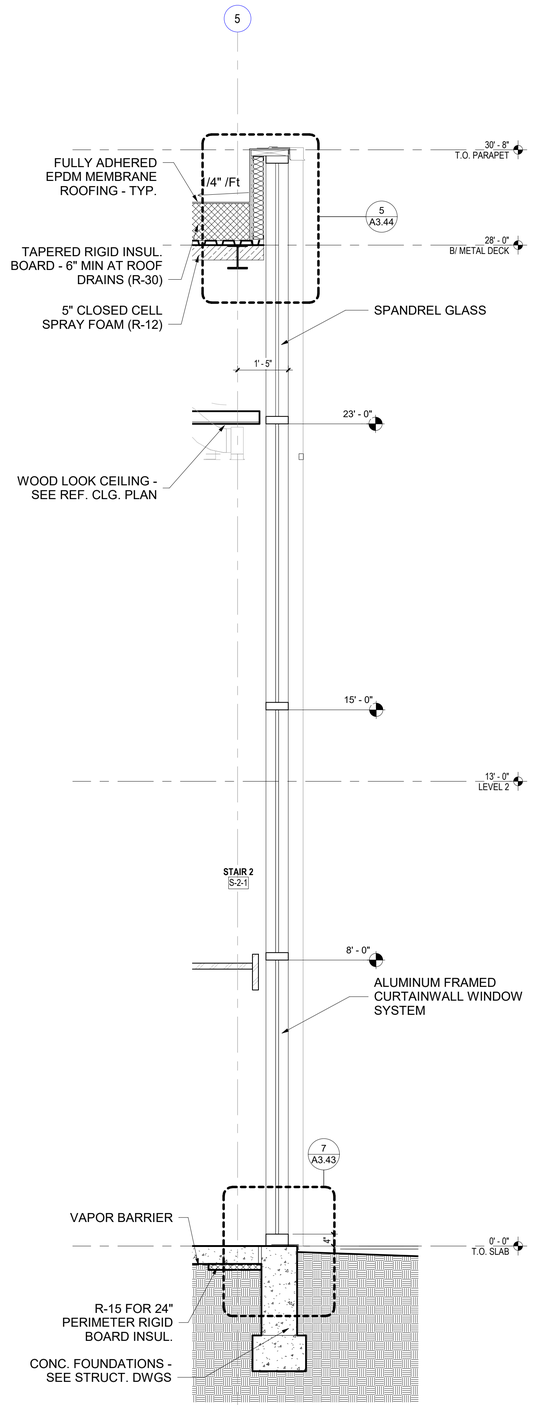
Scale: 1/2" = 1'-0"

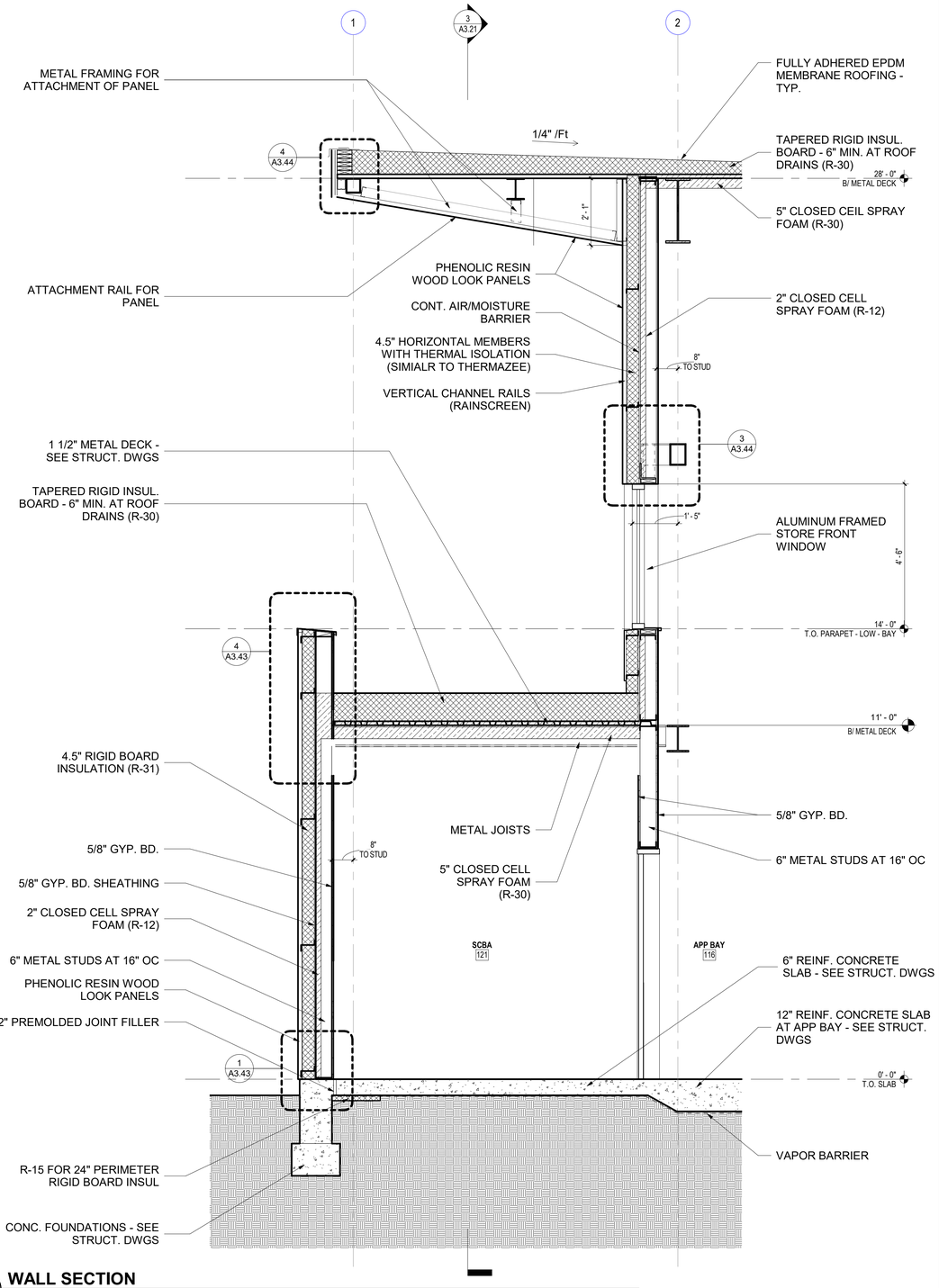
A3.23



2 WALL SECTION

Scale: 1/2" = 1'-0"

A3.23



1 WALL SECTION

Scale: 1/2" = 1'-0"

A3.22, A3.23

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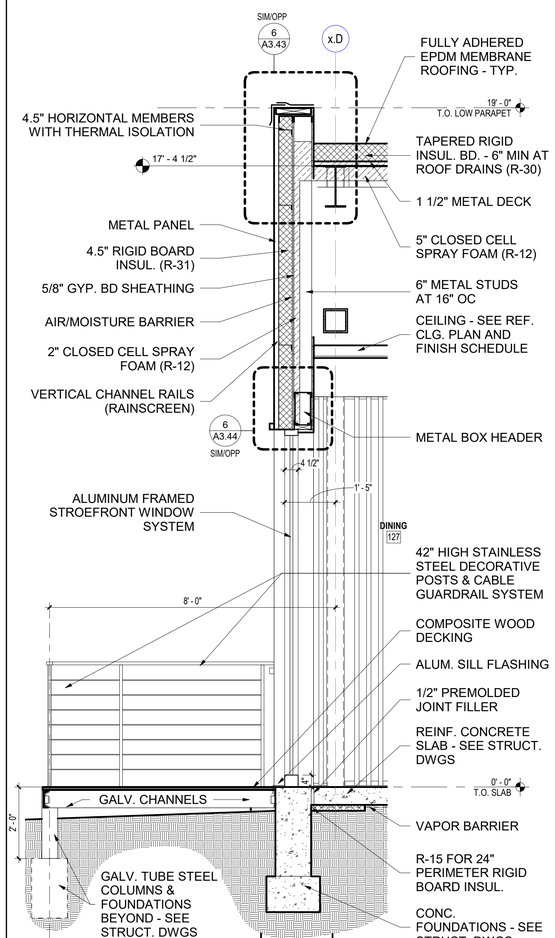
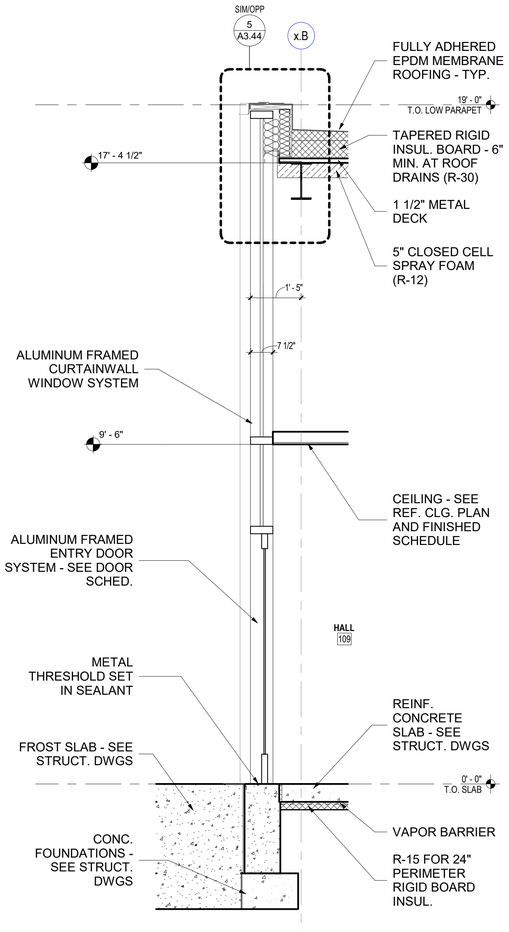


3 WALL SECTION
Scale: 1/2" = 1'-0"

A3.13



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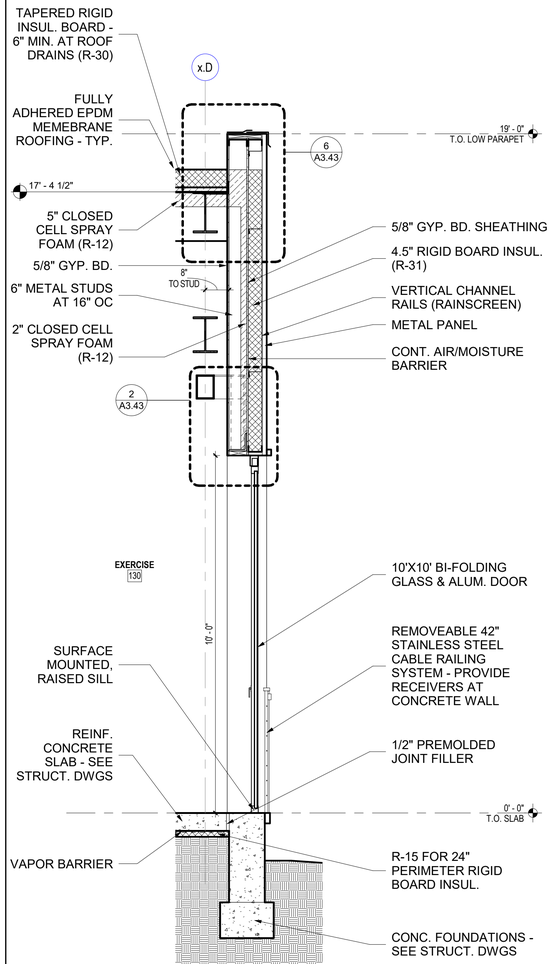
A2.11, A3.13



1 WALL SECTION
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A3.23

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STATE OF MICHIGAN
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City of Ann Arbor
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WALL SECTIONS

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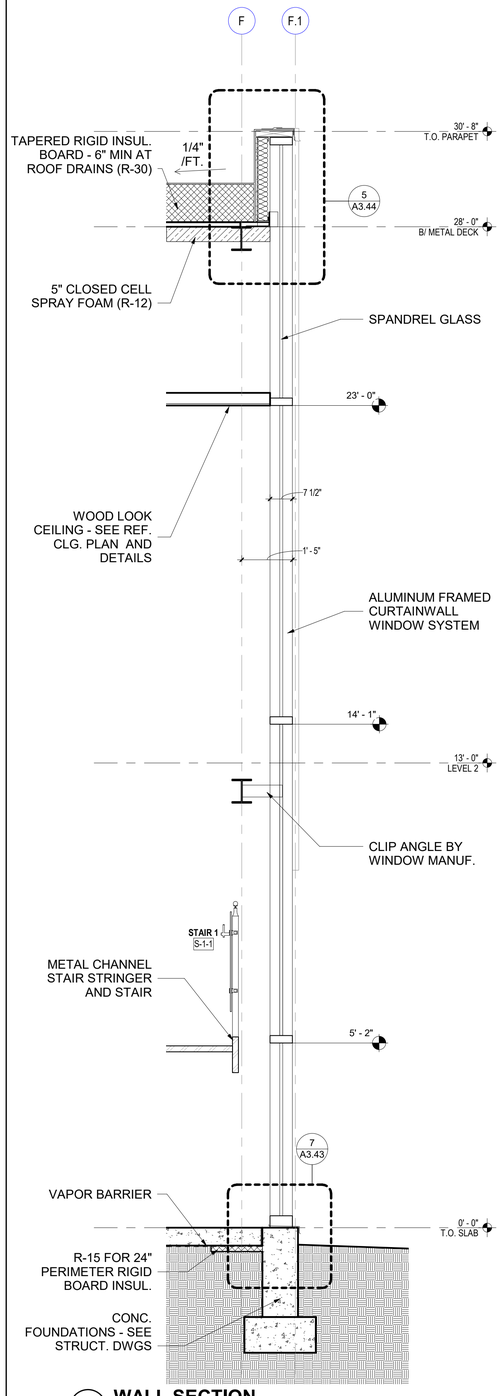

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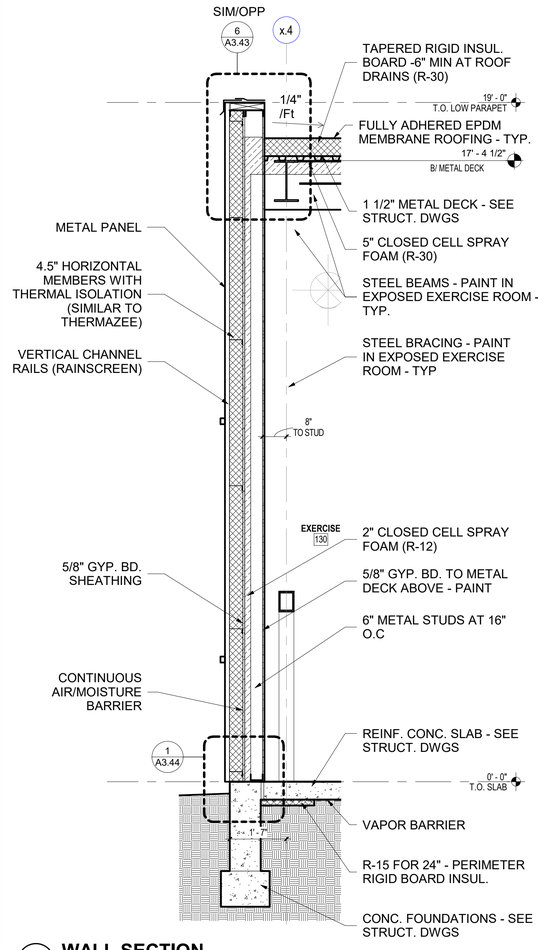
A3.12



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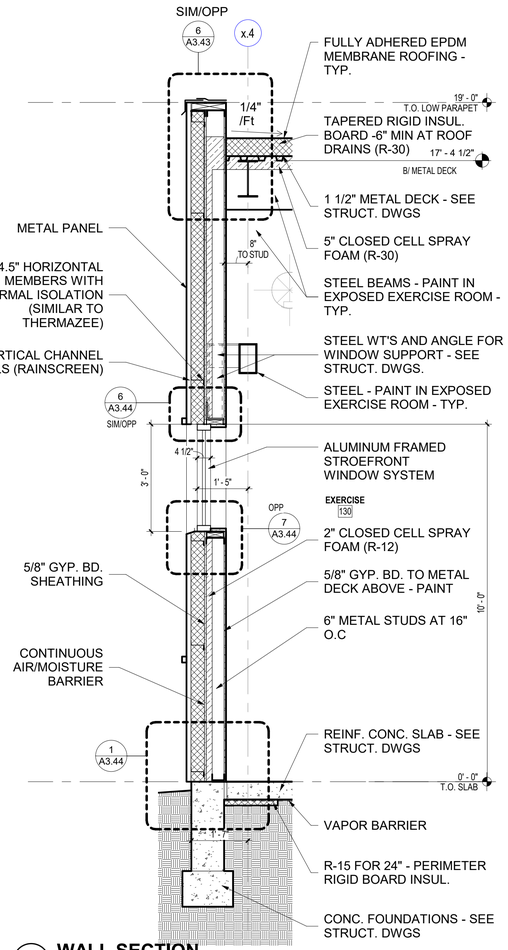
A2.11, A2.12, A3.13, A3.22



2 WALL SECTION
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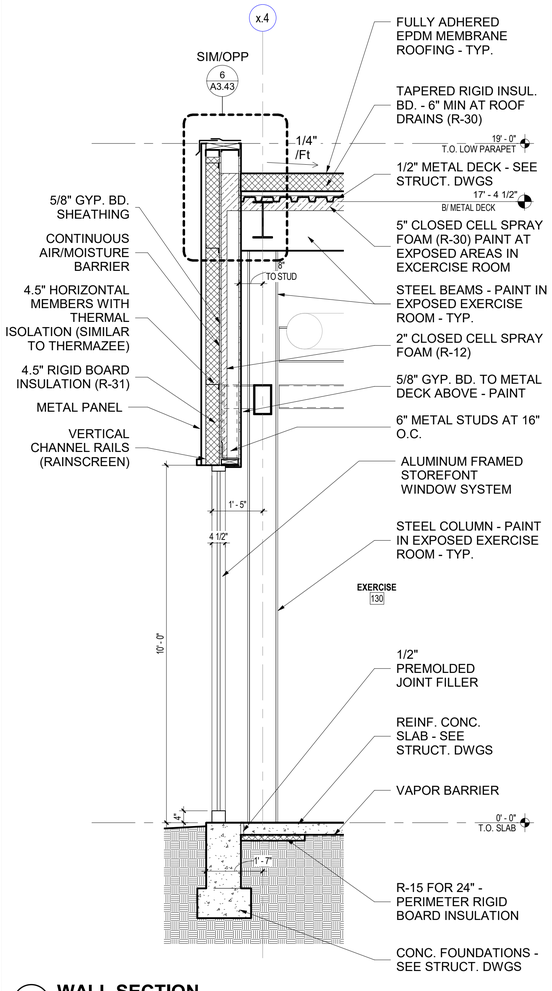
A3.13



1 WALL SECTION
Scale: 1/2" = 1'-0"

A3.13

10/11/2024 12:27:12 PM

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STATE OF MICHIGAN
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City of Ann Arbor
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WALL SECTIONS

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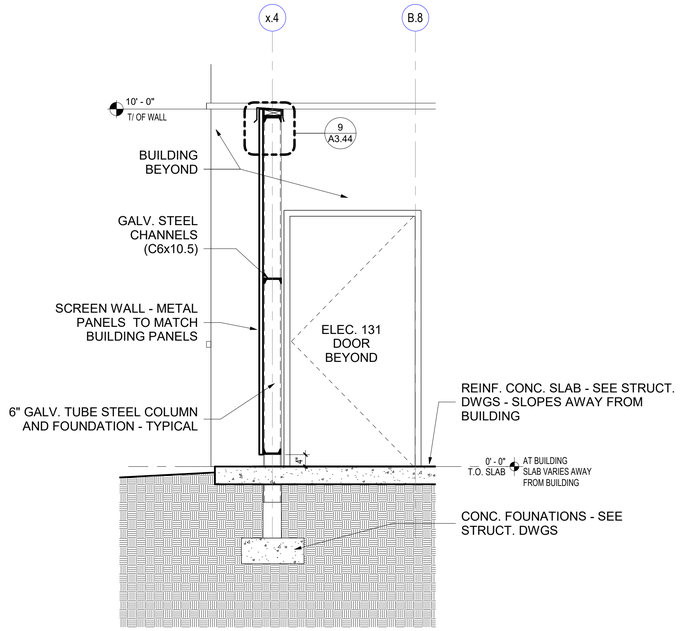
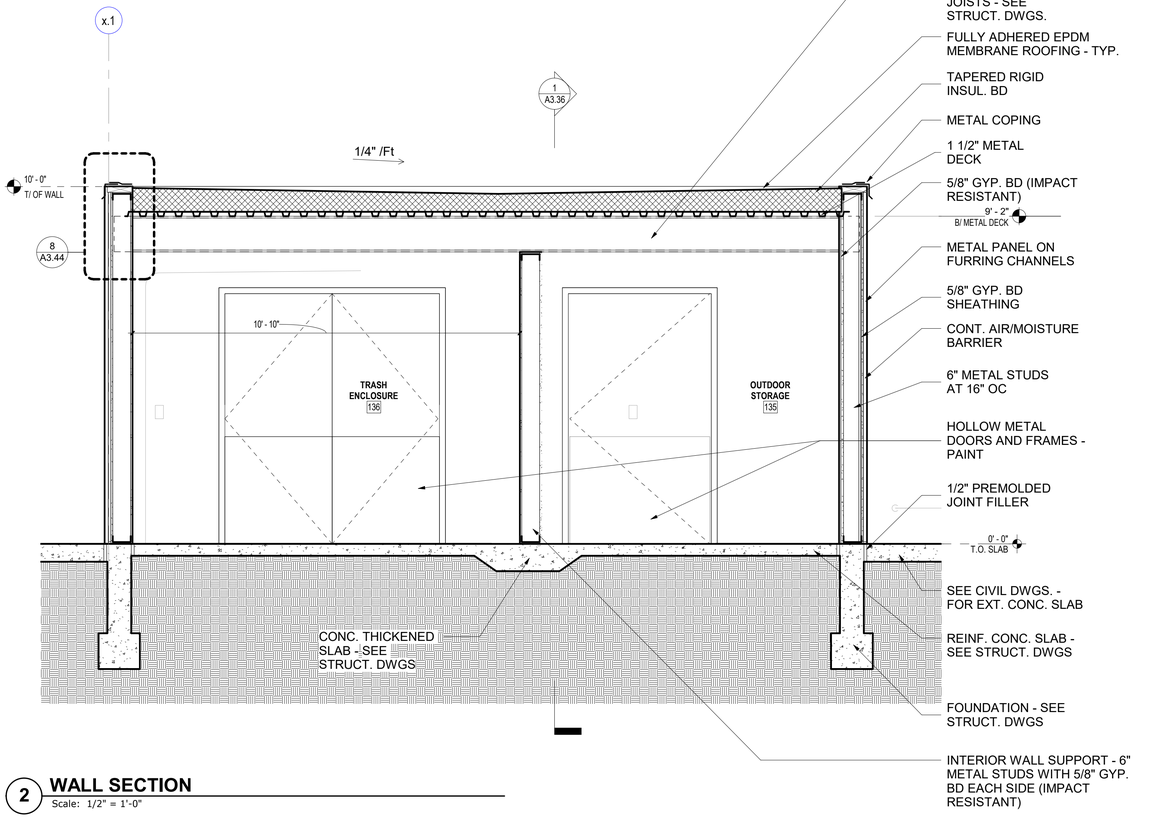


3 WALL SECTION

Scale: 1/2" = 1'-0"

A2.11, A3.13



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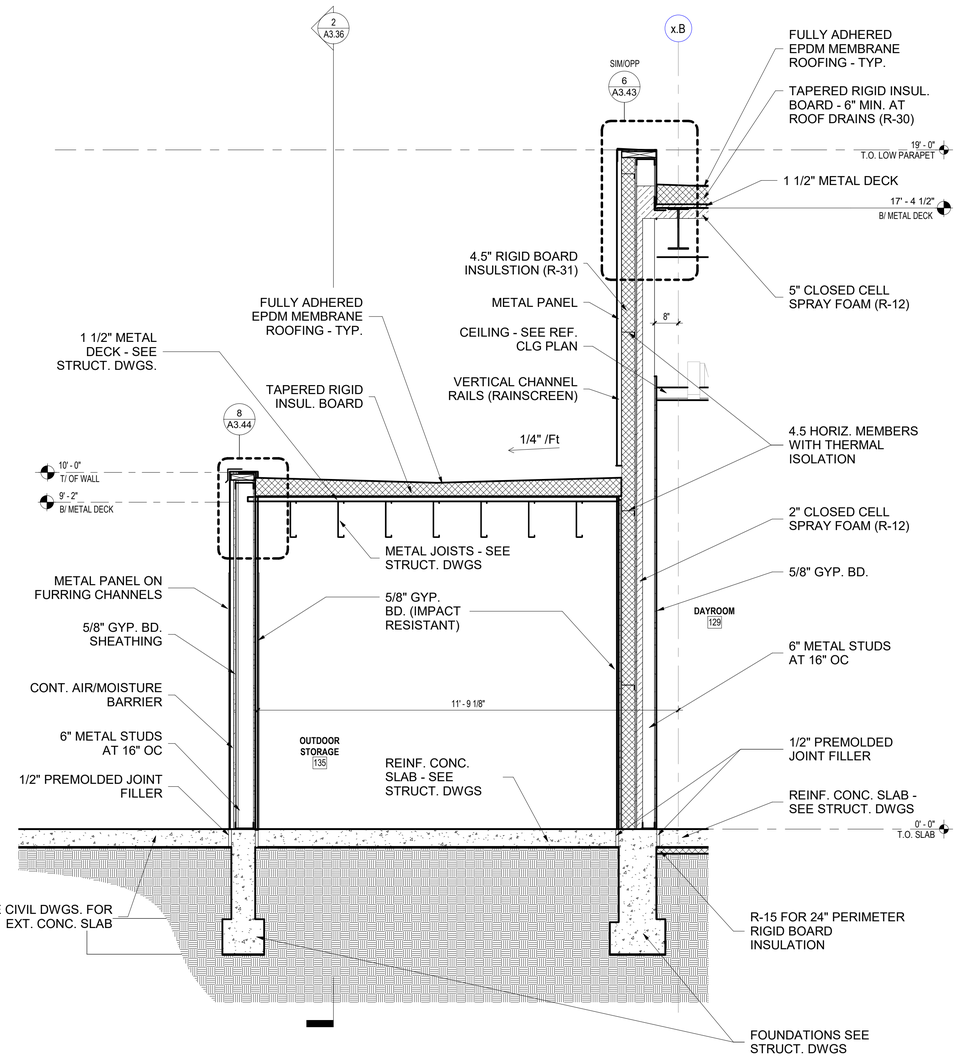
Scale: 1/2" = 1'-0"

A2.11, A3.36



1 WALL SECTION

Scale: 1/2" = 1'-0"

A2.11, A3.23

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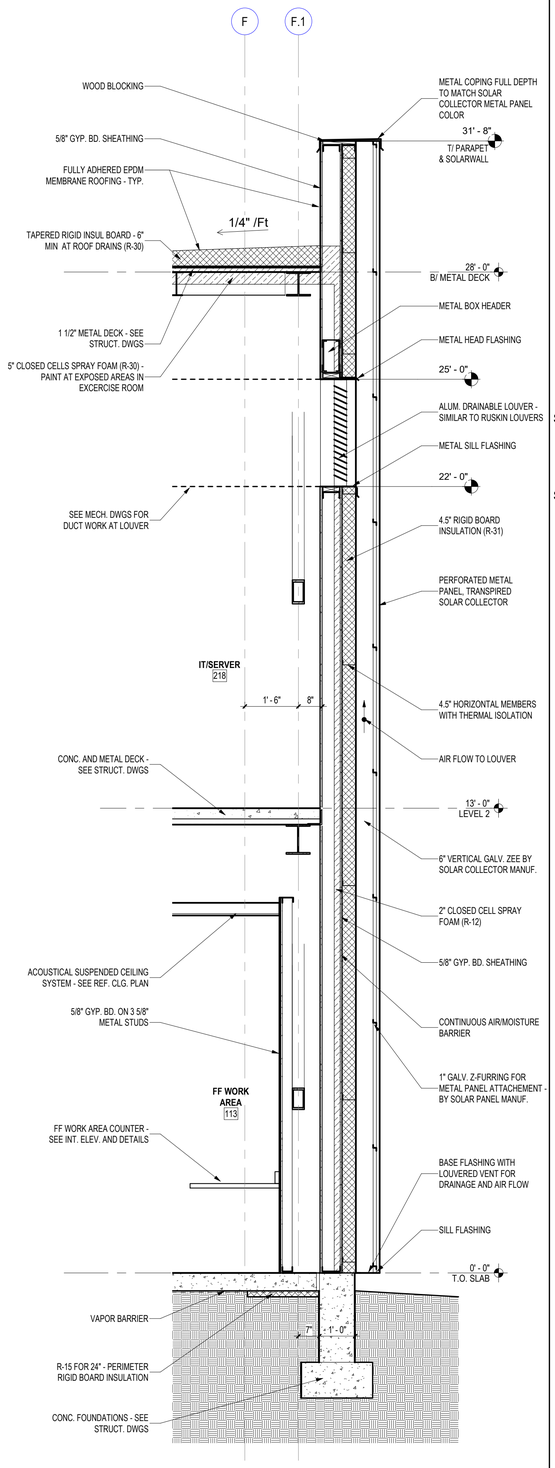

4 WALL SECTION SOLAR COLLECTOR
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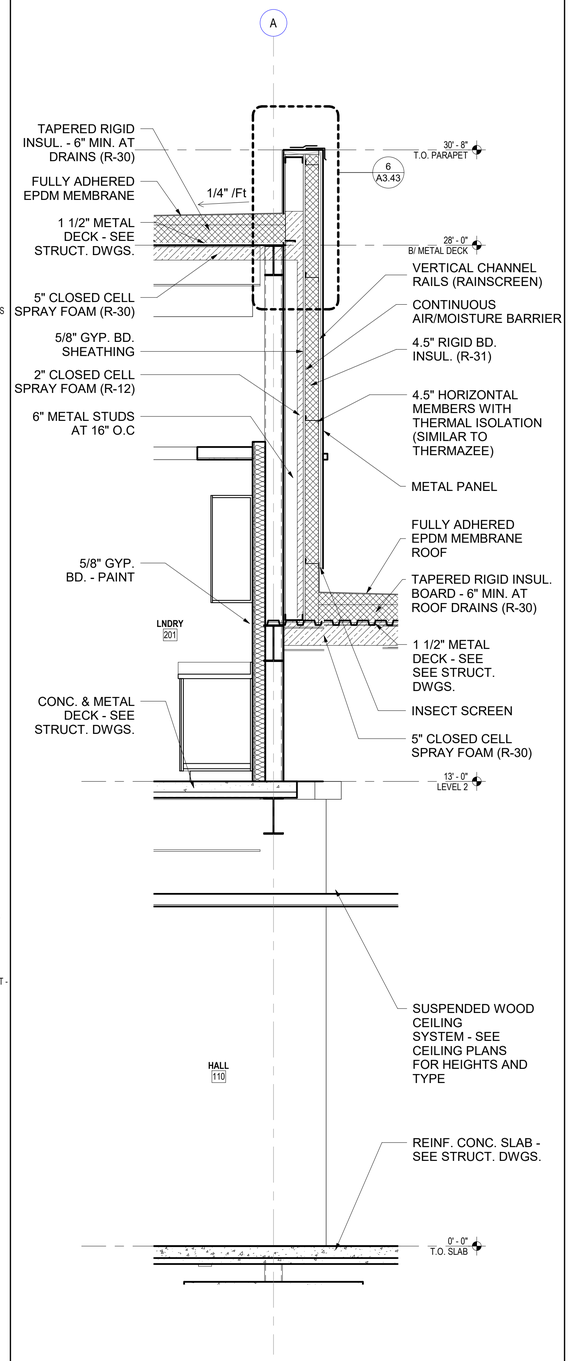
A3.12



3 WALL SECTION
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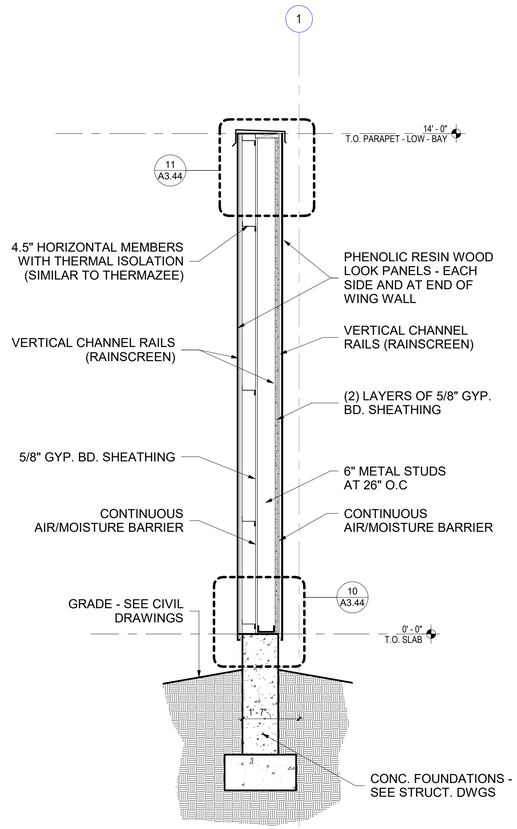
A2.12



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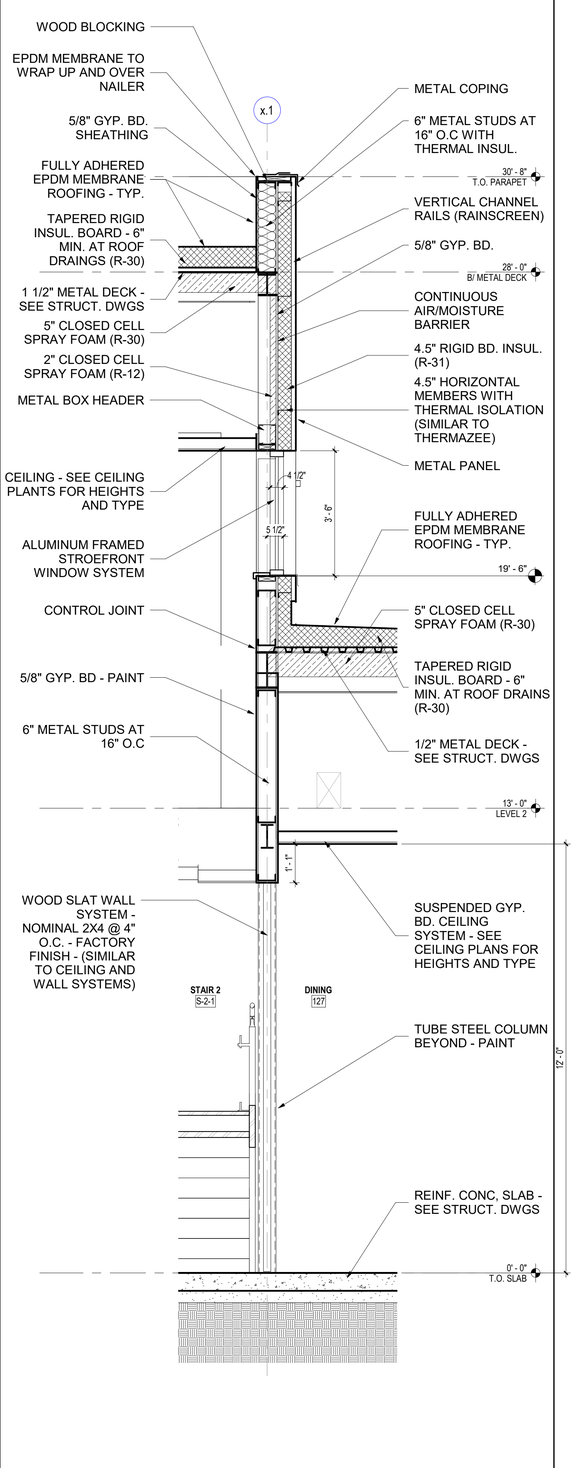
A2.11, A3.12



1 WALL SECTION
Scale: 1/2" = 1'-0"
A2.12

10/11/2024 12:27:19 PM

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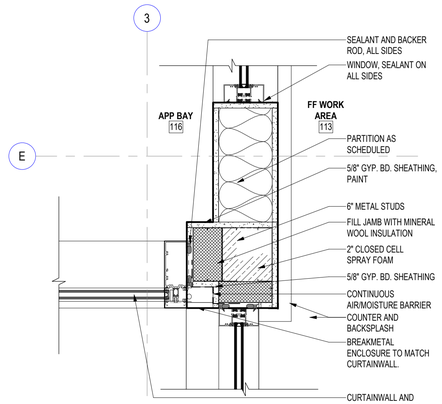
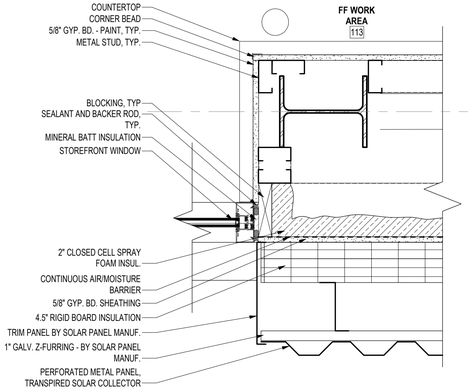
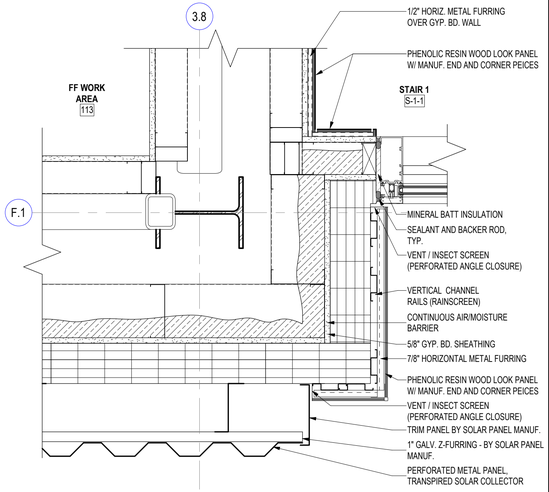


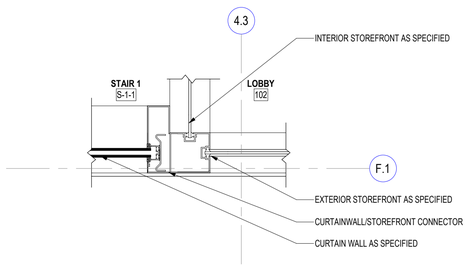
11 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



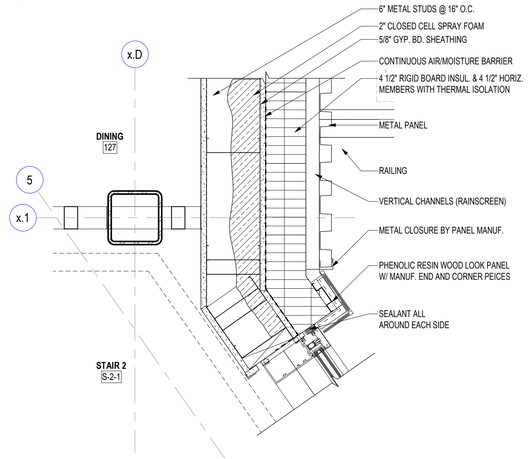
10 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



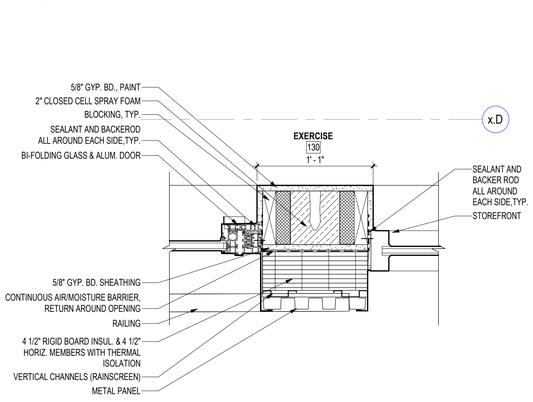
9 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



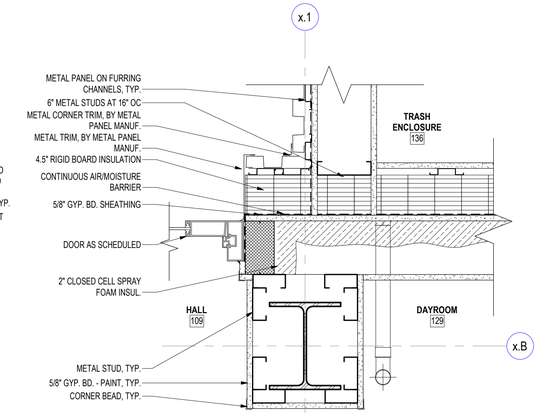
8 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



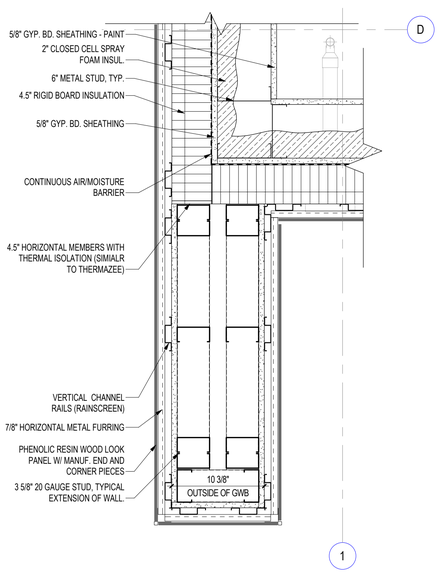
7 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



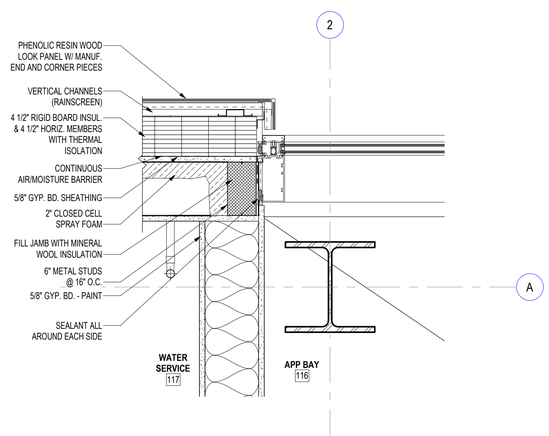
6 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



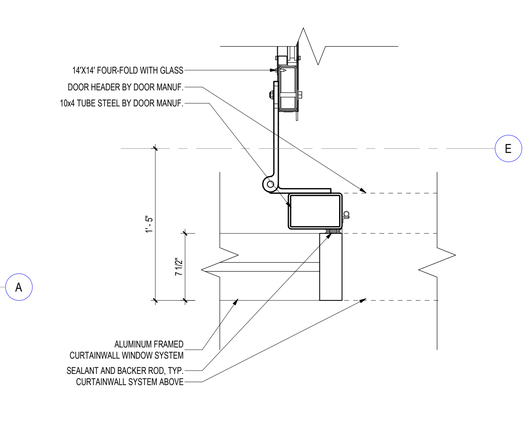
5 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



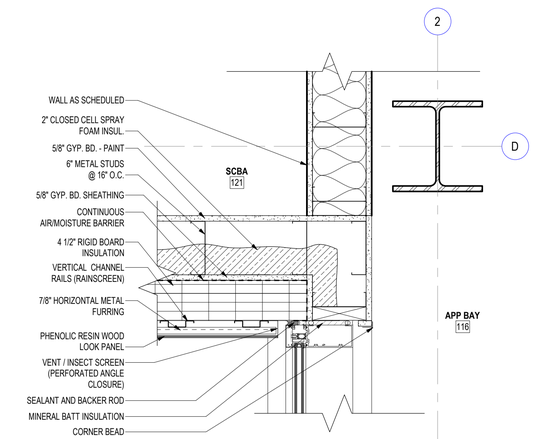
4 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



3 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



2 PLAN DETAIL
Scale: 1 1/2" = 1'-0"



1 PLAN DETAIL
Scale: 1 1/2" = 1'-0"

TCA
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23

Drawn: SAD Checked: FEA

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

EXTERIOR DETAILS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet A3.41

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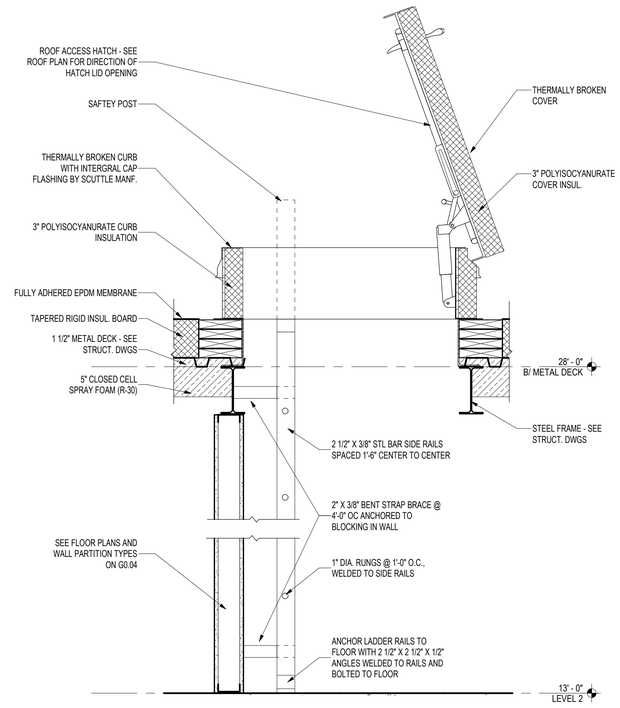

1 ROOF HATCH & LADDER DETAIL

Scale: 1" = 1'-0"

T C A
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

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City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

ROOF DETAILS

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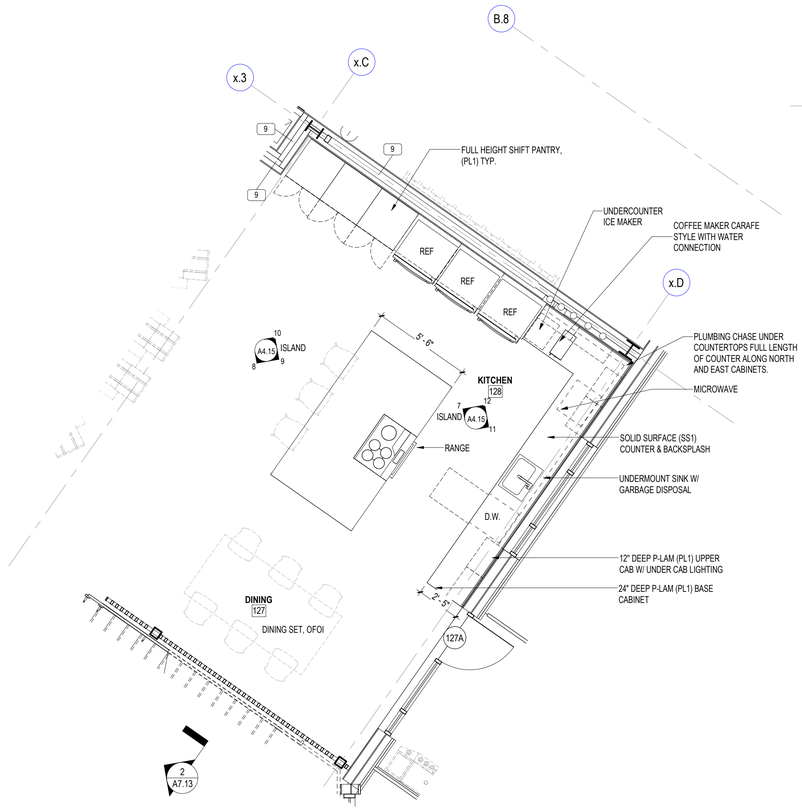
Sheet A3.61

10/11/2024 12:27:27 PM

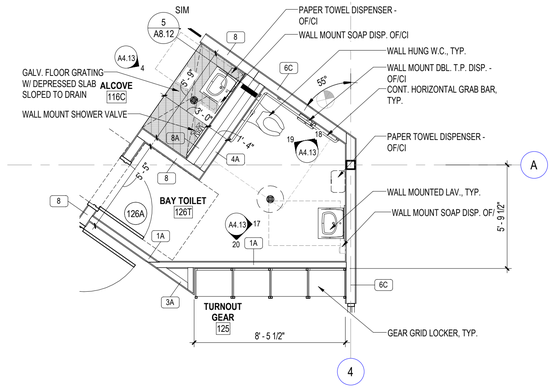
GENERAL NOTES

1. PROVIDE FULL HEIGHT BACKER BD. WALLS & CLG. OF SHOWER ENCLOSURES AND MOP SINKS, TYP.
2. PROVIDE WATER RESISTANT GWB AT ALL WET WALLS
3. PROVIDE 2X BLOCKING FOR WALL MOUNTED MARKER/ TACK BOARDS, TV'S, EQUIP., FURNISHINGS, ACCESSORIES, CABINETS, DOOR STOPS, BRACING, PLUMING FIXTURES, ETC - INCLUDING BLOCKING FOR ITEMS FURNISH BY OWNER. CONTRACTOR TO COORDINATE LOCATIONS W/ OWNER DURING ROUGH FRAMING.
4. REFER TO SHEET G0.04 FOR WALL TYPES AND FINISHES.
5. ADA RESTROOMS, FIXTURE MOUNTING HEIGHTS AND CLEARANCE REQUIREMENTS SHALL COMPLY WITH ICC A117.1 CHAPTER 6.
6. ELECTRICAL AND MECHANICAL UNITS ARE SHOWN FOR REFERENCE ONLY.
7. REFER TO A5.11 FOR RESTROOM FIXTURE AND ACCESSORY DIMENSIONS NOT SHOWN.
8. SEE APPLIANCE & EQUIPMENT SCHEDULES ON SHEET A2.41 FOR ALL APPLIANCES AND EQUIPMENT.



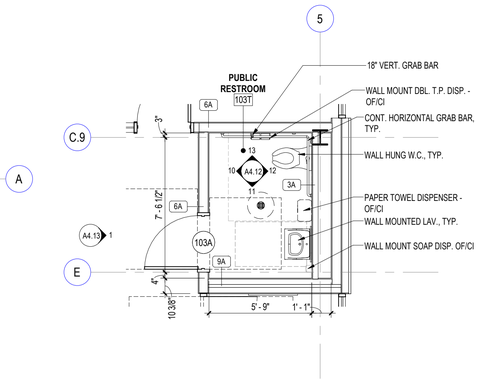
6 128 KITCHEN

Scale: 1/4" = 1'-0"



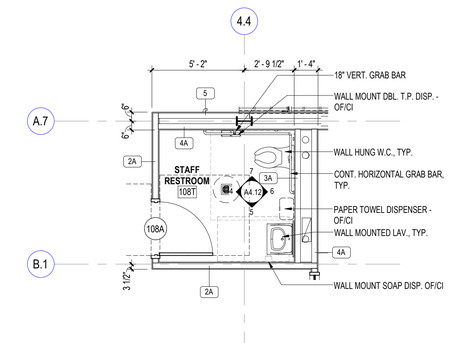
4 126T BAY TOILET

Scale: 1/4" = 1'-0"



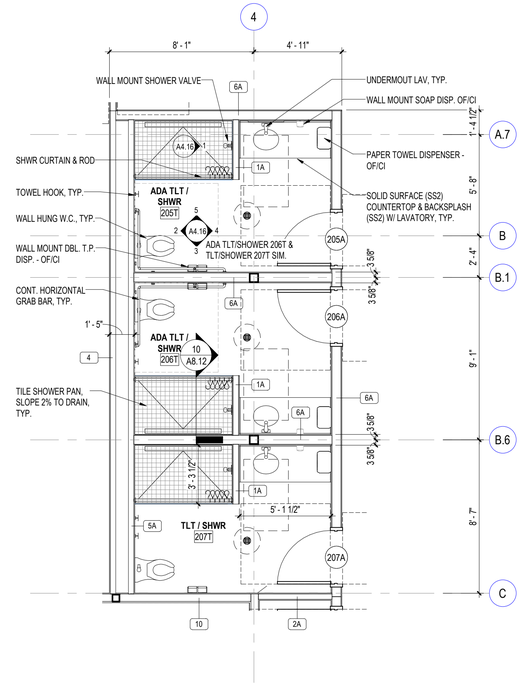
1 103T PUBLIC RESTROOM

Scale: 1/4" = 1'-0"



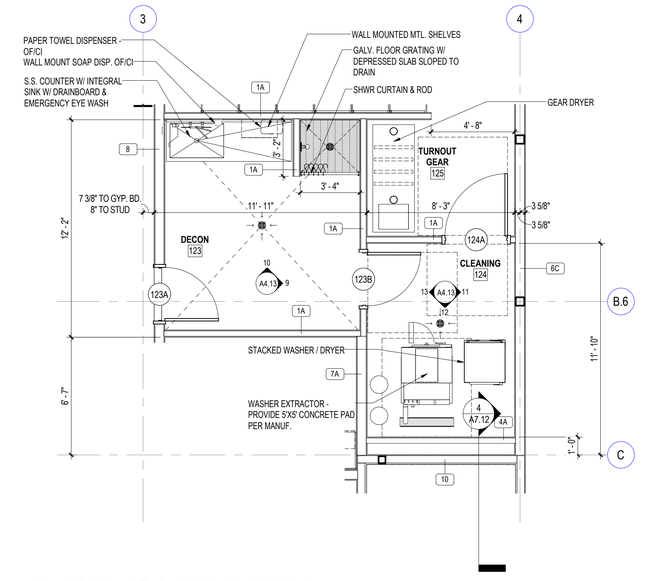
2 108T STAFF RESTROOM

Scale: 1/4" = 1'-0"



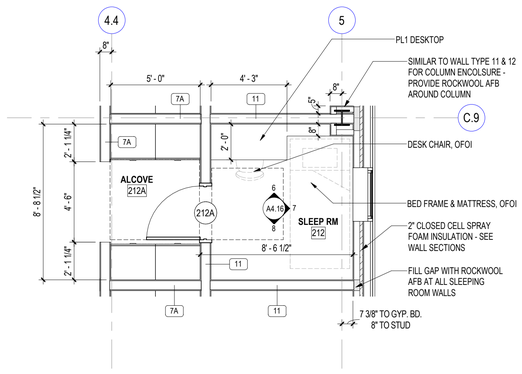
5 205T 206T 207T TOILET / SHOWERS

Scale: 1/4" = 1'-0"



3 123/124 DECON/CLEANING

Scale: 1/4" = 1'-0"



7 212 TYPICAL SLEEP ROOM

Scale: 1/4" = 1'-0"

T C A
ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
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Drawn TCA/A3C Checked TCA/A3C

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Sheet
A4.11

PROJECT TRUE

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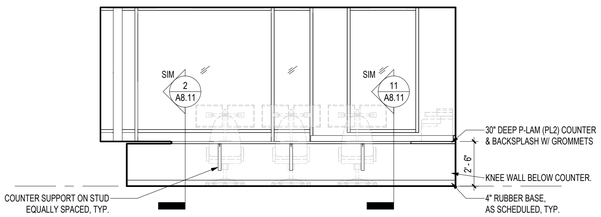
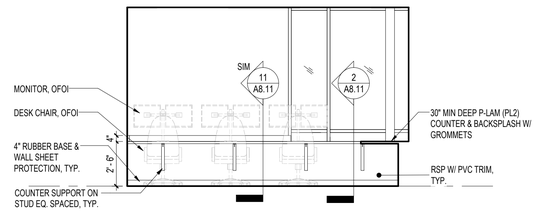
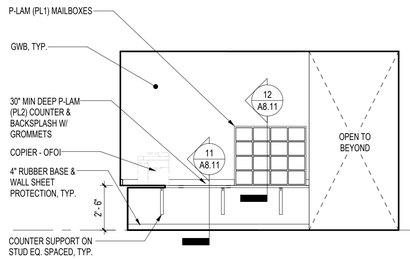


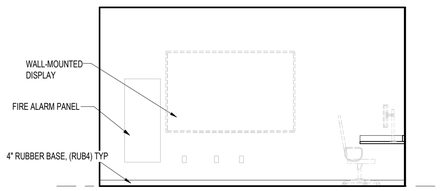
19 113 FF WORK - WEST
Scale: 1/4" = 1'-0"



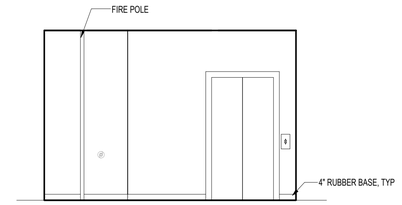
18 113 FF WORK - SOUTH
Scale: 1/4" = 1'-0"



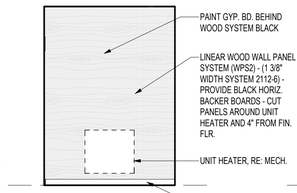
17 113 FF WORK - NORTH
Scale: 1/4" = 1'-0"



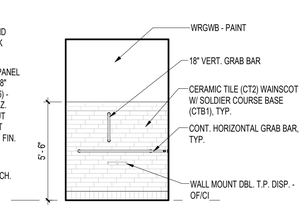
16 113 FF WORK - EAST
Scale: 1/4" = 1'-0"



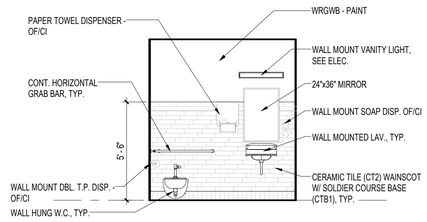
15 112 HALL - NORTH
Scale: 1/4" = 1'-0"



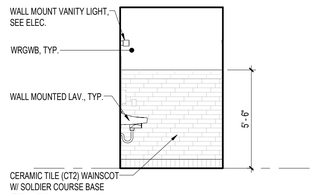
14 101 VEST - NORTH
Scale: 1/4" = 1'-0"



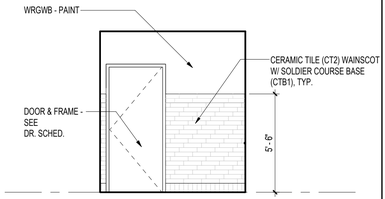
13 103T PUBLIC RR - NORTH
Scale: 1/4" = 1'-0"



12 103T PUBLIC RR - EAST
Scale: 1/4" = 1'-0"



11 103T PUBLIC RR - SOUTH
Scale: 1/4" = 1'-0"



10 103T PUBLIC RR - WEST
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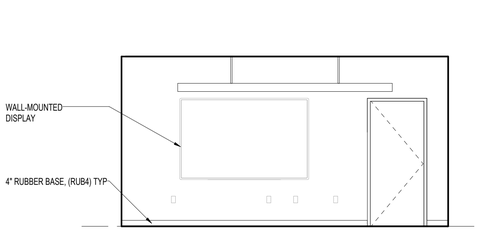

9 104 MEETING ROOM - NORTH
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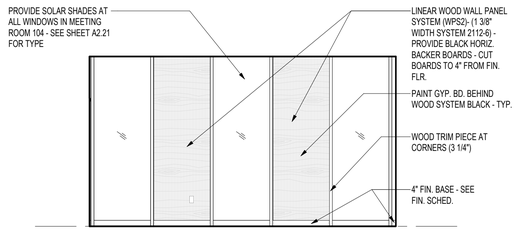

8 104 MEETING ROOM - EAST
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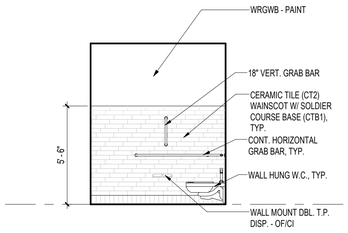
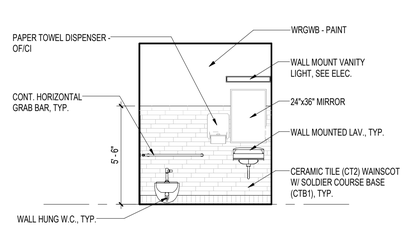
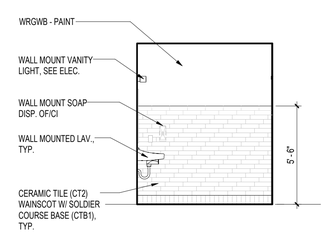


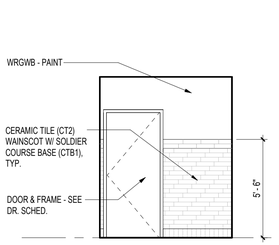
7 108 T STAFF RR - NORTH
Scale: 1/4" = 1'-0"



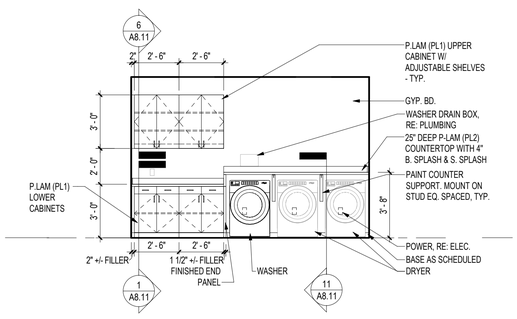
6 108T STAFF RR - EAST
Scale: 1/4" = 1'-0"



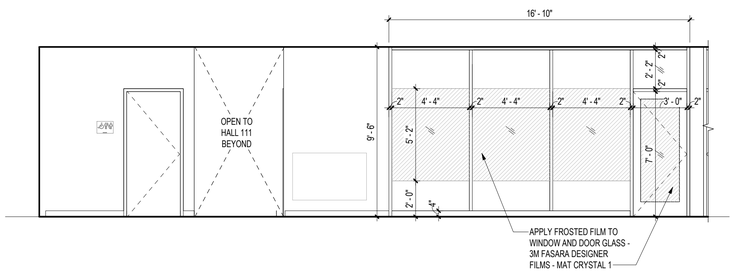
5 108T STAFF RR - SOUTH
Scale: 1/4" = 1'-0"



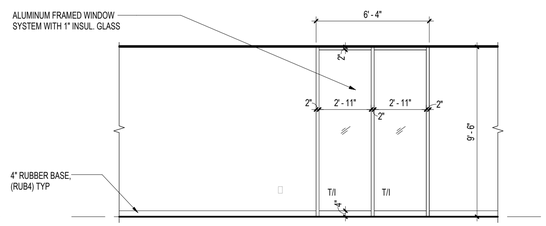
4 108T STAFF RR - WEST
Scale: 1/4" = 1'-0"



3 201 LAUNDRY - NORTH
Scale: 1/4" = 1'-0"



2 110 HALL - EAST
Scale: 1/4" = 1'-0"



1 110 HALL - WEST
Scale: 1/4" = 1'-0"

10/14/2024 4:16:47 PM

TCA
ARCHITECTURE + PLANNING + DESIGN

GENERAL NOTES

1. PROVIDE FULL HEIGHT BACKER BD. WALLS & CLG. OF SHOWER ENCLOSURES AND MOP SINKS, TYP.
2. PROVIDE WATER RESISTANT GWB AT ALL WET WALLS
3. PROVIDE 2X BLOCKING FOR WALL MOUNTED MARKER/ TACK BOARDS, TV'S, EQUIP., FURNISHINGS, ACCESSORIES, CABINETS, DOOR STOPS, BRACING, PLUMING FIXTURES, ETC - INCLUDING BLOCKING FOR ITEMS FURNISH BY OWNER. CONTRACTOR TO COORDINATE LOCATIONS W/ OWNER DURING ROUGH FRAMING.
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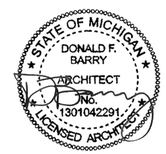

Project Number 21018

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Design Development	05/26/23

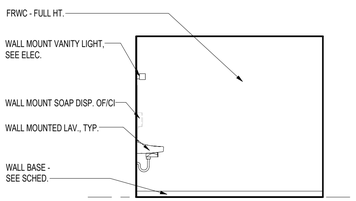
Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

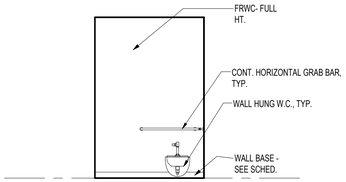
INTERIOR ELEVATIONS

A3C
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 643 - 1910
F: (866) 732 - 2168
www.a3c.com
COLLABORATIVE ARCHITECTURE

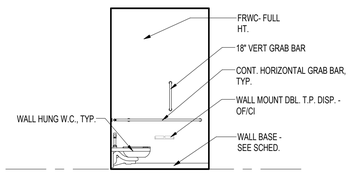
Sheet A4.12



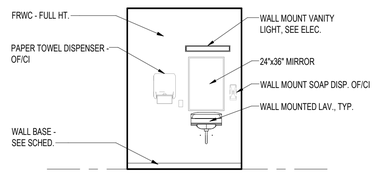
20 126T BAY TOILET - SOUTH
Scale: 1/4" = 1'-0"



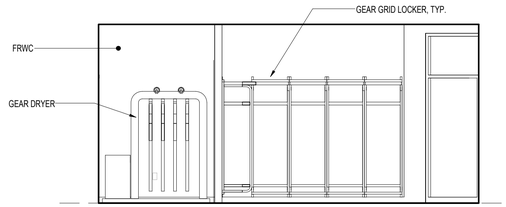
19 126T BAY TOILET - NORTHWEST
Scale: 1/4" = 1'-0"



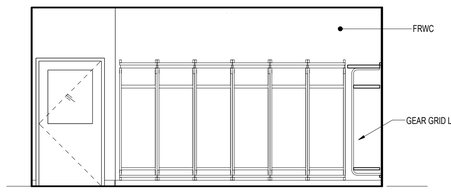
18 126T BAY TOILET - NORTHEAST
Scale: 1/4" = 1'-0"



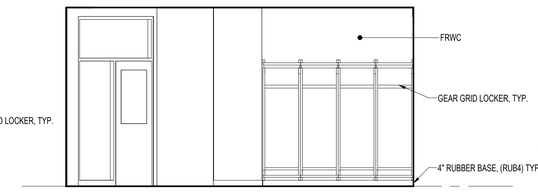
17 126T BAY TOILET - EAST
Scale: 1/4" = 1'-0"



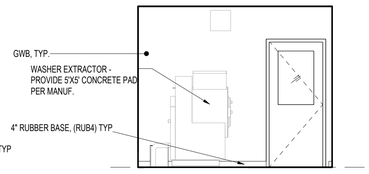
16 125 TURNOUT GEAR - WEST
Scale: 1/4" = 1'-0"



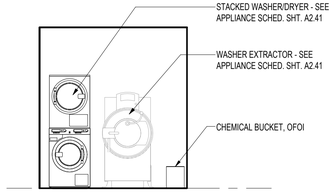
15 125 TURNOUT GEAR - SOUTH
Scale: 1/4" = 1'-0"



14 125 TURNOUT GEAR - NORTH
Scale: 1/4" = 1'-0"



13 124 CLEANING - WEST
Scale: 1/4" = 1'-0"



12 124 CLEANING - SOUTH
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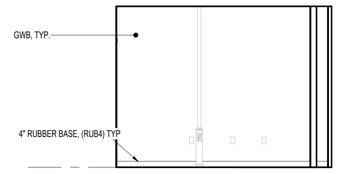

11 124 CLEANING - EAST
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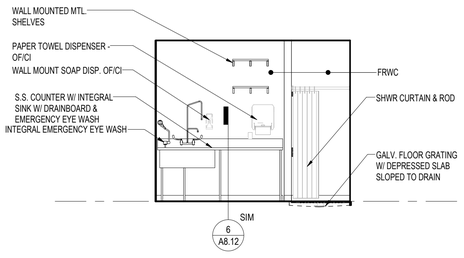
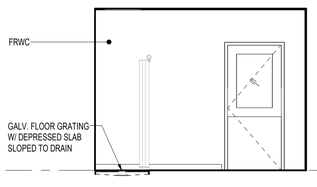
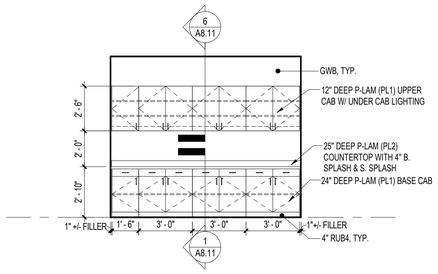


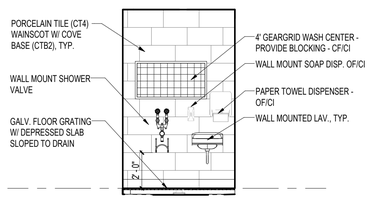
10 123 DECON - NORTH
Scale: 1/4" = 1'-0"



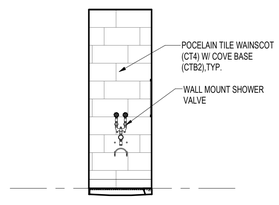
9 123 DECON - EAST
Scale: 1/4" = 1'-0"



8 122 EMS - SOUTH
Scale: 1/4" = 1'-0"



7 116A ALCOVE - NORTH
Scale: 1/4" = 1'-0"



6 116B WASH ALCOVE - SOUTH
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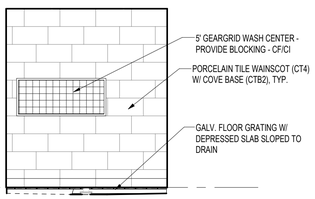
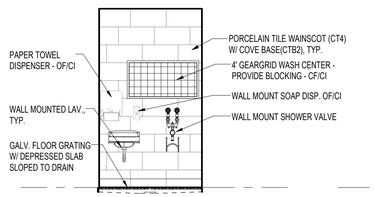
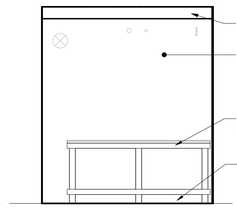


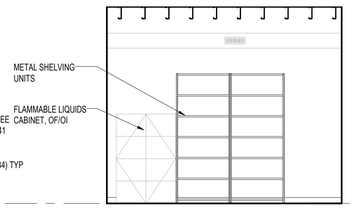
5 116B WASH ALCOVE - WEST
Scale: 1/4" = 1'-0"



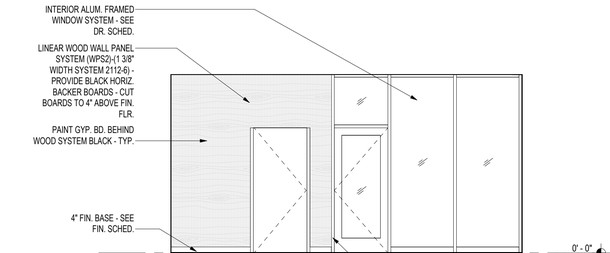
4 116C ALCOVE - SOUTHEAST
Scale: 1/4" = 1'-0"



3 119 SHOP - NORTH
Scale: 1/4" = 1'-0"



2 119 SHOP - WEST
Scale: 1/4" = 1'-0"



1 102 LOBBY - EAST
Scale: 1/4" = 1'-0"

10/14/2024 4:14:42 PM

TCA
ARCHITECTURE + PLANNING + DESIGN

GENERAL NOTES

1. PROVIDE FULL HEIGHT BACKER BD. WALLS & CLG. OF SHOWER ENCLOSURES AND MOP SINKS, TYP.
2. PROVIDE WATER RESISTANT GWB AT ALL WET WALLS
3. PROVIDE 2X BLOCKING FOR WALL MOUNTED MARKER/ TACK BOARDS, TV'S, EQUIP., FURNISHINGS, ACCESSORIES, CABINETS, DOOR STOPS, BRACING, PLUMING FIXTURES, ETC - INCLUDING BLOCKING FOR ITEMS FURNISH BY OWNER. CONTRACTOR TO COORDINATE LOCATIONS W/ OWNER DURING ROUGH FRAMING.
4. REFER TO SHEET G0.04 FOR WALL TYPES AND FINISHES.
5. ADA RESTROOMS, FIXTURE MOUNTING HEIGHTS AND CLEARANCE REQUIREMENTS SHALL COMPLY WITH ICC A117.1 CHAPTER 6.
6. ELECTRICAL AND MECHANICAL UNITS ARE SHOWN FOR REFERENCE ONLY.
7. REFER TO A5.11 FOR RESTROOM FIXTURE AND ACCESSORY DIMENSIONS NOT SHOWN.
8. SEE APPLIANCE & EQUIPMENT SCHEDULES ON SHEET A2.41 FOR ALL APPLIANCES AND EQUIPMENT.

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23
Design Development	05/26/23

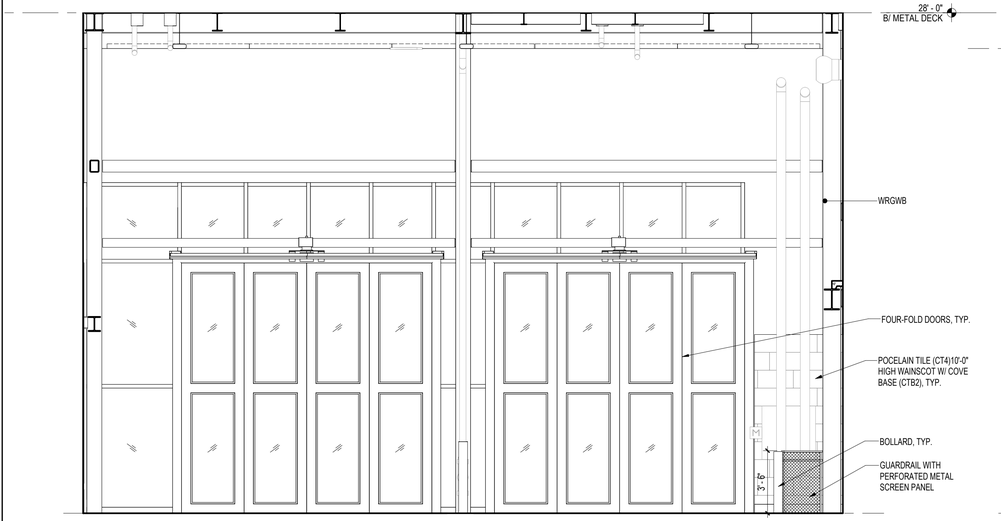
Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

INTERIOR ELEVATIONS

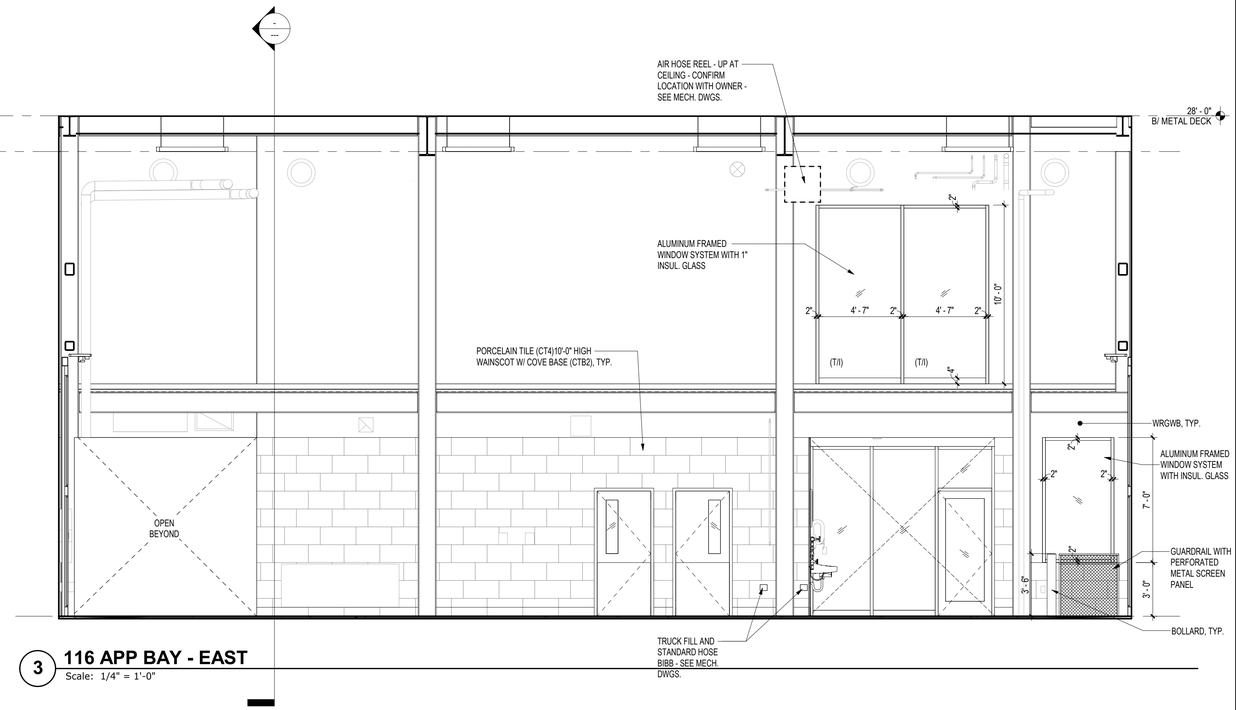
A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet A4.13



4 116 APP BAY - NORTH

Scale: 1/4" = 1'-0"



3 116 APP BAY - EAST

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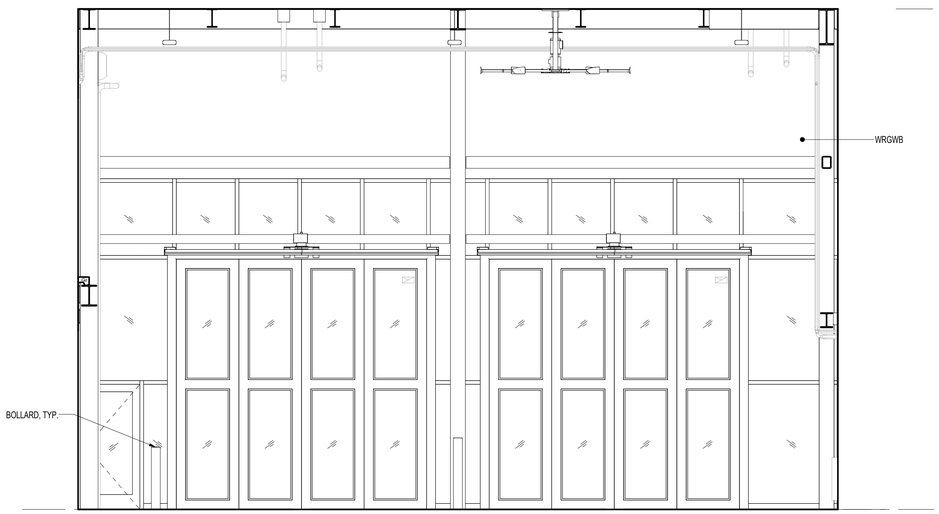
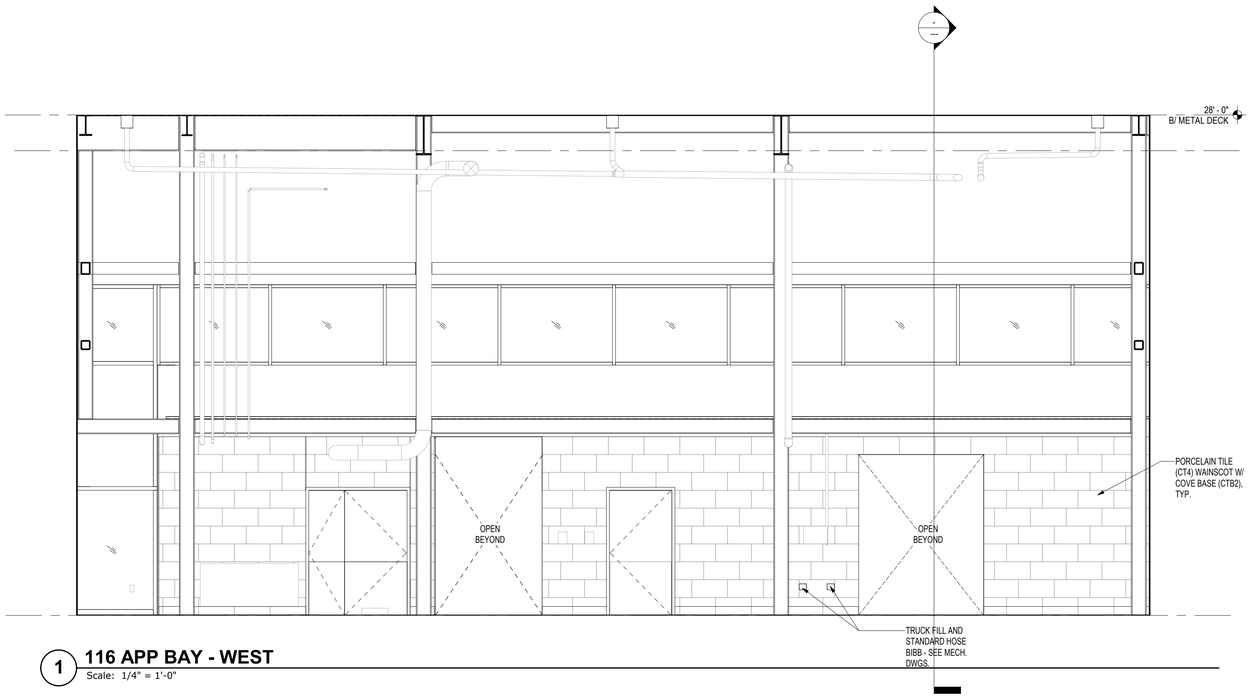


2 116 APP BAY - SOUTH

Scale: 1/4" = 1'-0"



1 116 APP BAY - WEST

Scale: 1/4" = 1'-0"

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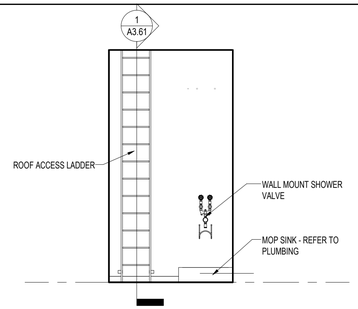

14 202 CUSTODIAL - WEST
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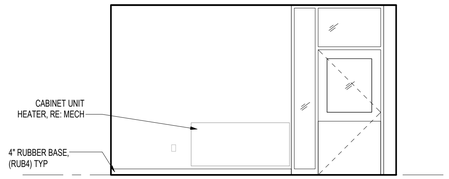
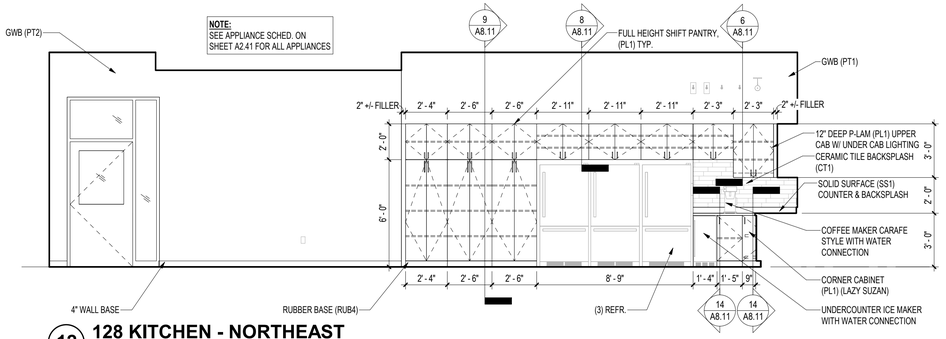
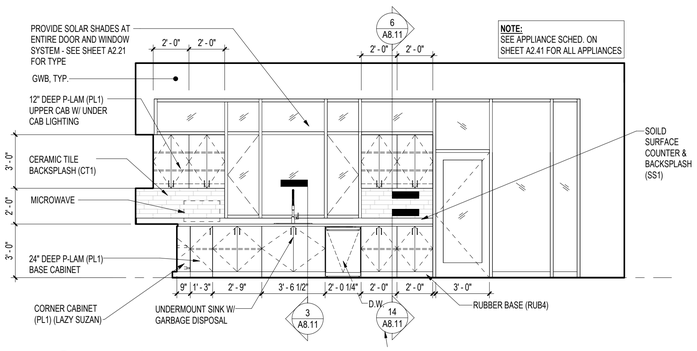


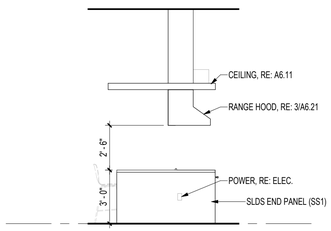
13 109 HALL - SOUTHWEST
Scale: 1/4" = 1'-0"



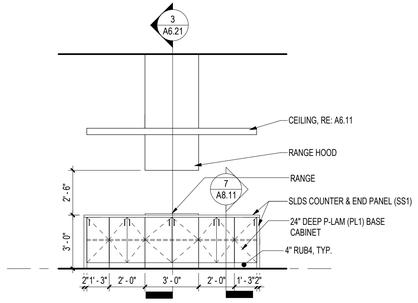
12 128 KITCHEN - NORTHEAST
Scale: 1/4" = 1'-0"



11 128 KITCHEN - SOUTHEAST
Scale: 1/4" = 1'-0"



10 128 KITCHEN ISLAND - NORTHEAST
Scale: 1/4" = 1'-0"



9 128 KITCHEN ISLAND - SOUTHEAST
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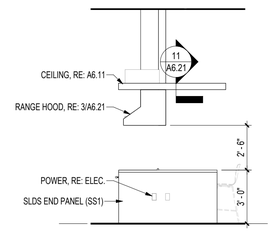
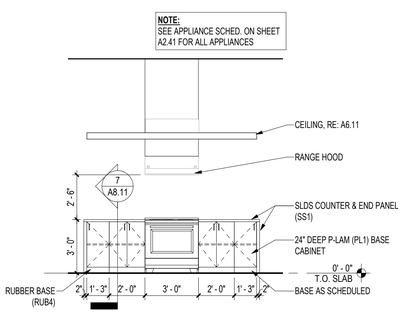
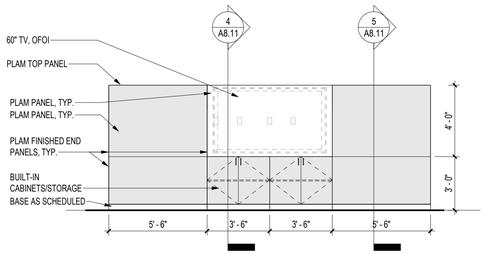


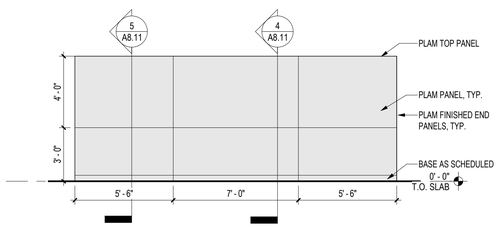
8 128 KITCHEN-SOUTHWEST
Scale: 1/4" = 1'-0"



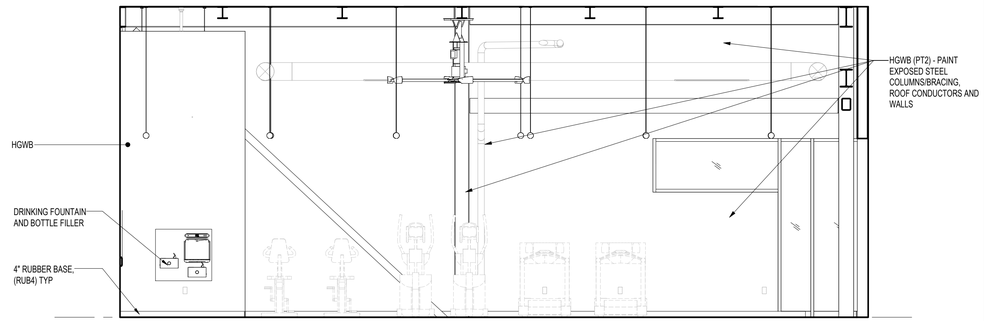
7 128 KITCHEN - NORTHWEST
Scale: 1/4" = 1'-0"



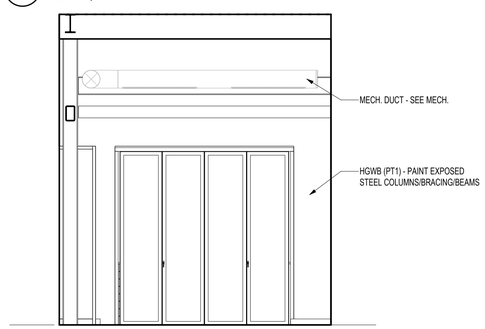
6 129 DAYROOM - NORTHWEST
Scale: 1/4" = 1'-0"



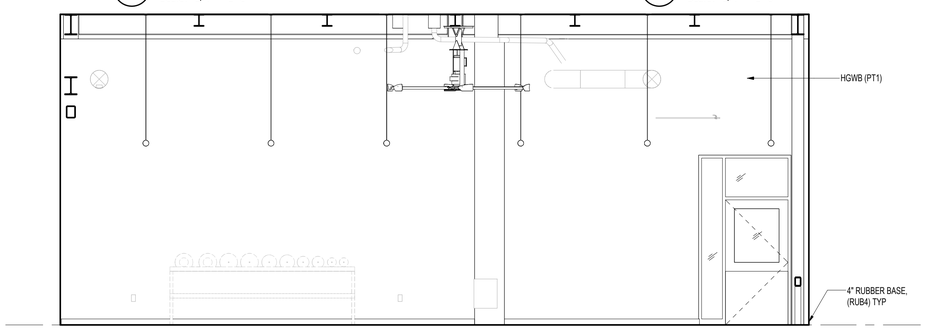
5 129 DAYROOM - SOUTHWEST
Scale: 1/4" = 1'-0"



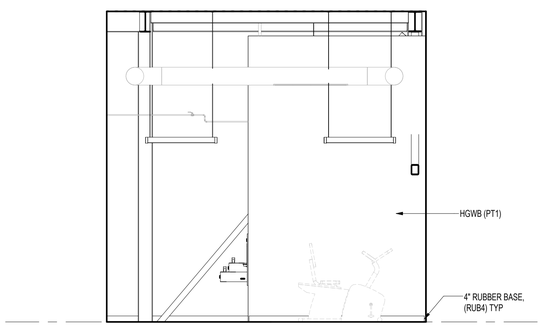
4 130 EXERCISE - NORTHEAST
Scale: 1/4" = 1'-0"



3 130 EXERCISE - SOUTHEAST
Scale: 1/4" = 1'-0"



2 130 EXERCISE - SOUTHWEST
Scale: 1/4" = 1'-0"



1 130 EXERCISE - NORTHWEST
Scale: 1/4" = 1'-0"

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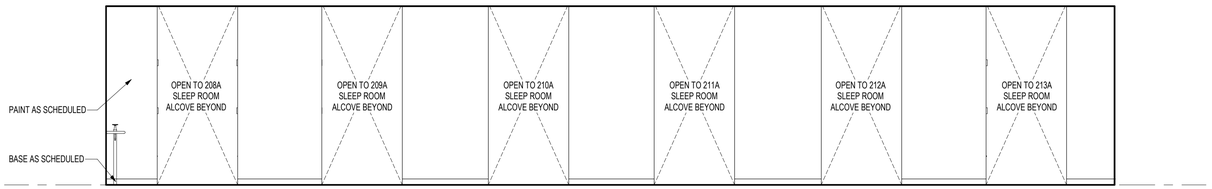
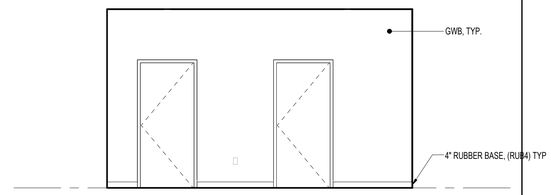
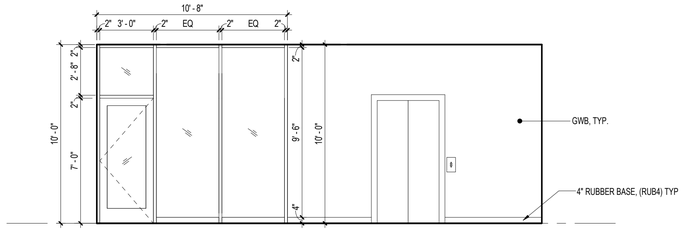


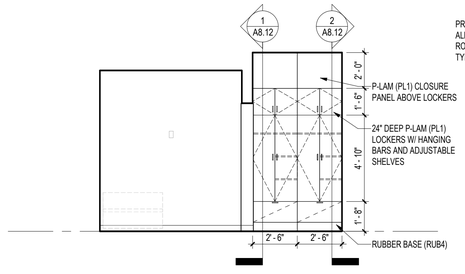
11 220 HALL - EAST
Scale: 1/4" = 1'-0"



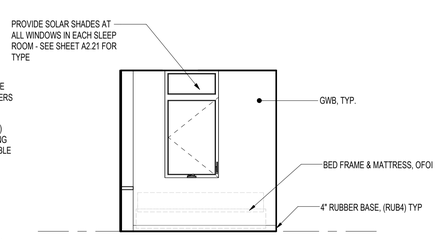
10 216 HALL - SOUTH
Scale: 1/4" = 1'-0"



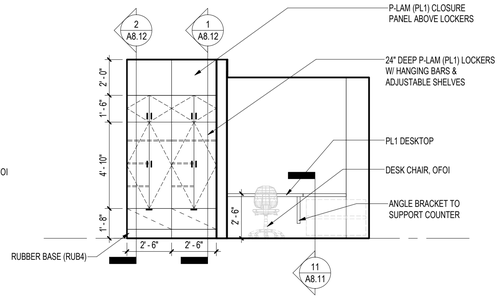
9 216 HALL - NORTH
Scale: 1/4" = 1'-0"



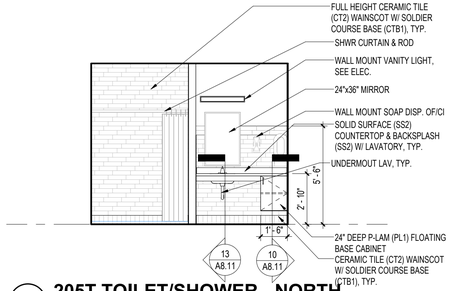
8 212 SLEEP ROOM - SOUTH
Scale: 1/4" = 1'-0"



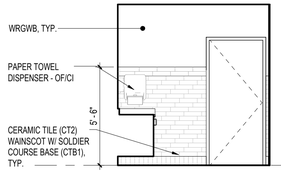
7 212 SLEEP ROOM - EAST
Scale: 1/4" = 1'-0"



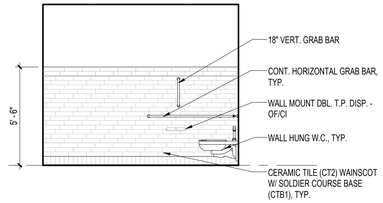
6 212 SLEEP ROOM - NORTH
Scale: 1/4" = 1'-0"



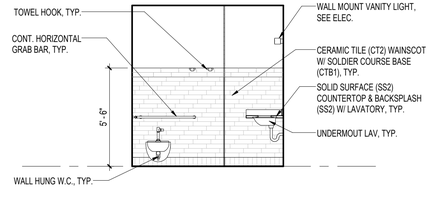
5 205T TOILET/SHOWER - NORTH
Scale: 1/4" = 1'-0"
NOTE: ROOMS 206T & 207T SIMILAR



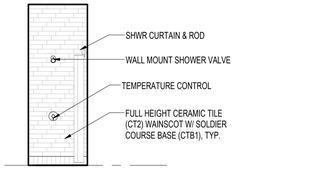
4 205T TOILET/SHOWER - EAST
Scale: 1/4" = 1'-0"
NOTE: ROOMS 206T & 207T SIMILAR



3 205T TOILET/SHOWER - SOUTH
Scale: 1/4" = 1'-0"
NOTE: ROOMS 206T & 207T SIMILAR



2 205T - TOILET/SHOWER - WEST
Scale: 1/4" = 1'-0"
NOTE: ROOMS 206T & 207T SIMILAR



1 205T TOILET/SHOWER - EAST SHOWER WALL
Scale: 1/4" = 1'-0"
NOTE: ROOMS 206T & 207T SIMILAR

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GENERAL NOTES

1. PROVIDE FULL HEIGHT BACKER BD. WALLS & CLG. OF SHOWER ENCLOSURES AND MOP SINKS, TYP.
2. PROVIDE WATER RESISTANT GWB AT ALL WET WALLS
3. PROVIDE 2X BLOCKING FOR WALL MOUNTED MARKER/ TACK BOARDS, TV'S, EQUIP., FURNISHINGS, ACCESSORIES, CABINETS, DOOR STOPS, BRACING, PLUMING FIXTURES, ETC - INCLUDING BLOCKING FOR ITEMS FURNISH BY OWNER. CONTRACTOR TO COORDINATE LOCATIONS W/ OWNER DURING ROUGH FRAMING.
4. REFER TO SHEET G0.04 FOR WALL TYPES AND FINISHES.
5. ADA RESTROOMS, FIXTURE MOUNTING HEIGHTS AND CLEARANCE REQUIREMENTS SHALL COMPLY WITH ICC A117.1 CHAPTER 6.
6. ELECTRICAL AND MECHANICAL UNITS ARE SHOWN FOR REFERENCE ONLY.
7. REFER TO A5.11 FOR RESTROOM FIXTURE AND ACCESSORY DIMENSIONS NOT SHOWN.
8. SEE APPLIANCE & EQUIPMENT SCHEDULES ON SHEET A2.41 FOR ALL APPLIANCES AND EQUIPMENT.

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

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Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

INTERIOR ELEVATIONS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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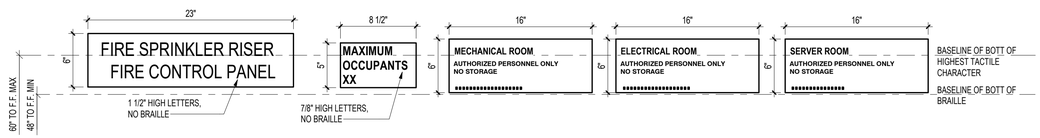
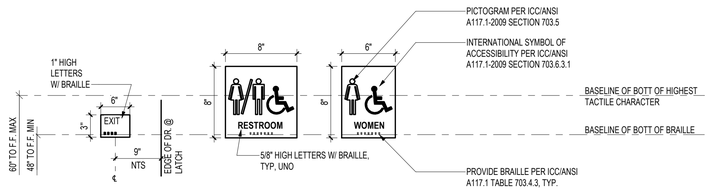
Sheet A4.16

CODE REQUIRED SIGNAGE





ROOM SIGNS & EXIT EGRESS SIGNS:

1. SIGNS TO COMPLY WITH ICC/ANSI A117.1-2009 AND 2015 MBC, SECTION 1013 AND 1111.
2. TACTILE SIGNAGE IS TO BE LOCATED NO LESS THAN 48" ABOVE THE FLOOR MEASURE TO THE BASELINE OF THE LOWEST RAISED CHARACTER AND NO MORE THAN 60" ABOVE FINISH FLOOR MEASURED TO THE BASELINE OF THE HIGH RAISED CHARACTER. TACTILE SIGNAGE TO BE LOCATED ON THE LATCH SIDE OF DOOR WHEN EVER POSSIBLE. REFER ALSO TO INTERIOR ELEVATIONS FOR LOCATIONS OF SIGNAGE.
3. CHARACTERS AND THEIR BACKGROUND, AND PICTOGRAM AND THEIR FIELD SHALL HAVE A NON-GLARE FINISH. CHARACTERS AND PICTOGRAMS SHALL HAVE A HIGH CONTRAST WITH THEIR BACKGROUND OR FIELD.
4. A SIGN STATING "EXIT" IN VISUAL CHARACTERS, RAISED CHARACTERS, AND BRAILLE, SHALL BE ADJACENT TO EACH DOOR TO AN AREA OF REFUGE, AN EXTERIOR AREA FOR ASSISTED RESCUE, AN EXIT STAIRWAY OR RAMP, AN EXIT PASSAGEWAY AND THE EXIT DISCHARGE. PER 2015 MBC, SECTION 1013.4.
5. ADA SIGNAGE W/ INTERNATIONAL ACCESSIBILITY SYMBOL SHALL HAVE WHITE CHARACTERS, SYMBOLS, BRAILLE AND LETTERS ON A BLUE BACKGROUND.
6. VERIFY OCCUPANT LOAD PRIOR TO FABRICATION.

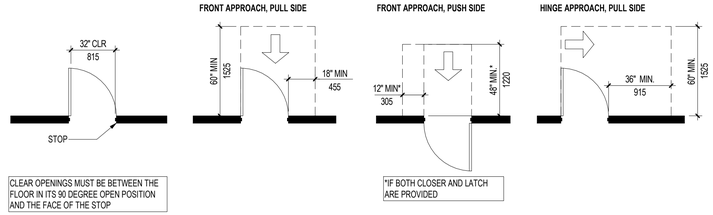
DOOR CLEARANCES (PER ANSI A117.1-2009)

404.2.2 CLEAR WIDTH: DOORWAYS SHALL HAVE A CLEAR OPENING WIDTH OF 32 INCHES (815 MM) MINIMUM.

404.2.6 DOOR HARDWARE: HANDLES, PULLS, LATCHES, LOCKS, AND OTHER OPERABLE PARTS ON ACCESSIBLE DOORS SHALL HAVE A SHAPE THAT IS EASY TO GRASP WITH ONE HAND AND DOES NOT REQUIRE TIGHT GRASPING, PINCHING, OR TWISTING OF THE WRIST TO OPERATE. OPERABLE PARTS OF SUCH HARDWARE SHALL BE 34 INCHES (856 MM) MINIMUM AND 48 INCHES (1220 MM) MAXIMUM ABOVE THE FLOOR. WHERE SLIDING DOORS ARE IN THE FULLY OPEN POSITION, OPERATING HARDWARE SHALL BE EXPOSED AND USABLE FROM BOTH SIDES.

404.2.7 CLOSING SPEEDS: DOOR CLOSERS SHALL BE ADJUSTED SO THAT FROM AN OPEN POSITION OF 90 DEGREES, THE TIME REQUIRED TO MOVE THE DOOR TO AN OPEN POSITION OF 12 DEGREES SHALL BE 5SECONDS MINIMUM.

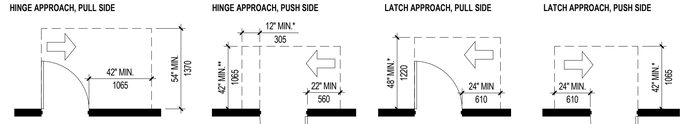
404.2.8 DOOR-OPENING FORCE: FIRE DOORS SHALL HAVE THE MINIMUM OPENING FORCE ALLOWABLE BY THE APPROPRIATE ADMINISTRATIVE AUTHORITY. THE FORCE FOR PUSHING OR PULLING DOORS OTHER THAN FIRE DOORS SHALL BE AS FOLLOWS: 5.0 POUNDS (22.2 N) MAXIMUM



CLEAR OPENINGS MUST BE BETWEEN THE FLOOR IN ITS 90 DEGREE OPEN POSITION AND THE FACE OF THE STOP

*IF BOTH CLOSER AND LATCH ARE PROVIDED

WHERE A TACTILE SIGN IS PROVIDED AT A DOOR, THE SIGN SHALL BE LOCATED ALONGSIDE THE DOOR AT THE LATCH SIDE. WHERE A TACTILE SIGN IS PROVIDED AT DOUBLE DOORS WITH ON ACTIVE LEAF, THE SIGN SHALL BE LOCATED ON THE INACTIVE LEAF. WHERE A TACTILE SIGN IS PROVIDED AT DOUBLE DOORS WITH TWO ACTIVE LEAFS, THE SIGN SHALL BE LOCATED TO THE RIGHT HAND SIDE OF THE DOUBLE DOORS. WHERE THERE IS NO WALL SPACE AT THE LATCH SIDE OF A SINGLE DOOR OR THE RIGHT SIDE OF DOUBLE DOORS, SIGNS CONTAINING TACTILE CHARACTERS SHALL BE LOCATED ON THE NEAREST ADJACENT WALL. SIGNS CONTAINING TACTILE CHARACTERS SHALL BE LOCATED SO THAT A CLEAR FLOOR SPACE OF 18 INCHES MINIMUM BY 18 INCHES MINIMUM, CENTERED ON THE TACTILE CHARACTERS, IS PROVIDED, BEYOND THE ARC OF ANY DOOR SWING BETWEEN THE CLOSED POSITION AND 45 DEGREE OPEN POSITION. WHERE PROVIDED, SIGNS IDENTIFYING PERMANENT ROOMS AND SPACES SHALL BE LOCATED AT THE ENTRANCE TO THE OUTSIDE OF THE ROOM OR SPACE. WHERE PROVIDED, SIGNS IDENTIFYING EXITS SHALL BE LOCATED AT THE EXIT DOOR WHEN APPROACHED IN THE DIRECTION OF EGRESS TRAVEL.



* IF BOTH CLOSER AND LATCH ARE PROVIDED
** 48 MIN. (1220) IF BOTH CLOSER AND LATCH PROVIDED

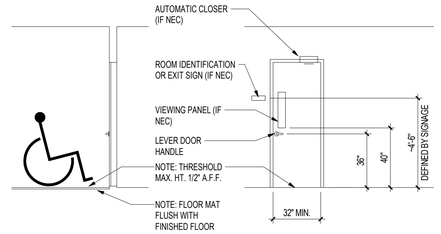
*54" MIN (1370) IF CLOSER IS PROVIDED

*48" MIN. (1220) IF CLOSER IS PROVIDED

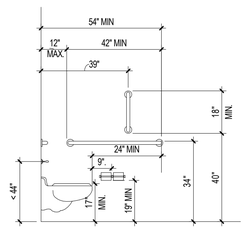
ICC A117.1 TABLE 404.2.3.2-MANEUVERING CLEARANCES AT MANUAL SWINGING DOORS

TYPE OF USE		MINIMUM CLEARANCES AT DOORS	
APPROACH DIRECTION	**DOOR SIDE**	**PERPENDICULAR TO DOORWAY**	**BEYOND LATCH PARALLEL TO DOOR**
FROM FRONT	PULL	60 INCHES (1525 MM)	18 INCHES (455 MM)
FROM FRONT	PUSH	48 INCHES (1220 MM)	0 INCHES (0 MM)[3]
FROM HINGE SIDE	PULL	60 INCHES (1525 MM)	36 INCHES (915 MM)
FROM HINGE SIDE	PULL	54 INCHES (1370 MM)	42 INCHES (1065 MM)
FROM HINGE SIDE	PUSH	42 INCHES (1065 MM)[1]	22 INCHES (560 MM)[3&4]
FROM LATCH SIDE	PULL	48 INCHES (1220 MM)[1]	24 INCHES (610 MM)
FROM LATCH SIDE	PUSH	42 INCHES (1065 MM)[2]	24 INCHES (610 MM)

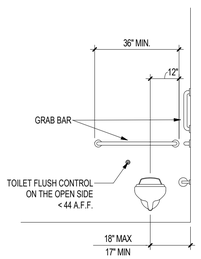
[1]ADD 6 INCHES (150 MM) IF CLOSER AND LATCH PROVIDED.
[2]ADD 6 INCHES (150 MM) IF CLOSER PROVIDED.
[3]ADD 12 INCHES (305 MM) BEYOND LATCH IF CLOSER AND LATCH PROVIDED.
[4]BEYOND HINGE SIDE.



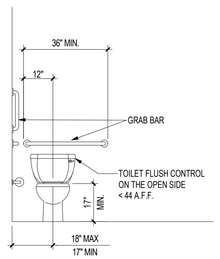
TYPICAL ACCESSIBLE MOUNTING HEIGHTS (PER ANSI A117.1-2009)



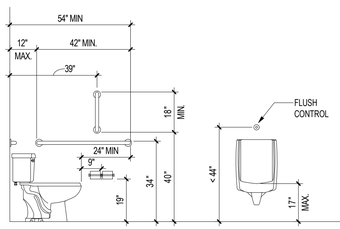
1A WALL MOUNTED TOILET



1B ADA GRAB BARS

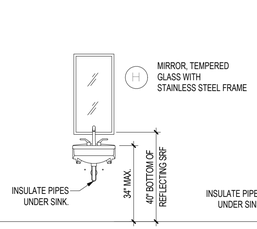


1C FLOOR MOUNTED TOILET

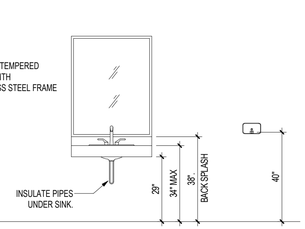


1D TOILET PAPER HOLDER

1E URINAL

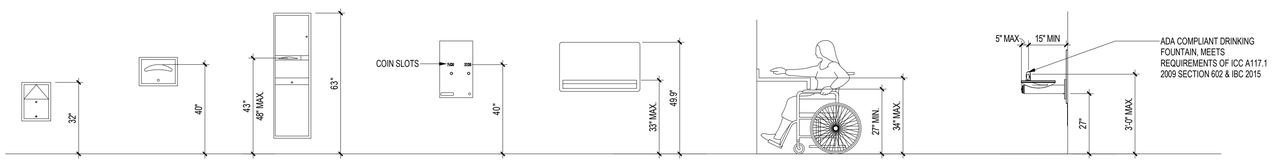


1J WALL HUNG SINK



1K LAVATORY

1L SOAP DISP.



1F SANITARY NAPKIN DISPOSAL
1G TOILET SEAT COVER DISPENSER
1M PAPER TOWEL DISP./ WASTE RECEPTACLE
1N SURFACE MOUNTED SANITARY NAPKIN VENDOR
1P SURFACE MOUNTED DIAPER CHANGING STATION
1Q COUNTERTOP
1R DRINKING FOUNTAIN

ACCESSIBLE TOILET AND BATHING ROOMS NOTES

GENERAL: ACCESSIBLE TOILET AND BATHING ROOMS SHALL COMPLY WITH ICC/ANSI CHAPTER 6 PLUMBING ELEMENTS AND FACILITIES AND MBC 2015 CHAPTER 12.

603.2 CLEARANCES

603.2.1 TURNING SPACE. A TURNING SPACE COMPLYING WITH SECTION 304 SHALL BE PROVIDED WITHIN THE ROOM. THE REQUIRED TURNING SPACE SHALL NOT BE PROVIDED WITHIN THE TOILET COMPARTMENT..

603.2.2 DOOR SWING. DOORS SHALL NOT SWING INTO THE CLEAR FLOOR SPACE OR CLEARANCE FOR ANY FIXTURE.
EXCEPTIONS:
1. DOORS TO A TOILET OR BATHING ROOM FOR A SINGLE OCCUPANT, ACCESSED ONLY THROUGH A PRIVATE OFFICE AND NOT FOR COMMON USE OR PUBLIC USE SHALL BE PERMITTED TO SWING INTO THE CLEAR FLOOR SPACE, PROVIDED THE SWING OF THE DOOR CAN BE REVERSED TO COMPLY WITH SECTION 603.2.2.

2. WHERE THE ROOM IS FOR INDIVIDUAL USE AND A CLEAR FLOOR SPACE COMPLYING WITH SECTION 305.3 IS PROVIDED WITHIN THE ROOM BEYOND THE ARC OF THE DOOR SWING, THE DOOR SHALL NOT BE REQUIRED TO COMPLY WITH SECTION 603.2.2.

603.3 MIRRORS.
WHERE MIRRORS ARE LOCATED ABOVE LAVATORIES, A MIRROR SHALL BE LOCATED OVER THE ACCESSIBLE LAVATORY AND SHALL BE MOUNTED WITH THE BOTTOM EDGE OF THE REFLECTING SURFACE 40 INCHES (1015 MM) MAXIMUM ABOVE THE FLOOR. WHERE MIRRORS ARE LOCATED ABOVE COUNTERS THAT DO NOT CONTAIN LAVATORIES, THE MIRROR HALL BE MOUNTED WITH THE BOTTOM EDGE OF THE REFLECTING SURFACE 40 INCHES (1015 MM) MAXIMUM ABOVE THE FLOOR.

603.4 COAT HOOKS AND SHELVES.
COAT HOOKS SHALL BE LOCATED WITHIN ONE OF THE REACH RANGES SPECIFIED IN SECTION 308. SHELVES SHALL BE 40 INCHES (1015 MM) MINIMUM AND 48 INCHES (1220 MM) MAXIMUM ABOVE THE FINISHED FLOOR.

603.6 OPERABLE PARTS.
OPERABLE PARTS ON TOWEL DISPENSERS AND HAND DRYERS SERVING ACCESSIBLE LAVATORIES SHALL COMPLY WITH IBC TABLE 603.6

IBC TABLE 603.6 MAXIMUM REACH DEPTH AND HEIGHT:

MAXIMUM REACH DEPTH	0.5 INCH (13 MM)	2 INCHES (51 MM)	5 INCHES (125 MM)	6 INCHES (150 MM)	9 INCHES (230 MM)	11 INCHES (280 MM)
MAXIMUM REACH HEIGHT	48 INCHES (1220 MM)	46 INCHES (1170 MM)	42 INCHES (1065 MM)	40 INCHES (1015 MM)	36 INCHES (915 MM)	34 INCHES (865 MM)

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STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

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Bids/Permits	08/04/23
Design Development	05/26/23
Drawn TCA/A3C	Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

ADA CODE SHEET

A3C
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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COLLABORATIVE ARCHITECTURE

Sheet A5.11

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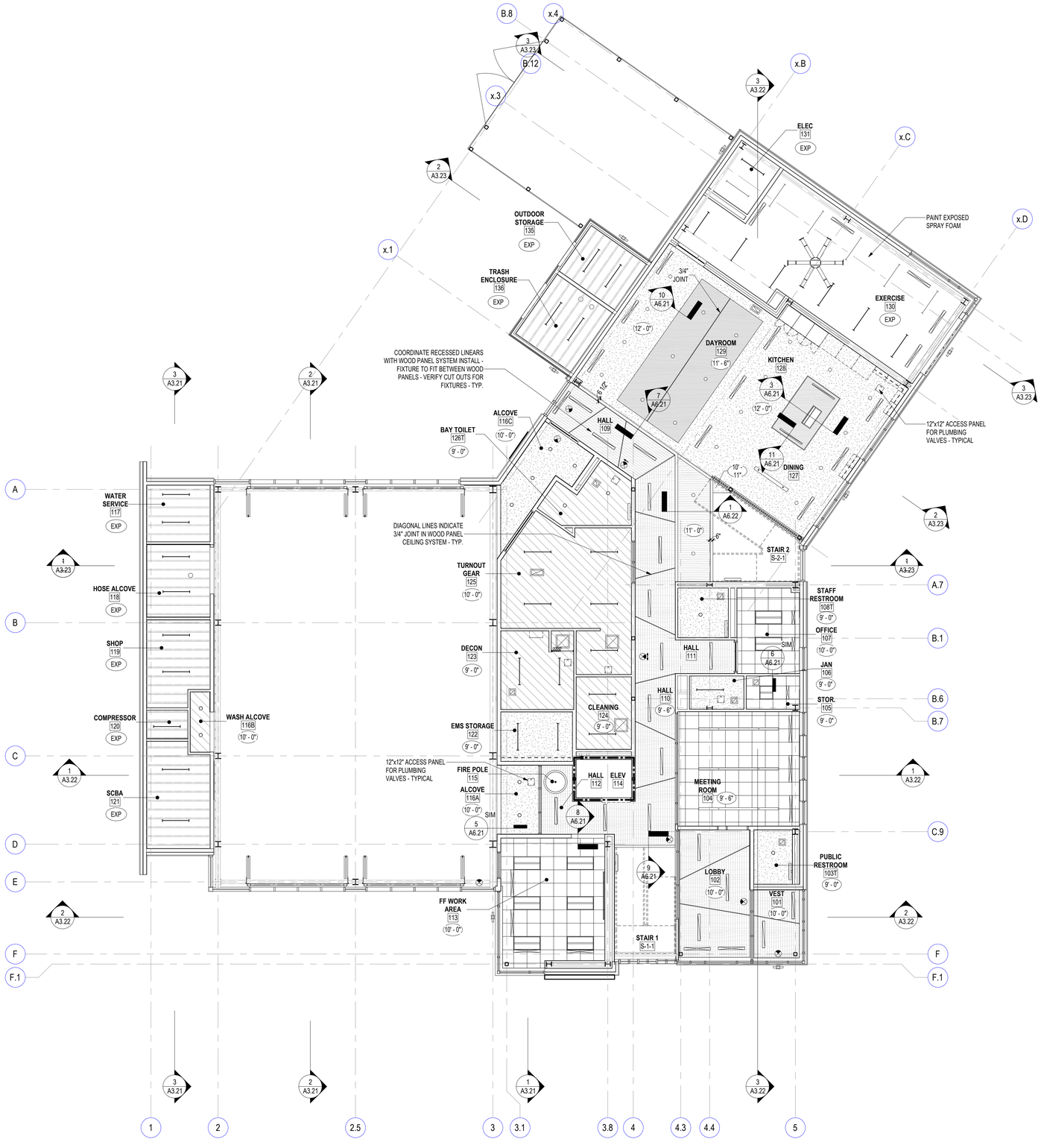

GENERAL NOTES - RCP:

1. SEE ELECTRICAL DRAWINGS FOR FIXTURE TYPES
2. SEE MECHANICAL & PLUMBING PLANS & SPECS FOR ADDITIONAL CEILING & WALL ACCESS PANELS AT MECHANICAL EQUIPMENT
3. SEE G0.02 - SHEET INDEX FOR GENERAL PROJECT NOTES, LEGENDS AND ABBREVIATIONS.
4. SEE FINISH SCHEDULE ON SHEET A2.41 FOR CEILING AND CEILING GRID TYPES.
5. EXCEPT WHERE INDICATED, CENTER CEILING GRIDS IN ROOMS. USE HALF TILES OF GREATER @ PERIMETERS WHERE POSSIBLE.
6. ALIGN CEILING ITEMS AS SHOWN, WITH COMMON CEILINGS TYPICALLY. CENTER ITEM SIN CEILINGS OR IN AREAS UNLESS INDICATED OTHERWISE.
7. WHERE TEGULAR OR BEVELED TILE IS USED, PAINT ALL CUT EDGES TO MATCH.
8. CAULK JOINT BETWEEN CEILING GRID (WALL ANGLE) AND WALL WHERE GAPS ARE GREATER THAN 1/8".
9. PROVIDE ACCESS PANELS AS REQUIRED IN GWB CEILINGS FOR ACCESS AS REQUIRED BY ALL TRADES.
10. FIRE SPRINKLERS SHALL BE CENTERED IN CEILING TILES OR HALF TILE. FIRE SPRINKLERS SHALL BE LOCATED IN ALIGNMENT WITH OTHER CEILING ITEMS AND SHALL BE PLACED IN COORDINATION WITH LIGHT FIXTURES POSITIONS INDICATED, TYPICAL.

RCP LEGEND:

- INDICATES GYPSUM BOARD CEILING: CEILING TYPE C2
- 2 X 2 ACOUSTICAL PANEL CEILING: CEILING TYPE C1
- GYP. BACKERBOARD CEILING - SKIMCOAT FOR SMOOTH SURFACE AS REQUIRED
- ACOUSTICAL WOOD PANEL
- INDICATES 12x12 ACCESS PANEL - SEE DETAIL #4/A6.21
- SUSPENDED LIGHT FIXTURE
- UNDERCABINET LIGHT FIXTURE
- RECESSED LINEAR (2" & 6") IN WOOD PANEL CEILING
- LAY-IN/RECESSED LIGHT FIXTURE
- RECESSED DOWNLIGHT
- WALL MOUNTED EXTERIOR LIGHT
- 4' UTILITY LIGHT FIXTURE SUSPENDED AT EXPOSED CEILINGS AND SURFACE MOUNTED AT ALL OTHERS
- 4' SUSPENDED HIGH BAY FIXTURE
- EXIT LIGHT
- RETURN AIR EXHAUST
- SUPPLY AIR
- WALL MOUNTED LIGHT
- RECESSED LINEAR IN EXTERIOR PHENOLIC PANEL ROOF OVERHANG
- SUSPENDED DECORATIVE LIGHT FIXTURE
- 1/2 HR WALL EXTEND TO DECK ABOVE
- 1 HR WALL EXTEND TO DECK ABOVE
- 10'-0" FINISH HEIGHT ABOVE FIN. FLOOR
- EXP EXPOSED CEILING & OPEN FRAMING
- 8' DIAMETER MECHANICAL CEILING FAN

1 REFLECTED CEILING PLAN - LEVEL 1
Scale: 1/8" = 1'-0"

0 4' 8' 16'

35° PROJECT TRUE

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DONALD F. BARRY
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A3C COLLABORATIVE ARCHITECTURE
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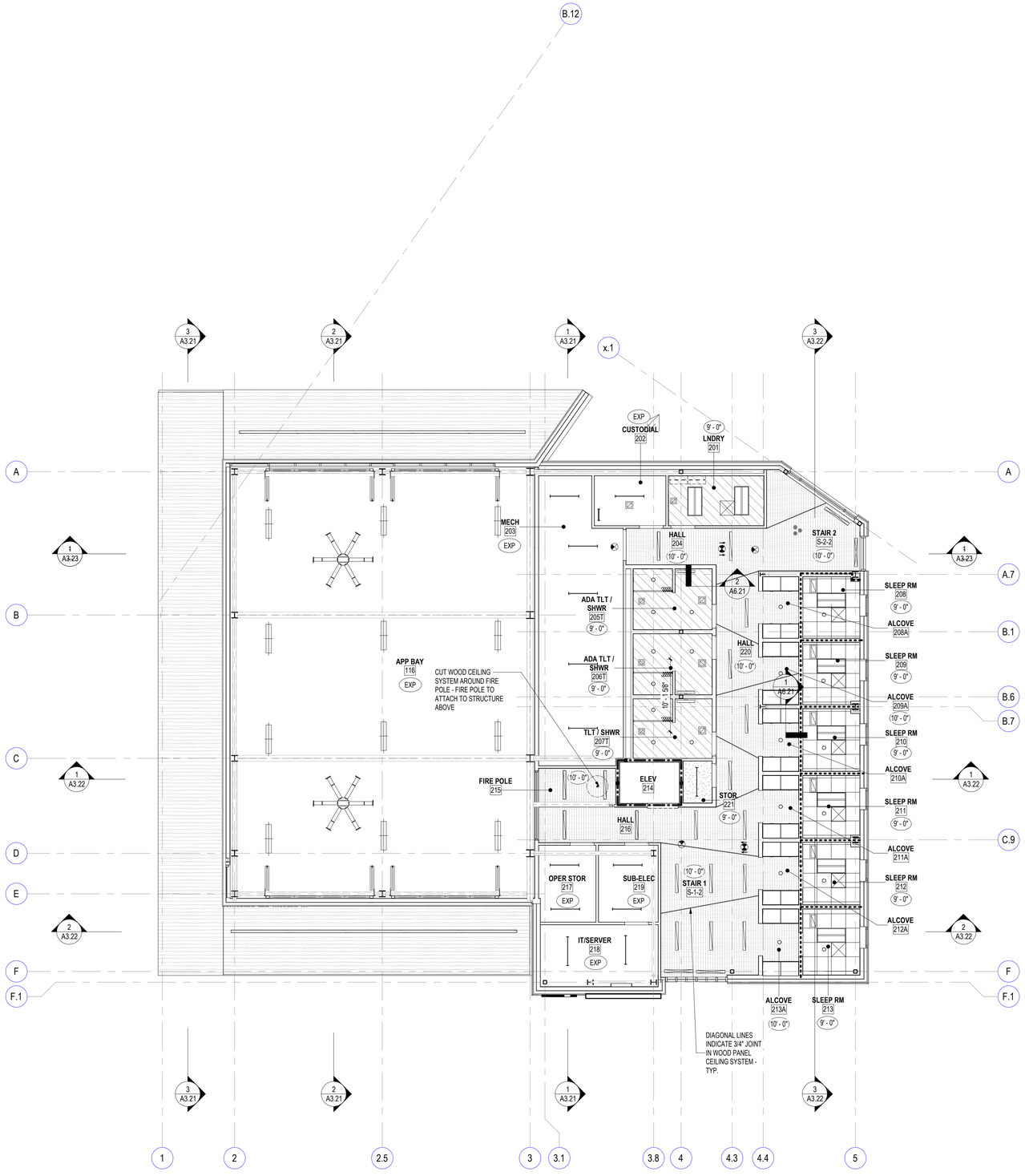
FIRST LEVEL REFLECTED CEILING PLAN

Sheet A6.11



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9. PROVIDE ACCESS PANELS AS REQUIRED IN GWB CEILINGS FOR ACCESS AS REQUIRED BY ALL TRADES.
10. FIRE SPRINKLERS SHALL BE CENTERED IN CEILING TILES OR HALF TILE. FIRE SPRINKLERS SHALL BE LOCATED IN ALIGNMENT WITH OTHER CEILING ITEMS AND SHALL BE PLACED IN COORDINATION WITH LIGHT FIXTURES POSITIONS INDICATED, TYPICAL.

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- 4' SUSPENDED HIGH BAY FIXTURE
- EXIT LIGHT
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- SUSPENDED DECORATIVE LIGHT FIXTURE
- 1/2 HR WALL EXTEND TO DECK ABOVE
- 1 HR WALL EXTEND TO DECK ABOVE
- 10'-0" FINISH HEIGHT ABOVE FIN. FLOOR
- EXP EXPOSED CEILING & OPEN FRAMING
- 8' DIAMETER MECHANICAL CEILING FAN

1 REFLECTED CEILING PLAN - LEVEL 2
Scale: 1/8" = 1'-0"

0 4' 8' 16'

35° PROJECT TRUE

T C A
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2415 S HURON PKWY
ANN ARBOR, MI 48104

SECOND LEVEL REFLECTED CEILING PLAN

A 3 C
COLLABORATIVE ARCHITECTURE
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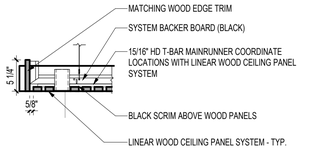
Sheet A6.12

10/11/2024 12:28:39 PM



11 CEILING DETAIL
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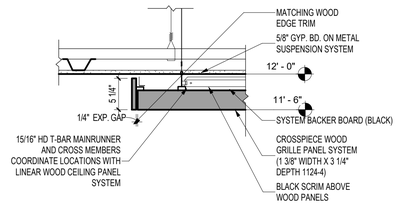

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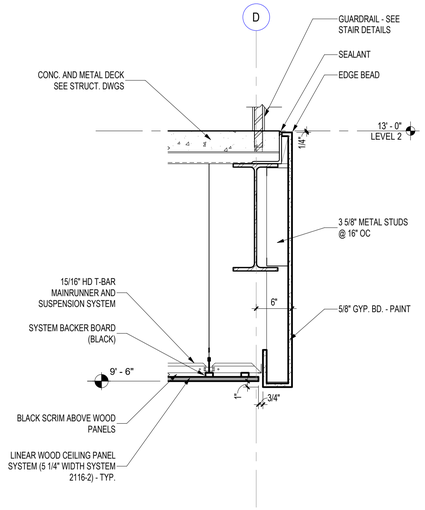

9 CEILING DETAIL
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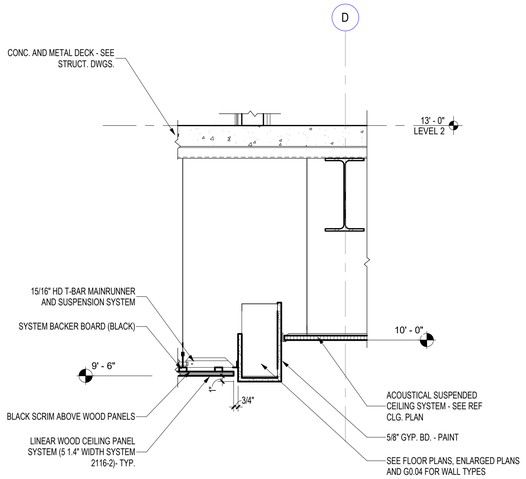
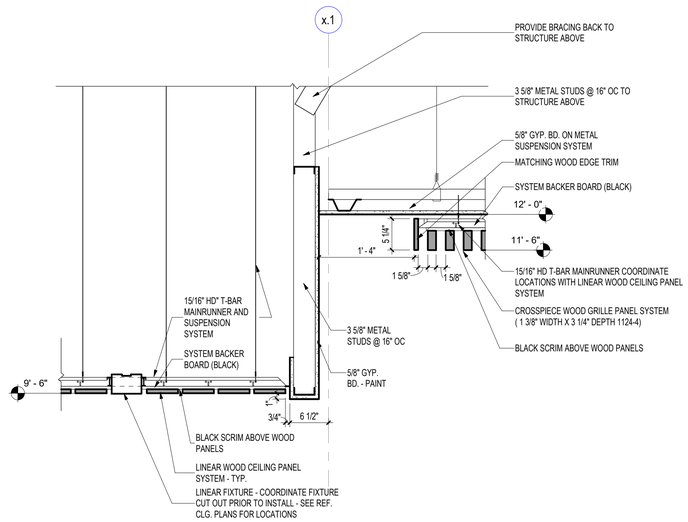


8 CEILING DETAIL
Scale: 1" = 1'-0"



7 CEILING DETAIL
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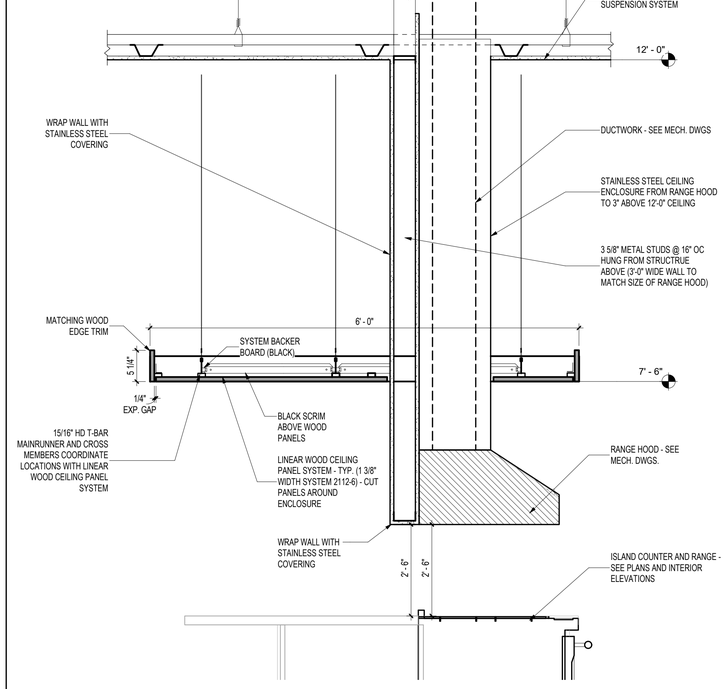

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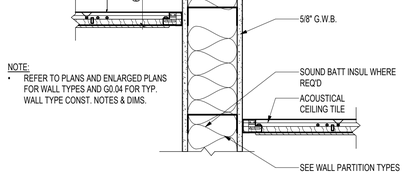

6 CEILING DETAIL
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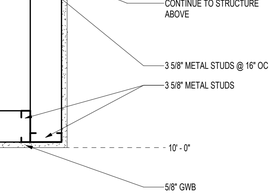

5 CEILING SOFFIT DETAIL
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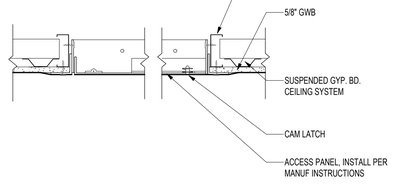
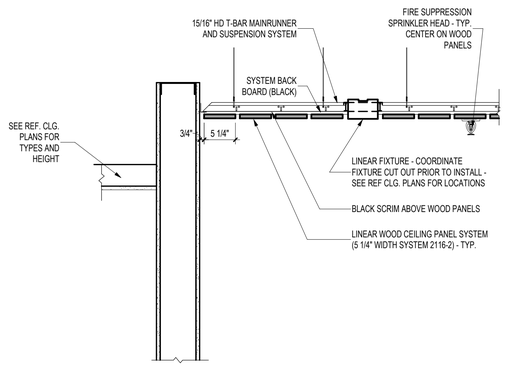


4 CEILING DETAIL ACCESS PANEL
Scale: 1 1/2" = 1'-0"



2 CEILING DETAIL
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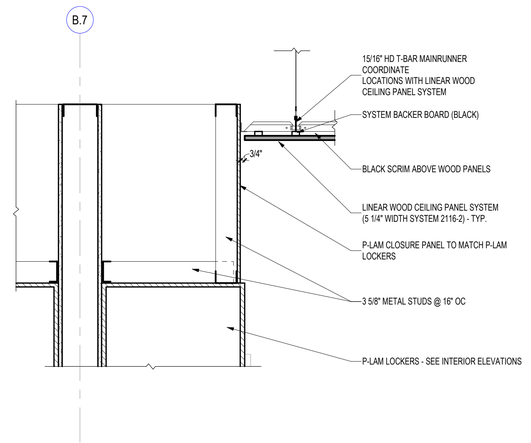

1 CEIILNG DETAIL
Scale: 1" = 1'-0"

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STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23

Drawn: KJ Checked: FEA

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

CEILING DETAILS

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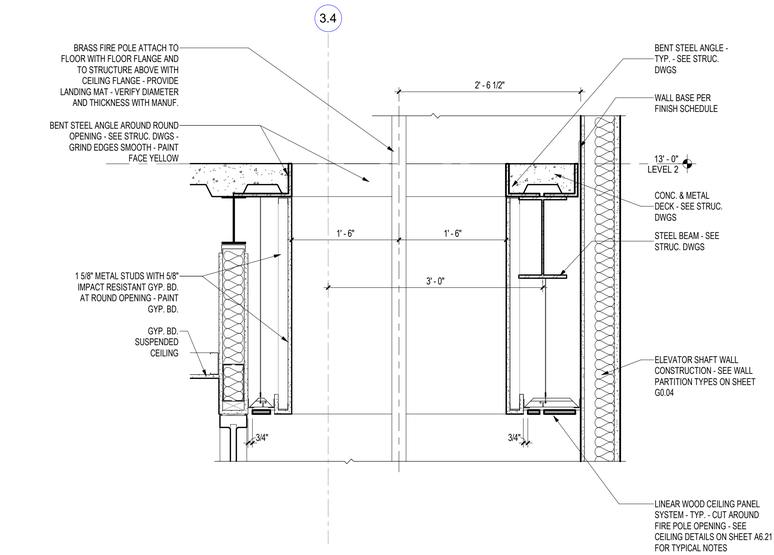

2 FIRE POLE DETAIL

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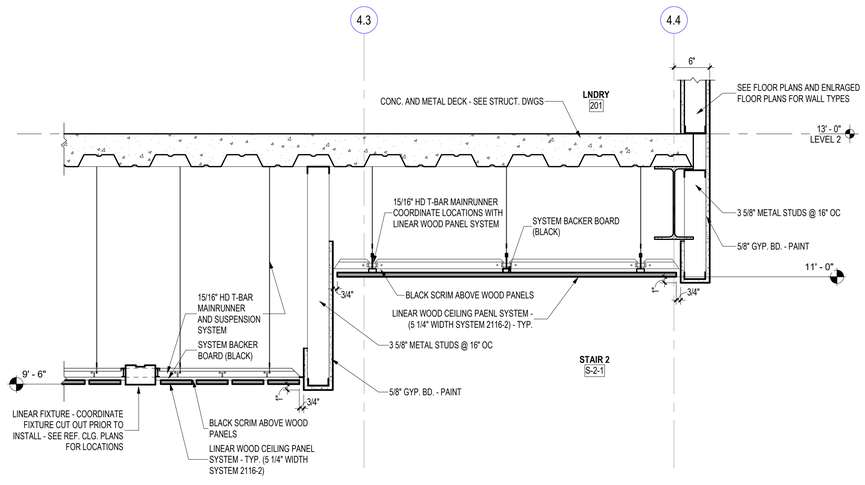

1 CEILING DETAIL

Scale: 1" = 1'-0"

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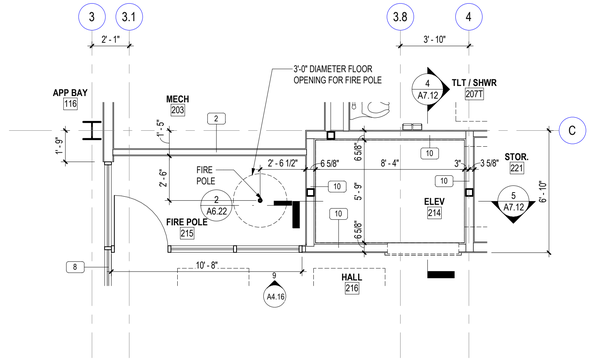
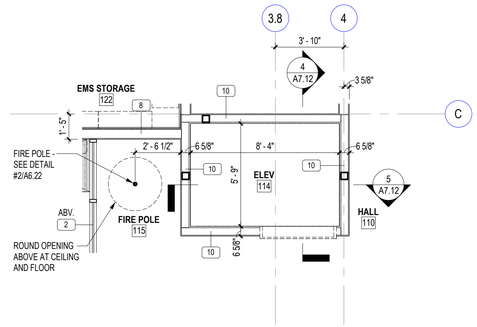


6 **ELEVATOR - LEVEL 2**
Scale: 1/4" = 1'-0"



5 **ELEVATOR - LEVEL 1**
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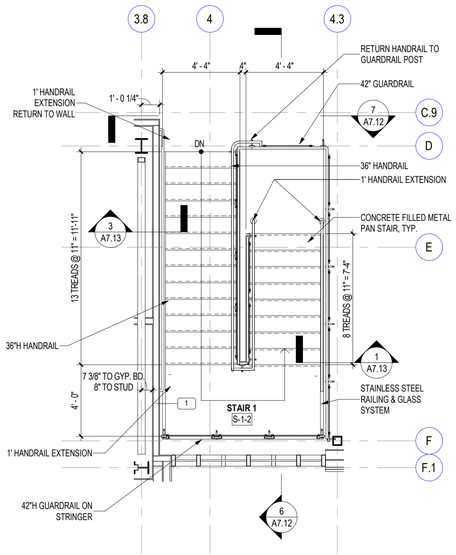

4 **STAIR 1 - LEVEL 2**
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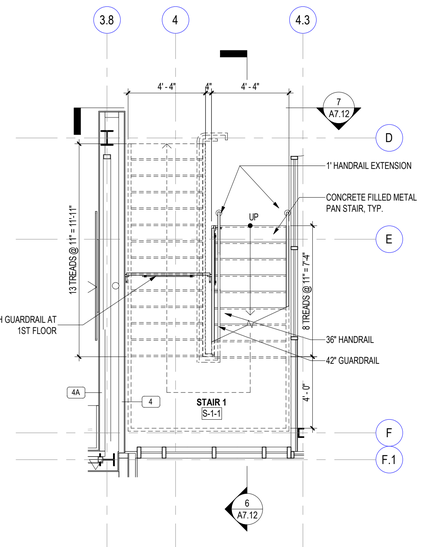
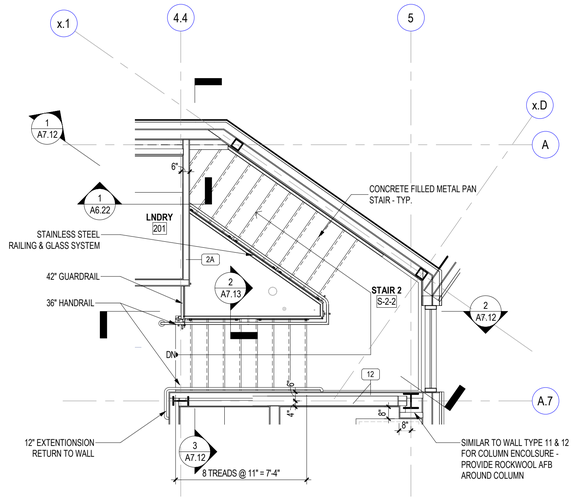


3 **STAIR 1 - LEVEL 1**
Scale: 1/4" = 1'-0"



2 **STAIR 2 - LEVEL 2**
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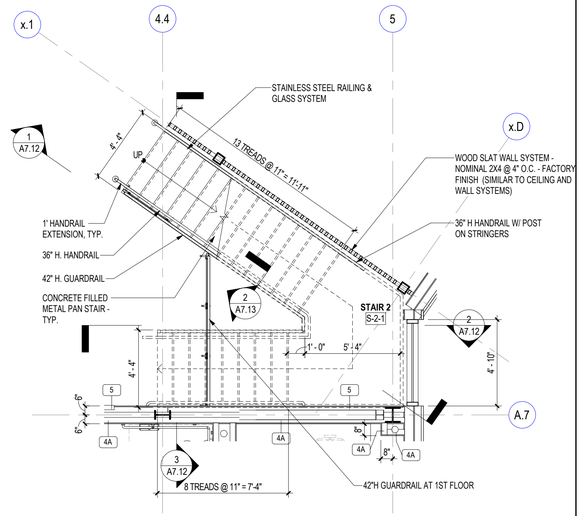

1 **STAIR 2 - LEVEL 1**
Scale: 1/4" = 1'-0"

39°
PROJECT
TRUE

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Design Development	05/26/23

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City of Ann Arbor
NEW FIRE STATION 4
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ENLARGED STAIR & ELEVATOR PLANS

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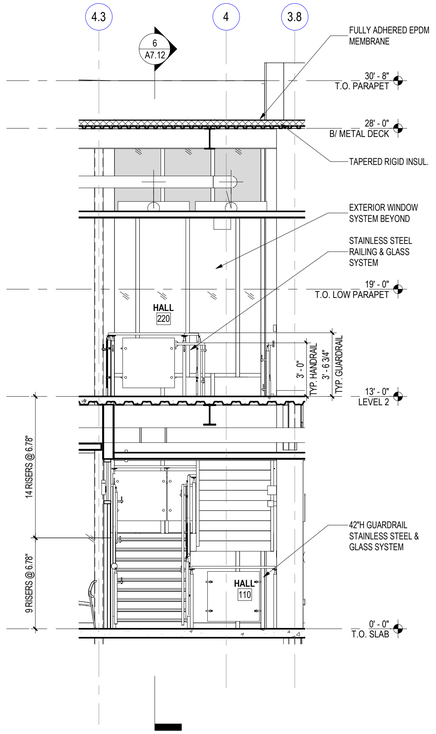

7 STAIR 1 NS SECTION

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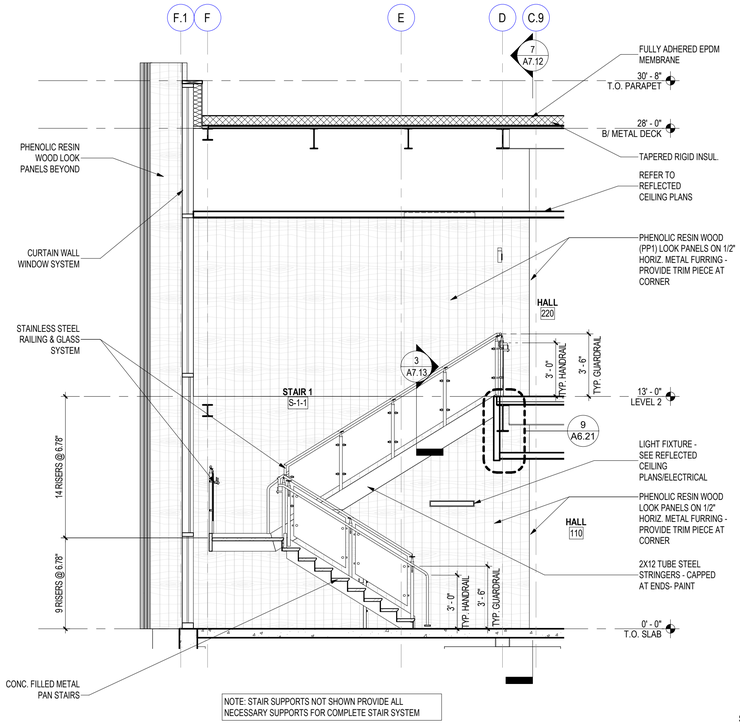

6 STAIR 1 EW SECTION

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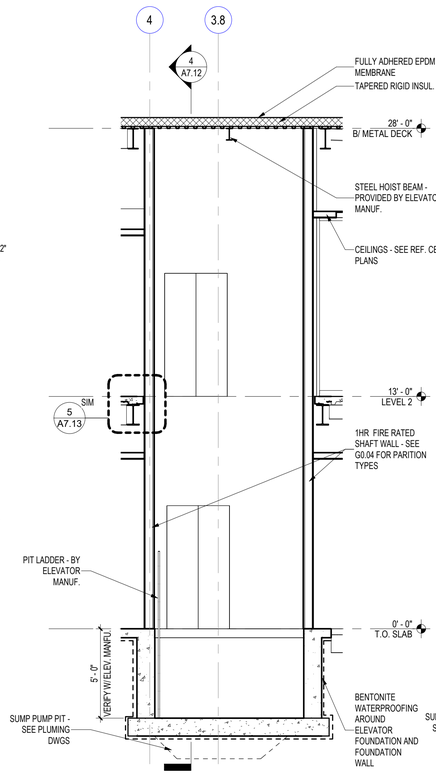

5 ELEVATOR SECTION

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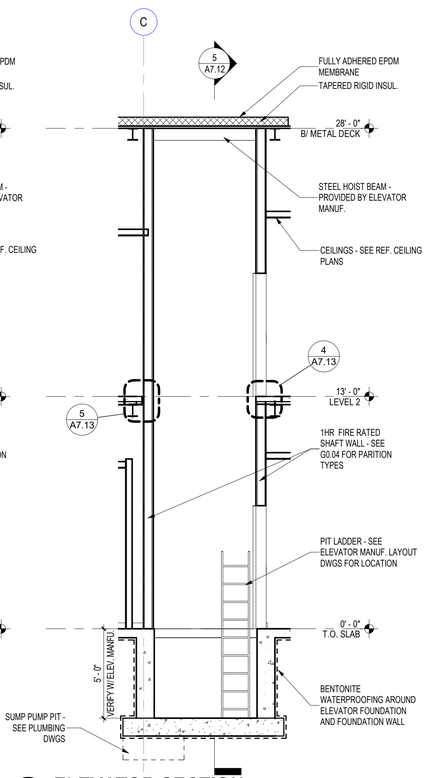

4 ELEVATOR SECTION

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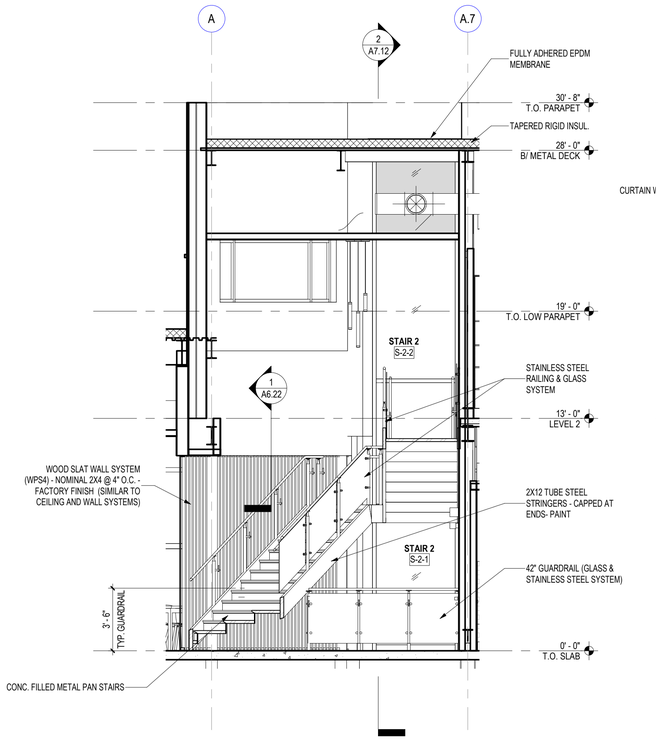
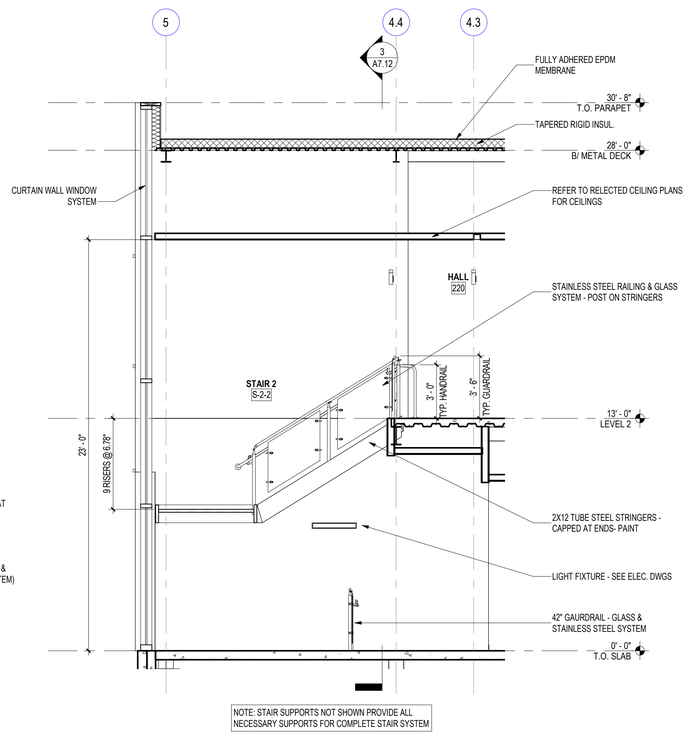


3 STAIR 2 NS SECTION

Scale: 1/4" = 1'-0"



2 STAIR 2 EW SECTION

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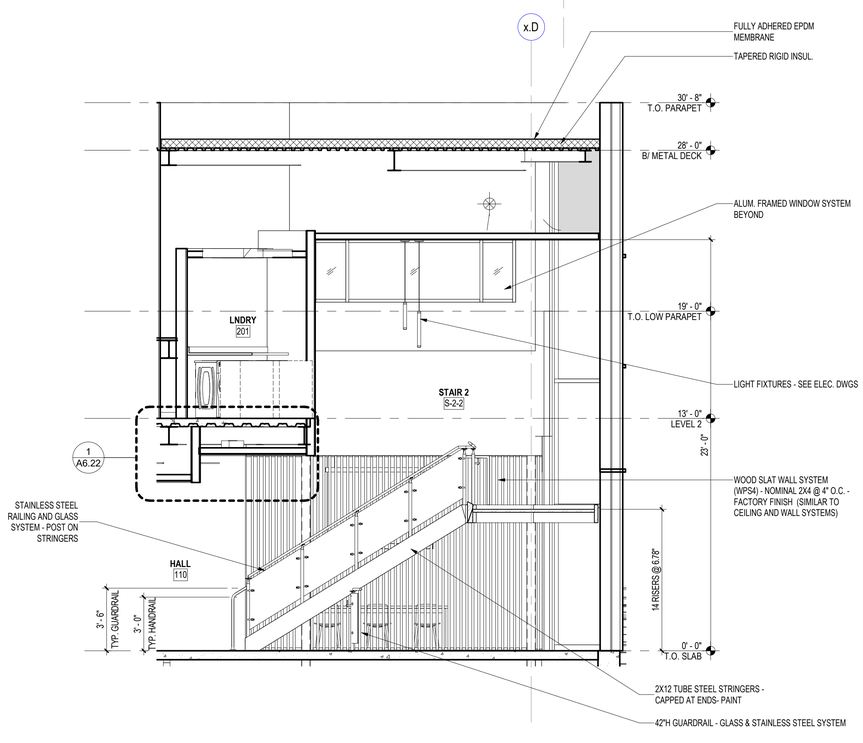

1 STAIR 2 SECTION

Scale: 1/4" = 1'-0"

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Drawn TCA/A3C Checked TCA/A3C

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

STAIR & ELEVATOR SECTIONS

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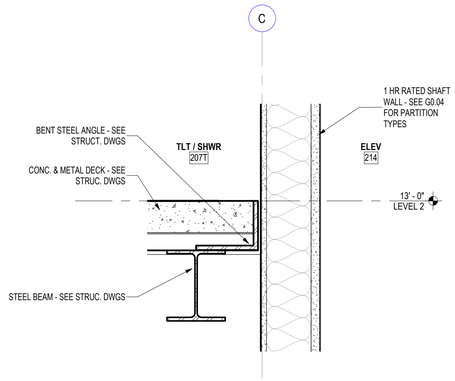

5 DETAIL
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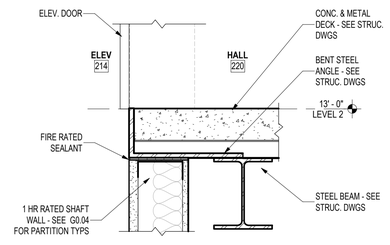

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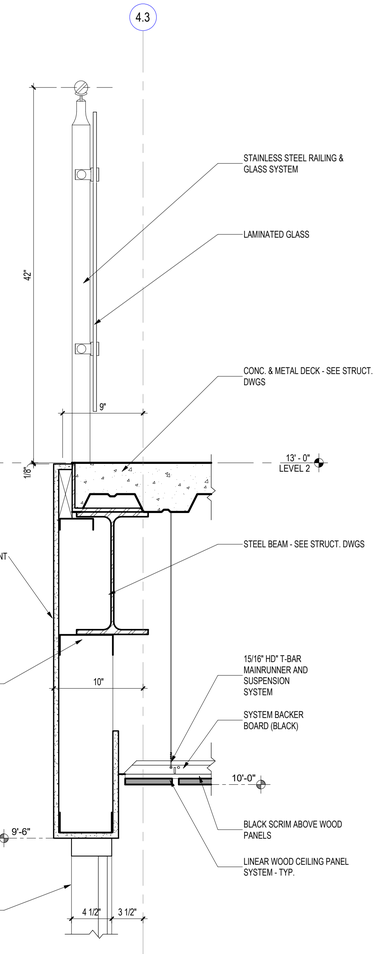

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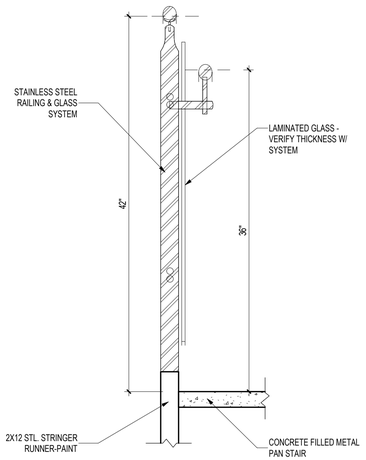

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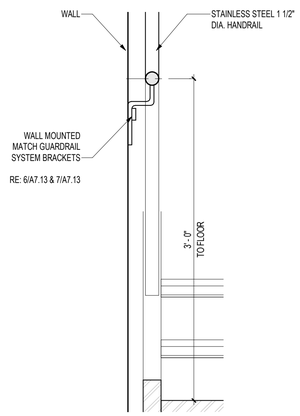

3 HANDRAIL DETAIL - WALL
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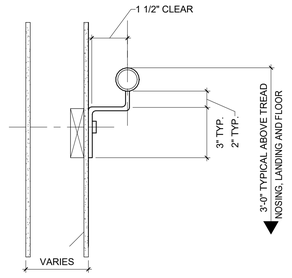

6 HANDRAIL MOUNTING - 1
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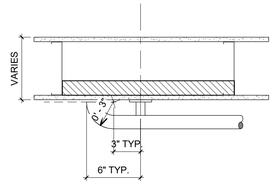

7 HANDRAIL MOUNTING - 2
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DONALD F. BARRY
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STAIR & ELEVATOR DETAILS

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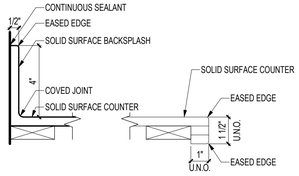
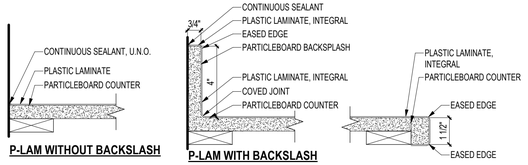
Sheet A7.13

MILLWORK HARDWARE SPECIFICATIONS:

SHORT DESCRIPTION	BRAND	MODEL	FINISH	COMMENT(S):
STANDARD DOOR HINGE	SALICE	SH-C1P6DD9	NICKEL PLATED	SOFT CLOSE
LAZY SUSAN HINGE	SALICE	SH-C2PYA	NICKEL PLATED	SOFT CLOSE
LAZY SUSAN CENTER HINGE	SALICE	SH-C2PFA	NICKEL PLATED	SOFT CLOSE
LAZY SUSAN SHELF	OMEGA NATIONAL PRODUCTS	NA-T8228K30TRDCBMNL1	MATCH P-LAM	LAZY SUSAN KIDNEY SHAPED INSERT, WITH ATTACHED CAST BEARINGS
DRAWER SLIDES	SALICE	SAA7555	ZINC	ZINC, SOFT CLOSE, ADJUSTABLE LOCKING
HANDLE	BERENSON	9401-2BPN-P	BRUSHED NICKEL	
COUNTER MOUNT	RAKKS	EHCS-24 / EH-1824	PAINTED	



16 TYPICAL SLDS DETAIL
Scale: 3" = 1'-0"



15 TYPICAL P-LAM DETAIL
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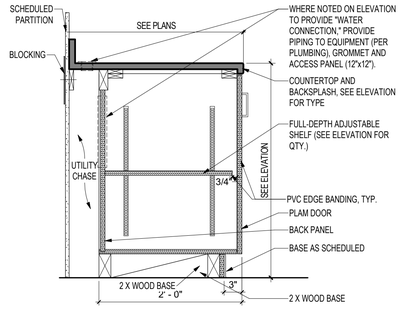

14 CASEWORK DETAIL
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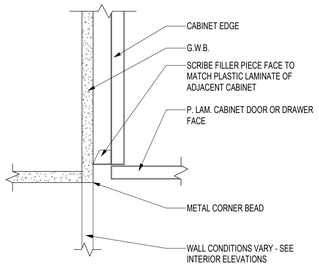

17 CABINET SCRIBE
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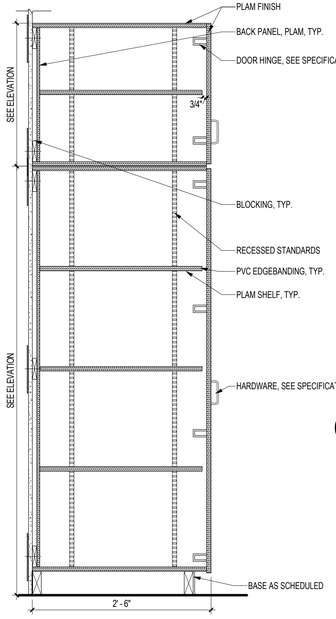
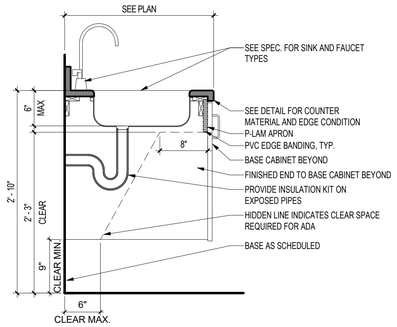
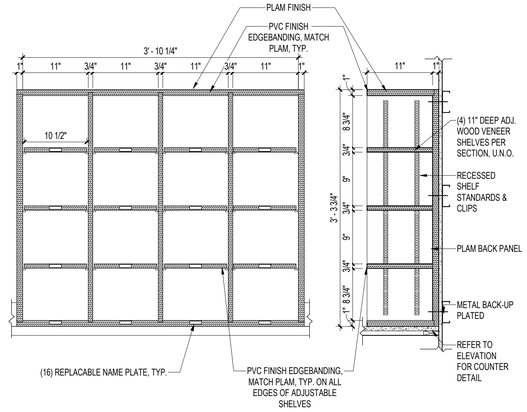


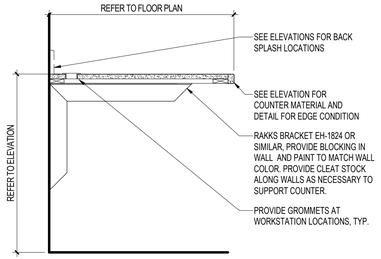
13 CASEWORK DETAIL
Scale: 1" = 1'-0"



12 CASEWORK DETAIL
Scale: 1" = 1'-0"



11 CASEWORK DETAIL
Scale: 1" = 1'-0"



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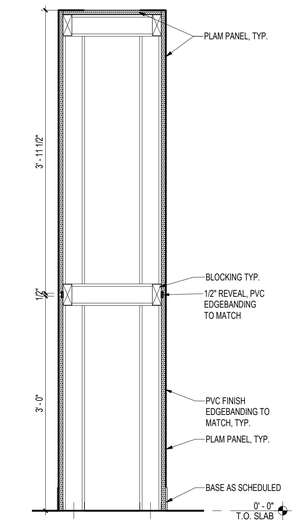

9 CASEWORK DETAIL
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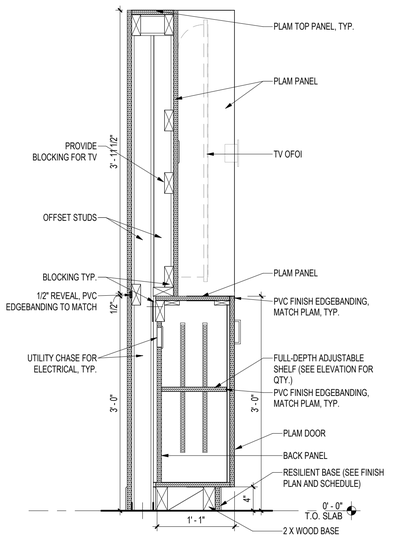

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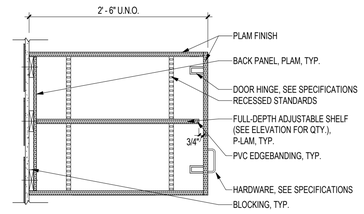

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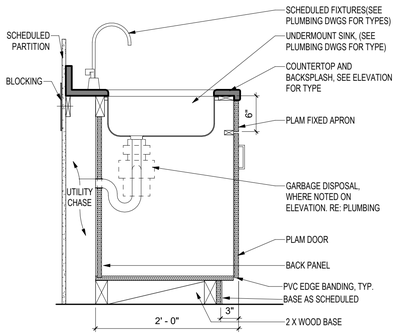

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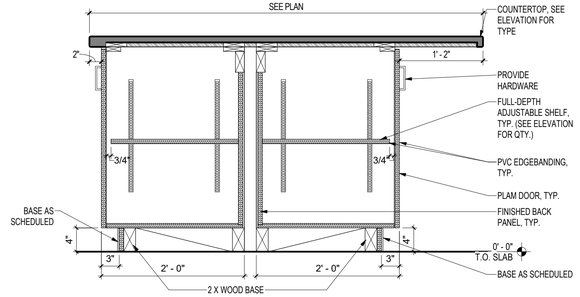

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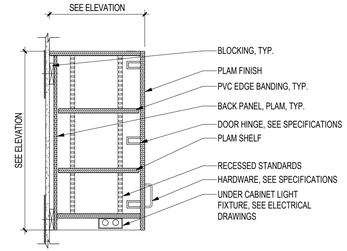

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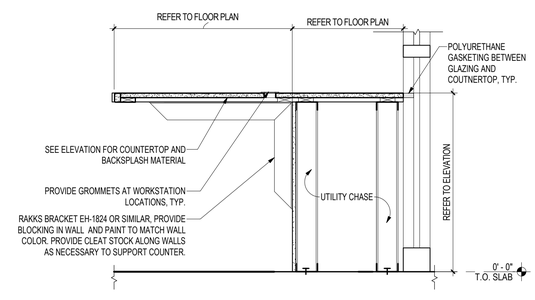

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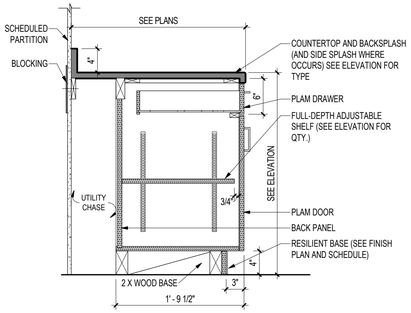

1 CASEWORK DETAIL
Scale: 1" = 1'-0"

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ARCHITECTURE + PLANNING + DESIGN

STATE OF MICHIGAN
DONALD F. BARRY
ARCHITECT
No. 1301042291
LICENSED ARCHITECT

Project Number 21018

Issue	Date
Bids/Permits	10/11/24
Bids/Permits	08/04/23

Drawn: SAD Checked: FEA

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

CASEWORK DETAILS

A3C
COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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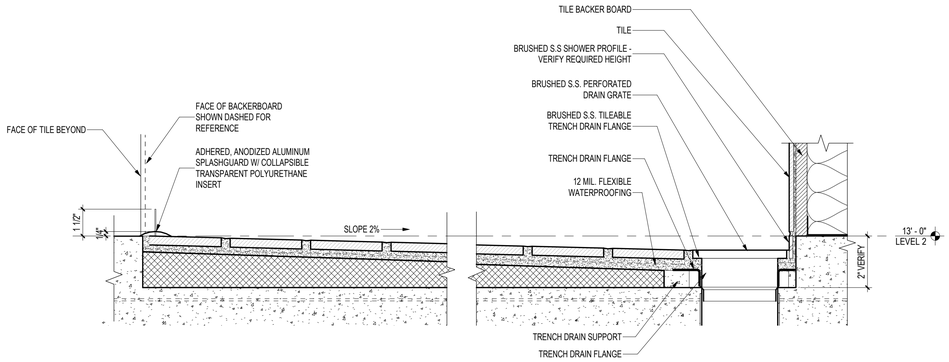

10 SHOWER ENCLOSURE SECTION

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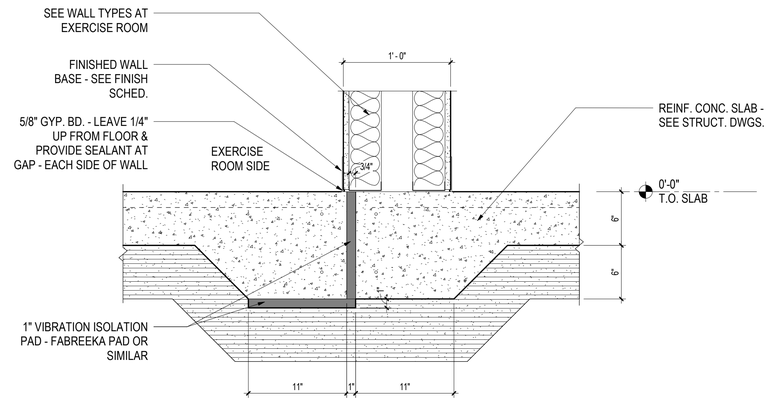

9 ISOLATION JOINT

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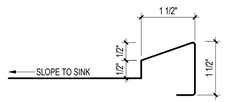
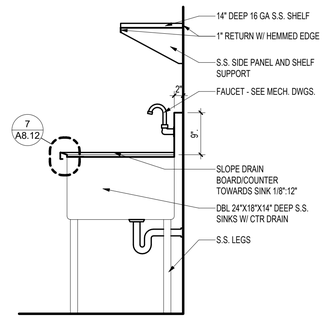


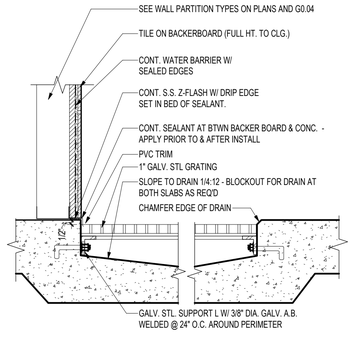
7 DECON SINK LIP PROFILE

Scale: 6" = 1'-0"



6 DECON SINK

Scale: 3/4" = 1'-0"



5 WASHOFF SINK SECTION

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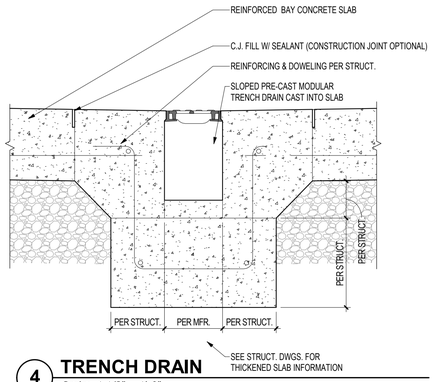
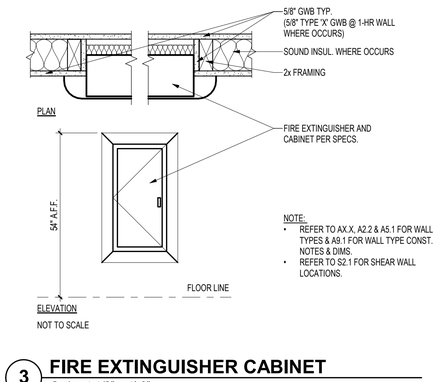


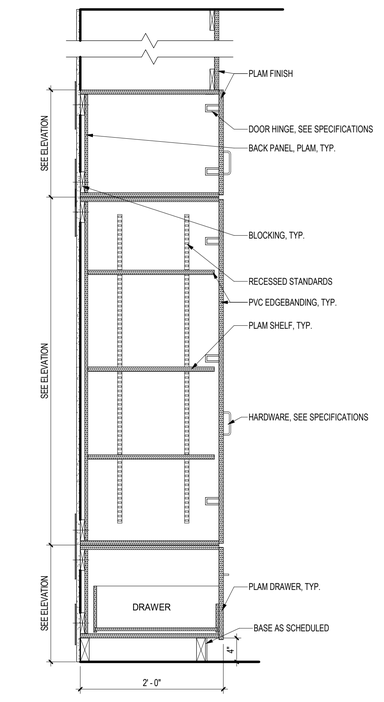
4 TRENCH DRAIN

Scale: 1 1/2" = 1'-0"



3 FIRE EXTINGUISHER CABINET

Scale: 1 1/2" = 1'-0"



2 CASEWORK DETAIL

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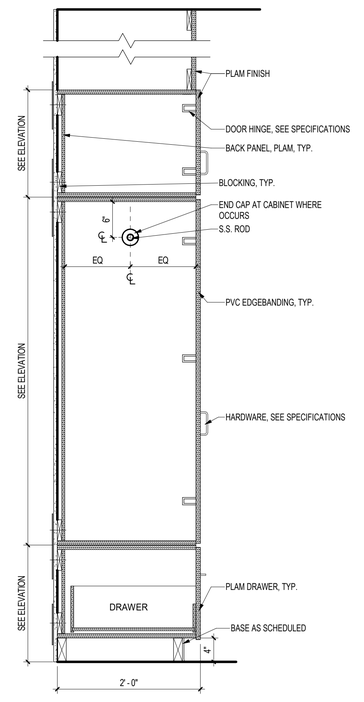

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INTERIOR FINISH DETAILS

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Sheet A8.12

GENERAL NOTES

1. ALL STRUCTURAL WORK SHALL BE COORDINATED WITH ARCHITECTURAL AND MECHANICAL DRAWINGS AND SHALL CONFORM TO THE PROJECT SPECIFICATIONS, INCLUDING THE XXX BUILDING CODE. ALL GOVERNING STANDARDS LISTED IN THESE NOTES SHALL BE THE EDITION REFERENCED IN THIS GOVERNING CODE.
2. CONTRACTOR SHALL PROVIDE TEMPORARY SHORING, BRACING, AND SHEETING AND SHALL MAKE SAFE ALL FLOORS, ROOFS, WALLS, AND ADJACENT PROPERTY AS PROJECT CONDITIONS REQUIRE. SHORING AND SHEETING SHALL BE DESIGNED BY A REGISTERED PROFESSIONAL ENGINEER LICENSED IN THE PROJECT JURISDICTION, HIRED BY THE CONTRACTOR, WHO SHALL SUBMIT SHOP DRAWINGS AND CALCULATIONS FOR THE OWNERS REVIEW.
3. THE CONTRACT DRAWINGS AND SPECIFICATIONS ARE COMPLEMENTARY. THESE NOTES HIGHLIGHT RATHER THAN REPLACE THE SPECIFICATIONS CONTAINED IN THE PROJECT MANUAL.

FOUNDATIONS

1. BUILDING FOUNDATIONS SHALL BEAR ON UNDISTURBED SOIL HAVING A MINIMUM BEARING CAPACITY OF 3,000 AS SPECIFIED BY THE GEOTECHNICAL CONSULTANT, PEA GROUP, PROJECT NO. 2021-0184. ADEQUACY OF BEARING STRATUM SHALL BE VERIFIED IN FIELD PRIOR TO PLACING CONCRETE. ALL NECESSARY ADJUSTMENTS TO THE BOTTOM OF FOOTINGS TO BE REVIEWED AND APPROVED BY THE STRUCTURAL ENGINEER OF RECORD.
2. DO NOT PLACE BACKFILL AGAINST BASEMENT WALLS UNTIL ALL FLOORS BRACING THESE WALLS ARE IN PLACE AND HAVE ATTAINED THEIR 28-DAY STRENGTH.
3. ALL EXTERIOR FOOTINGS SHALL BE PLACED A MINIMUM OF 3' - 6" BELOW FINAL GRADE.
4. CONCRETE SHALL BE POURED IN DRY EXCAVATIONS. CONTRACTOR SHALL NOTE SOIL AND WATER CONDITIONS AS SHOWN BY BORINGS INCLUDED IN THE REFERENCED GEOTECHNICAL SUBSURFACE INVESTIGATION REPORT(S) AND DEPTHS OF FOOTING AS SHOWN ON FOUNDATION PLANS.

CONCRETE

1. ALL CONCRETE WORK SHALL CONFORM TO THE FOLLOWING GOVERNING STANDARDS:
   A. AMERICAN CONCRETE INSTITUTE (ACI) "BUILDING CODE REQUIREMENTS FOR CONCRETE" (ACI 318)
   B. ACI COLLECTION, LATEST EDITION
   C. CONCRETE REINFORCING STEEL INSTITUTE (CRSI) "MANUAL OF STANDARD PRACTICE"
2. ALL CONCRETE COMPOSITE ON METAL DECK SHALL BE NORMAL WEIGHT CONCRETE WITH A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS, UNLESS OTHERWISE NOTED.
3. ALL OTHER CONCRETE SHALL BE NORMAL WEIGHT CONCRETE WITH A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS, UNLESS OTHERWISE NOTED.
4. REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO ASTM A615, GRADE 60 OR A775 EPOXY COATED WHEN CALLED OUT ON PLAN. REINFORCING STEEL SHALL BE DETAILED ACCORDING TO THE ACI "DETAILS AND DETAILING OF REINFORCEMENT" (ACI 315).
5. REINFORCING STEEL TO BE WELDED TO CONFORM TO ASTM A706 GRADE 60.
6. WELDED WIRE REINFORCEMENT (W.W.R.) SHALL CONFORM TO ASTM A1064, WITH A MINIMUM YIELD STRENGTH OF 65,000 PSI.
7. COORDINATE SIZE AND LOCATION OF ALL OPENINGS AND PIPE SLEEVES WITH ALL OTHER DISCIPLINES. MINIMUM CONCRETE BETWEEN SLEEVES SHALL BE 6".
8. ALL GROUT SHALL BE NONSHRINK WITH A MINIMUM COMPRESSIVE STRENGTH OF 5000 PSI.
9. MINIMUM CONCRETE COVER FOR REINFORCING STEEL IN CAST-IN-PLACE NON-PRESTRESSED MEMBERS SHALL BE AS FOLLOWS:
   A. ALL CONCRETE CAST AGAINST AND PERMANENTLY IN CONTACT WITH GROUND: 3"
   B. ALL CONCRETE EXPOSED TO WEATHER OR IN CONTACT WITH GROUND:
      a. 2" (#6 THROUGH #18 BARS)
      b. 1-1/2" (#5 BAR, W31 OR D31 WIRE, AND SMALLER)
   C. NOT EXPOSED TO WEATHER OR IN CONTACT WITH GROUND:
      a. SLABS, JOISTS, AND WALLS:
         - 1-1/2" (#14 THROUGH #18 BARS)
         - 3/4" (#11 BAR AND SMALLER)
      b. BEAMS, COLUMNS, PEDESTALS, AND TENSION TIES (STIRRUPS, TIES, SPIRALS, HOOPS, AND PRIMARY REINFORCEMENT): 1-1/2"
10. SHOP DRAWINGS SHALL BE SUBMITTED TO THE STRUCTURAL ENGINEER FOR REVIEW AND APPROVAL. NO CONCRETE WORK SHALL COMMENCE WITHOUT APPROVED SHOP DRAWINGS.
11. CLEAN AND ROUGHEN TO 1/4" AMPLITUDE ALL EXISTING CONCRETE SURFACES TO RECEIVE NEW CONCRETE PRIOR TO PLACEMENT.
12. SEE OTHER DRAWINGS IN THIS PROJECT FOR SIZE AND LOCATIONS OF EQUIPMENT PADS, INSERT AND EMBED ITEMS.
13. REINFORCING DOWELS, WATER STOPS, AND OTHER EMBED ITEMS SHALL BE INSTALLED AND SECURED PRIOR TO CONCRETE PLACEMENT. "WET-SETTING" OF EMBEDDED ITEMS IS NOT PERMITTED.
14. CONDUIT EMBEDDED IN CONCRETE SHALL FOLLOW THE GUIDELINES IN THE TYPICAL DETAILS. THE CONTRACTOR SHALL NOT VIOLATE THESE GUIDELINES WITHOUT WRITTEN APPROVAL BY THE STRUCTURAL ENGINEER OF RECORD.

STRUCTURAL STEEL

1. ALL STRUCTURAL STEEL WORK SHALL CONFORM TO THE FOLLOWING GOVERNING STANDARDS:
   A. AISC 360 "SPECIFICATIONS FOR STRUCTURAL STEEL BUILDINGS".
   B. AISC 303 "CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES".
   C. AMERICAN WELDING SOCIETY (AWS D1.1) "STRUCTURAL WELDING CODE - STEEL".
   D. RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC) "SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH-STRENGTH BOLTS".
2. ALL STRUCTURAL STEEL SHALL CONFORM TO THE FOLLOWING ASTM SPECIFICATIONS:
   A. WIDE FLANGE BEAMS, COLUMNS, AND STRUCTURAL TEES: ASTM A992.
   B. HOLLOW STRUCTURAL SECTIONS: ASTM A500, GRADE C.
   C. STRUCTURAL PIPE SECTIONS: ASTM A53, GRADE B.
   D. CHANNELS AND ANGLES: ASTM A36 UNLESS OTHERWISE NOTED.
   E. STRUCTURAL STEEL PLATE SHALL BE ASTM A572 GRADE 50 HAVING A MINIMUM YIELD POINT OF 50,000 PSI. GRADE 42 HAVING A MINIMUM YIELD POINT OF 42,000 PSI FOR THICKNESS GREATER THAN 4".
   F. BOLTED CONNECTIONS SHALL BE PER ASTM F3125. GRADES ARE TO BE SELECTED AS FOLLOWS:
      a. STANDARD BEAM TO BEAM/GIRDER: ASTM F3125, GRADES A325, F1852, A490 OR F2280 BOLTS IN SNUG-TIGHTENED JOINTS (3/4" DIAMETER MINIMUM WITH HARDENED WASHERS).
      b. BEAM/GIRDER TO COLUMN CONNECTIONS, COLUMN SPLICES AND BOLTS EXPERIENCING TENSION LOADS (UNLESS OVERSIZED OR SLOTTED HOLES ARE USED, IN WHICH CASE SLIP-CRITICAL JOINTS SHALL BE USED): ASTM F3125, GRADES A325, F1852, A490 OR F2280 BOLTS IN PRETENSIONED JOINTS (3/4" DIAMETER MINIMUM WITH HARDENED WASHERS).
      c. MOMENT CONNECTIONS AND BRACED FRAME CONNECTIONS: ASTM F3125, GRADES A325, F1852, A490 OR F2280 BOLTS IN SLIP CRITICAL JOINTS (3/4" DIAMETER MINIMUM WITH HARDENED WASHERS). FAYING SURFACES SHALL BE CLASS A UNLESS OTHERWISE NOTED.
   G. ANCHOR RODS: ASTM F1554, GRADE 36.
   H. STRUCTURAL STEEL NOTED TO BE STAINLESS STEEL SHALL BE ASTM A276 STAINLESS STEEL TYPE 316L [304L], UNLESS NOTED OTHERWISE.
   I. ALL STAINLESS STEEL BOLTS SHALL CONFORM TO ASTM F593 GRADE B8/B8M FOR TYPE 304/316, RESPECTIVELY, TO MATCH BOLT MATERIAL.
   J. ALL STAINLESS STEEL NUTS SHALL CONFORM TO ASTM F594 GRADE 8/8M FOR TYPE 304/316, RESPECTIVELY, TO MATCH BOLT MATERIAL.
3. STEEL CONNECTION SHALL BE STANDARD AISC FRAMED BEAM CONNECTIONS, AND SHALL BE
   - DESIGNED BY A LICENSED ENGINEER WORKING FOR THE FABRICATOR, WHO SHALL PROVIDE CALCULATIONS.
   - UTILIZING LRFD LOADS AND PROCEDURES.
   - UNLESS OTHERWISE NOTED ON PLAN, PROVIDE CONNECTIONS BASED ON MINIMUM SHEAR CAPACITY REQUIREMENTS IN THE FOLLOWING TABLE WHICH ARE BASED ON AISC SINGLE SHEAR TAB CONNECTIONS.

MINIMUM SHEAR CAPACITY REQUIREMENTS		
BEAM DEPTH (NOMINAL)	MIN. SHEAR CAPACITY, LRFD (Kips)	MIN. NUMBER OF BOLT ROWS
8", 10"	24	2
12", 14"	42	3
16"	62	3
18"	78	4
21"	88	4
24"	90	5
27"	108	6
30"	126	7
33"	142	7
36"	155	8
40"+	165	9

   B. REINFORCING IS TO BE PROVIDED AT CONNECTIONS WHERE CUTS REDUCE THE SHEAR OR MOMENT CAPACITY BELOW THAT REQUIRED TO SUSTAIN THE REACTION. FLANGES AND WEBS ARE TO BE REINFORCED WHERE THE LOCAL CAPACITY TO SUSTAIN CONNECTION LOADS ARE INADEQUATE. CUTS OR COPES MAY PREVENT MINIMUM NUMBER OF BOLT ROWS SHOWN ABOVE FROM BEING ACHIEVED, WHICH IS ACCEPTABLE PENDING WRITTEN APPROVAL AND CONFIRMATION THAT MINIMUM SHEAR CAPACITY HAS BEEN MET.
   C. CONNECTIONS SHALL BE DESIGNED FOR SHEAR AND ECCENTRICITY, CONSIDERING THAT THE CONNECTIONS ARE AN EXTENSION OF THE BEAMS AND GIRDERS.
4. MINIMUM WELD SIZE IS 1/4" FILLET UNLESS NOTED OTHERWISE.
5. ALL BEAMS EXCEPT CANTILEVER BEAMS SHALL BE FABRICATED AND INSTALLED WITH NATURAL CAMBER UP. CANTILEVER BEAMS SHALL BE FABRICATED AND INSTALLED SO THAT NATURAL CAMBER RAISES CANTILEVER END.
6. FIELD CUTTING OR BURNING OF STEEL IS PROHIBITED EXCEPT WITH THE EXPRESS WRITTEN APPROVAL OF THE STRUCTURAL ENGINEER OF RECORD. (IN WHICH CASE ALL BURNING OF STEEL MUST CONFORM TO THE THERMAL CUTTING REQUIREMENTS OF AISC AND AWS)
7. WELDING SHALL BE PERFORMED BY CERTIFIED, AWS-QUALIFIED WELDERS. WELDING ELECTRODES FOR CARBON STEEL SHALL BE AWS 5.1, CLASS E70XX. FOR ASTM A572 GRADE 50 KSI PLATE USE ELECTRODE E7018 OR APPROVED EQUAL (OR ELECTRODES THAT MEET THE REQUIREMENT OF__). WELDING ELECTRODES FOR ASTM A276 STAINLESS STEEL, TYPE 304, SHALL CONFORM TO AWS A5.4 FOR SHIELDED METAL ARC WELDING, ELECTRODE CLASS E308; OR AWS A5.9 FOR GAS METAL ARC WELDING, ELECTRODE CLASS ER308. WELDING ELECTRODES FOR ASTM A276 TYPE 316L STAINLESS STEEL SHALL CONFORM TO AWS A5.4 FOR SHIELDED METAL ARC WELDING, ELECTRODE CLASS E316; OR AWS A5.9 FOR GAS METAL ARC WELDING, ELECTRODE CLASS ER316. WELDING ELECTRODES FOR JOINING STAINLESS STEEL TO CARBON STEEL SHALL CONFORM TO ELECTRODE CLASS E309/ER309.
8. SHOP PAINT EXPOSED STEEL MEMBERS, STEEL MEMBERS NOT ENCASED IN CONCRETE OR SPRAY FIREPROOFED, AND ALL STEEL MEMBERS AT THE EXTERIOR WALL WITH TNEMEC V10-99 OR APPROVED EQUAL EXCEPT FOR MEMBERS TO BE HOT DIPPED GALVANIZED.
9. ALL EXTERIOR EXPOSED STEEL AND STEEL SUPPORTING EXTERIOR SHALL BE HOT DIPPED GALVANIZED. HOT DIP GALVANIZING SHALL CONFORM TO ASTM A123, REPAIR SCRATCHES OR ABRADED GALVANIZED SURFACE WITH ZINC RICH PAINT.
10. LINTELS SHALL BE INSTALLED OVER ALL OPENINGS IN MASONRY WALLS AS FOLLOWS:

MASONRY OPENING	LINTEL
4' - 0" OR LESS	L4x3-1/2x5/16 LLV
4' - 1" TO 7' - 0"	L6x3-1/2x5/16 LLV

    A. 3-1/2" LEGS ARE HORIZONTAL.
    B. PROVIDE ONE ANGLE FOR EACH 4" OF WALL THICKNESS.
    C. PROVIDE L5x5x5/16 ANGLES FOR 6" THICK WALLS AND PARTITIONS WITH OPENINGS UP TO 6' - 0".
    D. PROVIDE MINIMUM 6" BEARING AT EACH END.
    E. LINTELS OVER 6' - 4" SHALL BE FIREPROOFED.
11. SHOP AND ERECTION DRAWINGS SHALL BE SUBMITTED TO THE STRUCTURAL ENGINEER FOR REVIEW AND APPROVAL. NO FABRICATION OF STEEL SHALL COMMENCE WITHOUT APPROVED SHOP DRAWINGS.
12. PROVIDE MECHANICALLY GALVANIZED BOLTS FOR EXTERIOR APPLICATIONS.

STEEL DECK

1. STEEL DECKING WORK SHALL CONFORM TO THE AISI NORTH AMERICAN "SPECIFICATION FOR THE DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS."
2. STEEL DECKING UNITS AND ACCESSORY ITEMS SHALL BE FORMED FROM STEEL SHEETS CONFORMING TO ASTM A1008 OR A653 WITH A MINIMUM YIELD STRENGTH OF 50,000 PSI (33,000 PSI FOR STEEL ROOF DECKING UNITS). SEE DECK SCHEDULE FOR MORE INFORMATION. BEFORE FORMING, THE STEEL SHEET SHALL RECEIVE A HOT DIP GALVANIZED COATING CONFORMING TO ASTM A653, GRADE 90.
3. STEEL DECKING SHALL BE SHORED AS REQUIRED BY PLANS OR BY SPAN AND LOAD CONDITIONS TO SUPPORT WET WEIGHT OF CONCRETE AND ALL CONSTRUCTION LOADS.
4. THE SIDE LAPS OF ADJACENT UNITS SHALL BE FASTENED BY APPROVED METHOD (TO BE SHOWN ON SHOP DRAWINGS) BETWEEN SUPPORTS, AT INTERVALS TO PROVIDE SUFFICIENT DIAPHRAGM STRENGTH TO MAINTAIN BUILDING ALIGNMENT AND TO SUSTAIN LOCAL CONSTRUCTION LOADS WITHOUT DISTORTION OR SEPARATION, MAXIMUM SPACING SHALL BE 3'-0" BETWEEN SUPPORT BEAMS. END LAPS OF SHEETS SHALL BE A MINIMUM OF 2 INCHES.
5. EXCEPT AS OTHERWISE NOTED, DECK SHALL BE ATTACHED TO STRUCTURAL STEEL BY 3/4"Ø FUSION WELDS @ 12" ON CENTER AT END AND INTERIOR SUPPORTS PERPENDICULAR TO THE DECK SPAN AND AT EDGE AND INTERIOR SUPPORTS PARALLEL TO THE DECK SPAN. WELDS MAY BE OMITTED IN RIBS IN WHICH SHEAR CONNECTORS ARE TO BE APPLIED, AS LONG AS MAXIMUM SPACING BETWEEN ATTACHMENTS DOES NOT EXCEED 18" ON CENTER. AND SUCH THAT EACH DECK SECTION SHALL HAVE SUFFICIENT WELDS TO ADEQUATELY SECURE THE DECK, BRING THE DECK INTO DIRECT CONTACT WITH THE SUPPORTING STEEL AND TO PROVIDE SUFFICIENT DIAPHRAGM STRENGTH TO MAINTAIN BUILDING ALIGNMENT
6. AS AN ALTERNATE TO PUDDLE WELDS FOR STEEL DECK ATTACHMENT TO STRUCTURAL STEEL, HILTI X-HSN-24 OR X-ENP-19 POWDER ACTUATED FASTENERS, OR AN APPROVED EQUAL, WITH EQUIVALENT OR GREATER CAPACITY TO THE SPECIFIED ATTACHMENT MAY BE USED. PRIOR TO INSTALLATION, THE CONTRACTOR SHALL SUBMIT ALTERNATE FASTENING PATTERN TO THE ENGINEER OF RECORD FOR REVIEW AND APPROVAL. SUBMITTAL SHALL INCLUDE PROPOSED ALTERNATE PATTERN AND ANY CALCULATIONS OR SUPPORTING MANUFACTURER DATA NEEDED TO DEMONSTRATE THAT THE PATTERN MEETS OR EXCEEDS THE CAPACITY OF THE SPECIFIED ATTACHMENT.
7. POWDER ACTUATED FASTENERS SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS. CONTRACTOR SHALL BE CERTIFIED AND TRAINED BY THE MANUFACTURER'S REPRESENTATIVE ON PROPER USE PRIOR TO INSTALLATION.
8. PRIOR TO FABRICATION, THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS FOR THE STEEL DECKING SHOWING DECK GAUGE, SIZE, AND LAYOUT AS WELL AS CLOSURE CONDITIONS, WELDS TO SUPPORTS AND SIDE LAP DETAILS.
9. ALL REINFORCED OPENINGS IN STEEL DECK SHALL BE INSTALLED BY STEEL DECK SUBCONTRACTOR. STEEL DECK SUBCONTRACTOR TO PROVIDE REINFORCING AS PER TYPICAL DETAILS.
10. AT STEEL DECK WITHOUT CONCRETE FILL THE FOLLOWING MAY BE ATTACHED WITHOUT SPECIFIC APPROVAL OF THE STRUCTURAL ENGINEER: ACOUSTICAL TILE AND GYPSUM BOARD CEILING ONLY; NO PIPING, DUCTING OR CONDUIT. MAXIMUM CEILING WEIGHT = 3.5 PSF. MAXIMUM WIRE HANGER LOAD = 60 LBS.
11. WHERE SUSPENSION OF HANGER WIRES ARE REQUIRED BY OTHERS, VERIFY AND COORDINATE LOCATIONS, PATTERNS, SPACING, ETC. WITH THE APPROPRIATE TRADE. DRILL OR PUNCH HOLES AT BOTTOM OF DECK FLUTES OF SUFFICIENT SIZE TO PASS SUPPORT WIRES. WIRE SUPPORTS SHALL BE LOOPED AND SECURED WITH A MINIMUM OF THREE (3) TIGHT TURNS AROUND A MINIMUM 1-1/2" x 12" LONG FURRING CHANNEL OR NO. 3x12" LONG REINFORCING BAR CENTERED ABOVE THE HOLE AND LAID IN THE DECK FLUTES.

COLD FORMED METAL FRAMING

1. ALL COLD FORMED METAL FRAMING WORK SHALL COMPLY WITH THE AISI NORTH AMERICAN "SPECIFICATION FOR THE DESIGN OF COLD FORMED STEEL STRUCTURAL MEMBERS", AS WELL AS ANSI A42.4 "SPECIFICATIONS FOR INTERIOR LATHING AND FURRING."
2. ALL SHEATHING APPLIED TO METAL JOISTS SHALL BE SCREWED AND GLUED TO THE JOISTS. PROVIDE HILTI S-WW 12-24x2-1/2 PFH #4 WINGS @ 12" O.C. CONNECT TO PERIMETER SUPPORTS PARALLEL TO DECK WITH HILTI S-WW 12-24x2-1/2 PFH #4 WINGS @ 12" O.C. THE ADHESIVE SHALL BE AN APA APPROVED ELASTOMERIC ADHESIVE.
3. INSTALL METAL FRAMING IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS AND RECOMMENDATIONS, UNLESS OTHERWISE INDICATED. ALL MATERIALS SHALL BE GALVANIZED
4. ALL LOAD BEARING STUDS, JOISTS, AND ACCESSORIES SHALL BE MADE OF THE MINIMUM TYPE, SIZE, GAUGE, AND SPACING SHOWN ON DRAWINGS AND PROVEN IN THE CALCULATIONS.
5. SUBMIT SIGNED AND SEALED SHOP DRAWINGS AND CALCULATIONS FOR ALL LOAD BEARING COLD FORMED METAL FRAMING (JOISTS, STUDS, ETC.) PRIOR TO FABRICATION. SHOP DRAWINGS SHALL INDICATE PLACING OF ALL FRAMING MEMBERS SHOWING TYPE, SIZE, GAGE, NUMBER, LOCATION AND SPACING. THEY SHALL ALSO INDICATE SUPPLEMENTAL STRAPPING, BRACING, SPLICES, BRIDGING, ACCESSORIES AND DETAILS REQUIRED FOR PROPER INSTALLATION. SEE SPECIFICATIONS, LOADING DIAGRAMS AND SCHEDULE FOR STRUCTURAL PERFORMANCE CRITERIA.
6. SHOP DRAWINGS SHALL SHOW SIZE AND LENGTH OF WELDS FOR ALL WELDED CONNECTIONS AND TYPE, SIZE AND NUMBER OF SCREWS FOR ALL SCREWED CONNECTIONS. SUBMIT MANUFACTURER DATA GIVING STRENGTH VALUES FOR ALL FASTENERS USED. WELDED CONNECTIONS SHALL BE WIRE BRUSHED AND COATED WITH A ZINC RICH PAINT.
7. ALL GALVANIZED STUDS AND/OR JOISTS, 10, 12, 14 AND 16 GAGE, SHALL BE FORMED FROM STEEL THAT CORRESPONDS TO THE REQUIREMENTS OF ASTM A446, WITH A MINIMUM YIELD OF 50,000 PSI.
8. ALL GALVANIZED 18 AND 20 GAGE STUDS AND/OR JOISTS, AND ALL GALVANIZED TRACK, BRIDGING AND ACCESSORIES SHALL BE FORMED FROM STEEL THAT CORRESPONDS TO THE REQUIREMENTS OF ASTM A653, WITH A MINIMUM YIELD OF 33,000 PSI.
9. ALL STUDS, JOIST AND ACCESSORIES SHALL BE PRIMED WITH RUST - INHIBITIVE PAINT MEETING THE PERFORMANCE REQUIREMENTS OF TT-P-636C, OR SHALL BE FORMED FROM STEEL HAVING A G-60 GALVANIZED COATING.
10. FRAMING COMPONENTS MAY BE PRE-ASSEMBLED INTO PANELS PRIOR TO ERECTING. PREFABRICATED PANELS SHALL BE SQUARE WITH COMPONENTS ATTACHED IN A MANNER AS TO PREVENT RACKING.
11. AXIALLY LOADED STUDS SHALL BE INSTALLED IN A MANNER WHICH WILL ASSURE THE ENDS OF THE STUDS ARE POSITIONED AGAINST THE INSIDE TRACK WEB, PRIOR TO STUD AND TRACK ATTACHMENT.
12. STUDS SHALL BE PLUMBED, ALIGNED AND SECURELY ATTACHED TO THE FLANGES OR WEBS OF BOTH UPPER AND LOWER TRACKS.
13. WALL STUD BRIDGING SHALL BE ATTACHED IN A MANNER TO PREVENT STUD ROTATION. BRIDGING ROWS SHALL BE SPACED ACCORDING TO THE FOLLOWING SCHEDULE. WALLS UP TO 10'-0" HEIGHT: ONE ROW AT MID-HEIGHT. WALLS EXCEEDING 10'-0" HEIGHT; BRIDGING ROWS SPACED NOT TO EXCEED 5'-0" ON-CENTER.
14. CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL TEMPORARY BRACING AND SHORING AS REQUIRED UNTIL ERECTION IS COMPLETED AND ALL ATTACHED ADJACENT FRAMING IS COMPLETE.
15. SPLICES IN AXIALLY LOADED STUDS ARE NOT PERMITTED.
16. JOISTS SHALL BE LOCATED DIRECTLY OVER BEARING STUDS OR LOAD DISTRIBUTION MEMBER TO BE PROVIDED AT THE TOP TRACK.

POST-INSTALLED ADHESIVE AND MECHANICAL ANCHORS

1. POST INSTALLED ANCHORAGE SHALL BE INSTALLED BY QUALIFIED PERSONNEL PER THE MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII), AS INCLUDED IN THE ANCHOR PACKAGING, TO INTACT BASE MATERIAL. INSTALLATION OF ANCHORS SHALL BE CARRIED OUT BY AN INSTALLER TRAINED TO INSTALL THE SPECIFIED ANCHORS. NOTIFY ENGINEER OF RECORD PRIOR TO INSTALLATION IF BASE MATERIAL CONDITION DEVIATES FROM STRUCTURAL DRAWINGS OR ASSUMPTIONS AND CONDITIONS OF THE MPII. ALL HOLES SHALL BE DRY AND HAMMER DRILLED UNLESS OTHERWISE NOTED, AND ALL CONCRETE BASE MATERIAL TO RECEIVE ADHESIVE ANCHORS SHALL HAVE A MINIMUM AGE OF 21 DAYS.
2. INSTALLATION OF ADHESIVE ANCHORS IN A HORIZONTAL OR UPWARDLY INCLINED ORIENTATION AND SUPPORTING A SUSTAINED TENSION LOAD SHALL BE PERFORMED BY A CERTIFIED ADHESIVE ANCHOR INSTALLER. CERTIFICATION SHALL INCLUDE WRITTEN AND PERFORMANCE TESTS IN ACCORDANCE WITH THE ACI/CRSI ADHESIVE ANCHOR INSTALLER CERTIFICATION PROGRAM OR APPROVED EQUAL. PRIOR TO THE COMMENCEMENT OF INSTALLING ANCHORS PROVIDE OWNER AND ENGINEER OF RECORD WITH DOCUMENTED CONFIRMATION THAT ALL OF THE CONTRACTOR'S PERSONNEL WHO INSTALL HORIZONTAL OR UPWARDLY INCLINED ADHESIVE ANCHORS SUPPORTING SUSTAINED TENSION LOADS ARE TRAINED AND CERTIFIED.
   A. OVERHEAD ADHESIVE ANCHORS MUST BE INSTALLED USING THE PISTON PLUG SYSTEM SPECIFIED BY THE MPII AND PRODUCED BY THE CORRESPONDING MANUFACTURER FOR THE ANCHOR SYSTEM BEING INSTALLED.
3. EXISTING REINFORCING BARS IN THE STRUCTURE MAY CONFLICT WITH SPECIFIC ANCHOR LOCATIONS. REINFORCING BARS SHALL NOT BE CUT WITHOUT THE WRITTEN APPROVAL OF THE ENGINEER OF RECORD. UNLESS NOTED ON THE DRAWINGS THAT THE EXISTING REBARS CAN BE CUT, THE CONTRACTOR SHALL REVIEW THE EXISTING STRUCTURAL DRAWINGS AND SHALL UNDERTAKE TO LOCATE THE POSITION OF THE REINFORCING BARS BY A MEANS APPROVED BY THE ENGINEER OF RECORD.
4. ANCHOR CAPACITY IS DEPENDENT UPON SPACING BETWEEN ADJACENT ANCHORS, PROXIMITY OF ANCHORS TO EDGE OF CONCRETE, AND EMBEDMENT DEPTH INTO THE SUBSTRATE. INSTALL ANCHORS IN ACCORDANCE WITH SPACING, EDGE CLEARANCES, AND EMBEDMENT DEPTHS INDICATED ON THE DRAWINGS.
5. UNLESS OTHERWISE INDICATED, POST INSTALLED ANCHORAGE SHALL BE ADHESIVE TYPE HILTI HIT-HY 200-R INTO CONCRETE OR HILTI HIT-HY 270 INTO BRICK MASONRY, GROUT FILLED CMU OR UNGROUTED CMU BASE MATERIAL. PROVIDE MESH SCREEN IN UNGROUTED CMU, UNREINFORCED MASONRY CONSTRUCTION, AND BRICK MASONRY WITH HOLES OR VOIDS.
6. SUBSTITUTION REQUESTS FOR ALTERNATE ANCHORAGE PRODUCTS SHALL BE SUBMITTED TO ENGINEER OF RECORD FOR REVIEW AND APPROVAL PRIOR TO USE. THIS SHALL INCLUDE MANUFACTURER PRODUCT DATA AND CALCULATIONS DEMONSTRATING THAT THE PROPOSED SUBSTITUTE CAN ACHIEVE THE PERFORMANCE VALUES OF THE SPECIFIED PRODUCT. ANCHOR CAPACITY USED IN DESIGN SHALL BE BASED ON THE TECHNICAL DATA PUBLISHED BY THE MANUFACTURER OR SUCH OTHER METHOD AS APPROVED BY THE ENGINEER OF RECORD. SUBSTITUTIONS WILL BE EVALUATED BY THEIR HAVING AN ICC-ES EVALUATION REPORT SHOWING COMPLIANCE WITH THE RELEVANT BUILDING CODE, SEISMIC USE, LOAD RESISTANCE, INSTALLATION CATEGORY, AND AVAILABILITY OF MPII. ADHESIVE ANCHOR EVALUATION WILL ALSO CONSIDER CREEP, IN-SERVICE TEMPERATURE AND INSTALLATION TEMPERATURE AND MUST PROVIDE INFORMATION ON THESE ITEMS. SUBSTITUTION REQUESTS FOR ALTERNATE PRODUCTS MUST BE APPROVED IN WRITING BY THE ENGINEER OF RECORD PRIOR TO USE.

SPECIAL INSPECTIONS (IBC)

1. INSPECTIONS REQUIRED BY THE LOCAL JURISDICTION SHALL BE PERFORMED BY A TESTING AGENCY PROVIDED BY THE OWNER FOR THE FOLLOWING ITEMS:
   A. STEEL CONSTRUCTION (IBC 1705.2)
      a. STRUCTURAL STEEL (IBC 1705.2.1)
         1. STRUCTURAL STEEL WELDING (AISC 360, AWS D1.1)
         2. HIGH STRENGTH BOLTS (AISC 360)
      b. STEEL CONSTRUCTION OTHER THAN STRUCTURAL STEEL
         1. COLD-FORMED STEEL DECK (IBC 1705.2.2)
   B. CONCRETE CONSTRUCTION (IBC 1705.3, TABLE 1705.3)
      a. WELDING OF REINFORCING BARS (IBC 1705.3.1, TABLE 1705.3)
      b. MATERIALS TESTS (IBC 1705.3.2, TABLE 1705.3)
      c. POST-INSTALLED ANCHORS (IBC TABLE 1705.3, ACI 318 CHAPTER 17)
   C. MASONRY CONSTRUCTION (IBC 1705.4, ACI 530 AND ACI 530.1 LEVEL B QUALITY ASSURANCE)
   D. SOILS (IBC 1705.6, TABLE 1705.6)
   E. FABRICATED ITEMS (IBC 1705.10)
   F. SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE (IBC 1705.12)
      a. STRUCTURAL STEEL (IBC 1705.12.1)
   G. TESTING AND QUALIFICATION FOR SEISMIC RESISTANCE (IBC 1705.13)
2. STRUCTURAL OBSERVATIONS REQUIRED BY THE LOCAL JURISDICTION AND IBC 1704.5 SHALL BE PERFORMED BY A REGISTERED DESIGN PROFESSIONAL PROVIDED BY THE OWNER. STRUCTURAL OBSERVATIONS SHALL BE THE VISUAL OBSERVATION OF THE STRUCTURAL SYSTEM FOR GENERAL CONFORMANCE TO THE APPROVED CONSTRUCTION DOCUMENTS.
3. TESTING AGENCY FOR THE INSPECTIONS SHALL FILE ALL APPROPRIATE FORMS WITH THE BUILDING DEPARTMENT.

TCA
ARCHITECTURE + PLANNING + DESIGN

Silman

STATE OF MICHIGAN
NATHANIEL ZARA OPPENHEIMER
ENGINEER
No. 6201052117
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMIT	08/04/23
BIDS/PERMIT	10/11/24

Drawn: AD Checked: RH

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

GENERAL STRUCTURAL NOTES

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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STANDARD ABBREVIATIONS

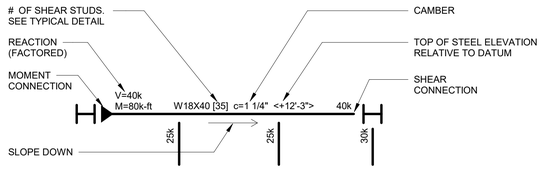
ADD'L.	ADDITIONAL
ADJ.	ADJACENT
A/E	DESIGN TEAM OF RECORD
ALT.	ALTERNATE
ANCH.	ANCHOR
APPROX.	APPROXIMATE/APPROXIMATELY
ARCH.	ARCHITECT/ARCHITECTURAL
BLDG.	BUILDING
BM.	BEAM
B.O.	BOTTOM OF
BOT.	BOTTOM
BRG.	BEARING
CANT.	CANTILEVER
CFS	COLD FORMED STEEL
C.I.P.	CAST IN PLACE
C.J.	CONTRACTION JOINT
CLG.	CEILING
CLR.	CLEAR
CMU	CONCRETE MASONRY UNIT
COL.	COLUMN
COMP.	COMPOSITE
CONC.	CONCRETE
CONST.	CONSTRUCTION
CONT.	CONTINUOUS
COORD.	COORDINATE/COORDINATION
CONTR.	CONTRACTOR
COTR	CONTRACT OFFICER'S TECHNICAL REPRESENTATIVE
CTR.	CENTER
DBL.	DOUBLE
DEMO	DEMOLITION/DEMOLISH
DIA.	DIAMETER
DIAG.	DIAGONAL
DIM.	DIMENSION
D.L.	DEAD LOAD
DN.	DOWN
DTL.	DETAIL
DWG(S)	DRAWING(S)
DWL.	DOWEL
EA.	EACH
E.F.	EACH FACE
E.J.	EXPANSION JOINT
EL.	ELEVATION
ELEC.	ELECTRICAL
ELEV.	ELEVATOR
EMBED.	EMBEDMENT
E.O.	EDGE OF
ENGR.	ENGINEER
E.O.R.	ENGINEER OF RECORD
EQ.	EQUAL
E.S.	EACH SIDE
E.W.	EACH WAY
EXP.	EXPANSION
EXT.	EXTERIOR
FDN.	FOUNDATION
FIN.	FINISH
FLR.	FLOOR
FRMG.	FRAMING
F.S.	FAR SIDE
FT.	FEET
FTG.	FOOTING
GA.	GAGE
GALV.	GALVANIZED
G.B.	GRADE BEAM
HDR.	HEADER
HGR.	HANGER
HORIZ.	HORIZONTAL
H.P.	HIGH POINT
HT.	HEIGHT
HVAC	HEATING, VENTILATION, & AIR CONDITIONING
I.D.	INSIDE DIAMETER
I.F.	INSIDE FACE
I.J.	ISOLATION JOINT
INFO	INFORMATION
INT.	INTERIOR
JT.	JOINT
K	KIP
LB.	POUND
L.L.	LIVE LOAD
LLBB	LONG LEGS BACK-TO-BACK
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
L.P.	LOW POINT
L.W.	LIGHTWEIGHT
L.W.	LONG WAY
MAS.	MASONRY
MAX.	MAXIMUM
MECH.	MECHANICAL
MEP	MECH., ELECT., PLUMBING, & FIRE PROTECTION
MFR.	MANUFACTURER
MIN.	MINIMUM
MISC.	MISCELLANEOUS
M.O.	MASONRY OPENING
MPII	MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS
N.F.	NEAR FACE
N.I.C.	NOT IN CONTRACT
NO.	NUMBER
N.S.	NEAR SIDE
N.T.S.	NOT TO SCALE
N.W.	NORMAL WEIGHT
O.C.	ON CENTER
O.D.	OUTSIDE DIAMETER
O.F.	OUTSIDE FACE
OPNG.	OPENING
OPP.	OPPOSITE
PC.	PIECE
PERP.	PERPENDICULAR
PL.	PLATE
PLF	POUNDS PER LINEAR FOOT
PREFAB.	PREFABRICATED
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
REINF.	REINFORCE(D)/REINFORCEMENT
REQ'D	REQUIRED
REV.	REVISION
SCHED.	SCHEDULE
SECT.	SECTION
S.I.F.	STEP IN FOOTING
SLBB	SHORT LEGS BACK-TO-BACK
SIM.	SIMILAR
S.O.G.	SLAB ON GRADE
SPEC.	SPECIFICATION
SQ.	SQUARE
S.S.	STAINLESS STEEL
STD.	STANDARD
STIFF.	STIFFENER
STL.	STEEL
S.W.	SHORT WAY
SYM.	SYMMETRIC
T & B	TOP & BOTTOM
TEMP.	TEMPORARY/TEMPERATURE
THK.	THICK(NESS)
T.O.	TOP OF
TR.	TRANSFER
TYP.	TYPICAL
U.N.O.	UNLESS NOTED OTHERWISE
VERT.	VERTICAL
W/	WITH
W.P	WORK POINT
W.W.R.	WELDED WIRE REINFORCEMENT
#	NUMBER/SIZE
Ø	DIAMETER

LEGEND

- CONCRETE FOOTING, GRADE BEAM, OR PILE CAP
- WALL OR CONCRETE BEAM BELOW
- CONCRETE WALL
- COLD FORMED METAL FRAMING WALL
- CONCRETE COLUMN
- STEEL COLUMN
- COLUMN ABOVE / BELOW
- HANGER COLUMN ABOVE / BELOW
- STEEL BEAM
- STEEL LINTEL (SEE SCHEDULE)
- STEEL BRACING
- STEEL BEAM PENETRATION (SEE DETAIL) — WP#
- LEDGER ANGLE (SEE DETAIL)
- BEAM SPLICE CONNECTION
- SHEAR CONNECTION
- MOMENT CONNECTION
- STEEL BEAM WALL PLATE CONNECTION (SEE DETAIL) — WP-#
- CONCRETE ON METAL DECK (SEE SCHEDULE), OPEN ARROW INDICATES SPAN DIRECTION — S-#
- METAL DECK (SEE SCHEDULE), OPEN ARROW INDICATES SPAN DIRECTION — R-#
- SLAB ON GRADE (SEE SCHEDULE) — S.O.G.
- RAMP/SLOPED FLOOR (TAIL INDICATES HIGH END)
- STEP IN SLAB
- SLAB SLOPE TRANSITION
- TOP OF SLAB ELEVATION — #' - #"
- SPOT ELEVATION — #' - #"
- OPENING IN SLAB
- FRAMING ELEVATION / WALL ELEVATION — MF-20
- COLUMN LINE — 0
- KEYNOTE — #
- REVISION — 1
- PROPERTY LINE — ℄

[## - ##"]	BOTTOM OF FOOTING ELEVATION RELATIVE TO DATUM
<## - ##">	TOP OF FRAMING ELEVATION RELATIVE TO DATUM
{## - ##"}	TOP OF PIER ELEVATION RELATIVE TO DATUM
(## - ##")	BOTTOM OF BASE PLATE ELEVATION RELATIVE TO DATUM
BP__	STEEL BEAM BEARING PLATE, SEE SCHEDULE & DETAILS
CBP__	STEEL COLUMN BASE PLATE, SEE SCHEDULE & DETAILS
F__	CONCRETE SPREAD FOOTING, SEE SCHEDULE & DETAILS
M__	CONCRETE MAT FOUNDATION, SEE SCHEDULE & DETAILS
P__	CONCRETE OR MASONRY PIER, SEE SCHEDULE & DETAILS
S__	CONCRETE SLAB OR CONCRETE SLAB ON METAL DECK, SEE SCHEDULE & DETAILS
W__	CONCRETE WALL, SEE SCHEDULE & DETAILS
WF__	WALL FOOTING, SEE SCHEDULE & DETAILS

STRUCTURAL STEEL FRAMING KEY

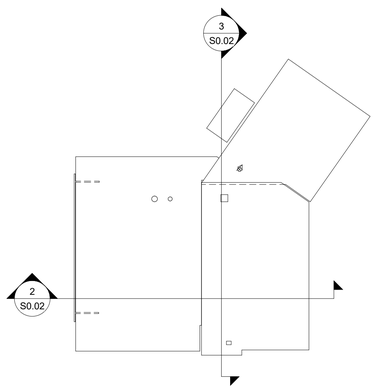


NOTE:

SEE GENERAL NOTES FOR SPECIFIC MINIMUM CONNECTION REQUIREMENTS.

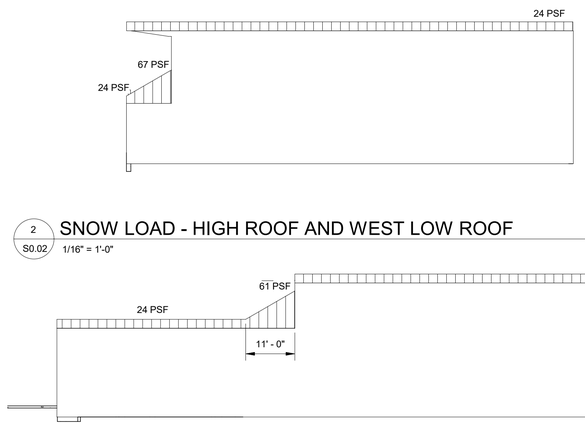
LOADS (PSF)	FIRST FLOOR, TYPICAL (PSF)	FIRST FLOOR, APPARATUS BAY (PSF)	FIRST FLOOR, ELEVATOR MAT (PSF)	SECOND FLOOR (PSF)	LOW ROOFS (PSF)	HIGH ROOF (PSF)
DEAD LOAD						
6" NW CONCRETE SLAB	72.5					
12" NW CONCRETE SLAB		145	145			
5-1/4" LW SLAB ON METAL DECK				41		
STEEL FRAMING				8	8	8
SUPERIMPOSED DEAD LOAD						
SOLAR PANELS						30
EPDM ROOF COVERING					1.5	1.5
WATERPROOFING AND INSULATION					6	6
1.5B 18 GAGE ROOF DECK					2.8	2.8
CEILING AND SERVICES				15	15	15
TILE FLOOR				16		
LIVE LOADS						
EMERGENCY VEHICLE		250				
ASSEMBLY	100		100			
RESIDENTIAL				40		
PARTITIONS				15		
ROOF					20	20

DESIGN PARAMETER TABLE		
GOVERNING CODE:		2015 MICHIGAN BUILDING CODE
BUILDING CATEGORY:		IV
SNOW LOAD:		
20	Pg	GROUND SNOW LOAD
1.0	Ce	SNOW EXPOSURE FACTOR
1.2	Is	SNOW LOAD IMPORTANCE FACTOR
1.0	Ct	THERMAL FACTOR
WIND LOAD:		
120	MPH	BASIC WIND SPEED
1.0	I	WIND IMPORTANCE FACTOR
B		WIND EXPOSURE CATEGORY
0.18	GCPi	INTERNAL PRESSURE COEFFICIENT
VARIES, SEE PLANS	PSF	C&C VELOCITY PRESSURE AT MEAN ROOF HEIGHT
82	K	DESIGN BASE SHEAR
SEISMIC DESIGN:		
1.5	I	SEISMIC IMPORTANCE FACTOR
0.095	Ss	SHORT PERIOD SPECTRAL RESPONSE ACCELERATION
0.048	S1	1-SECOND PERIOD SPECTRAL RESPONSE ACCELERATION
D		SITE CLASS
0.102	S(ds)	5-% DAMPED SPECTRAL RESPONSE COEFFICIENT AT SHORT PERIODS
0.077	S(d1)	5-% DAMPED SPECTRAL RESPONSE COEFFICIENT AT 1-SECOND PERIODS
C		SEISMIC DESIGN CATEGORY
STEEL ORDINARY MOMENT FRAMES AND BRACED FRAMES		BASIC SEISMIC FORCE RESISTING SYSTEM
55	K	DESIGN BASE SHEAR
0.051	Cs	SEISMIC RESPONSE COEFFICIENT
3	R	RESPONSE MODIFICATION FACTOR
EQUIVALENT STATIC FORCE		ANALYSIS PROCEDURE



1 S0.02 SNOW LOAD PLAN

1" = 30'-0"

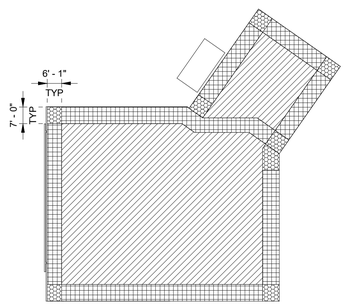


2 S0.02 SNOW LOAD - HIGH ROOF AND WEST LOW ROOF

1/16" = 1'-0"

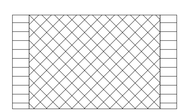
3 S0.02 SNOW LOAD - HIGH ROOF AND NORTHEAST LOW ROOF

1/16" = 1'-0"



WIND LOADS

- ZONE 1 (ROOF) 20.2 PSF; -23.7 PSF
- ZONE 2 (ROOF) 20.2 PSF; -28.1 PSF
- ZONE 3 (ROOF) 21.2 PSF; -29.0 PSF
- ZONE 4 (MIDDLE WALL)17.8 PSF; -19.7 PSF
- ZONE 5 (END WALL) 19.1 PSF; -22.3 PSF



NOTES:

1. POSITIVE PRESSURE PUSHES TOWARDS THE BUILDING'S INTERIOR. NEGATIVE PRESSURE PUSHES OUTWARD (SUCTION).
2. LOADS REPORTED ARE ULTIMATE STRENGTH (WIND VELOCITY PRESSURE V = 120 MPH). MULTIPLY LOADS BY 0.6 FOR SERVICE LEVEL PRESSURES (V = 90 MPH).
3. LOADS INDICATED FOR WALLS ARE APPLIED TO THE ENTIRE WALL ELEVATION ALONG THE PLAN EXTENTS INDICATED.
4. FINAL NET DESIGN WIND PRESSURE, INCLUDING ALL PERMITTED REDUCTIONS, USED IN THE DESIGN SHALL NOT BE LESS THAN 16 PSF ACTING IN EITHER DIRECTION.

4 S0.02 COMPONENTS AND CLADDING WIND LOADS

1" = 30'-0"

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TCA ARCHITECTURE + PLANNING + DESIGN

Silman

STATE OF MICHIGAN — NATHANIEL LEVERA OPPENHEIMER — ENGINEER — No. 6201052117 — LICENSED PROFESSIONAL ENGINEER

Project Number 21018

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City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

LEGEND & ABBREVIATIONS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet S0.02

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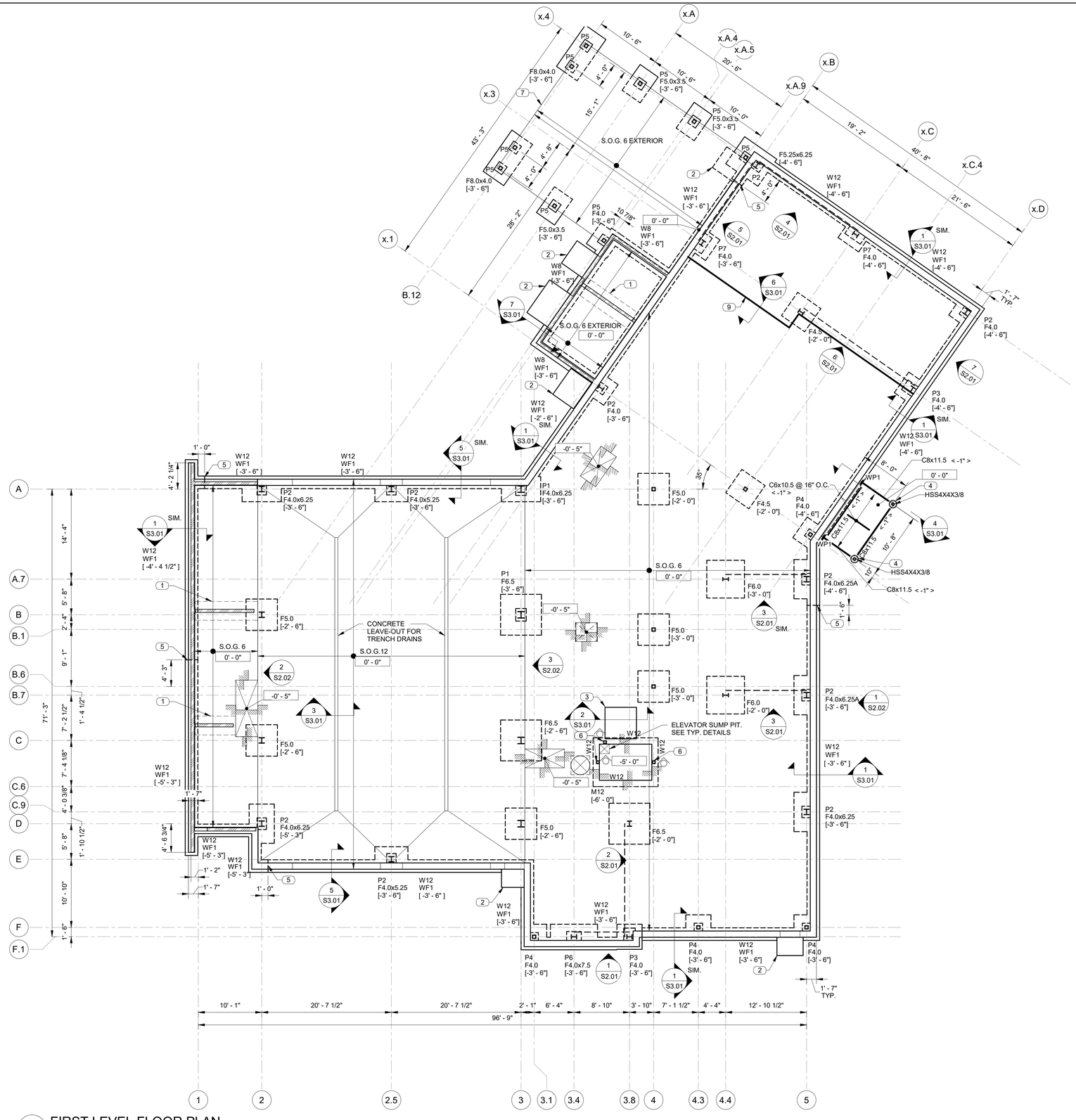

1 S1.01 FIRST LEVEL FLOOR PLAN

1/8" = 1'-0"

SHEET NOTES

1. DATUM ELEVATION 0' - 0" REFERENCES TOP OF LEVEL 1 ELEVATION 0' - 0".
2. BOTTOM OF FOOTING ELEVATIONS IS [-3' - 6"] BELOW DATUM UNLESS NOTED THUS [X' - X"].
3. REFER TO S0.01 FOR GENERAL NOTES.
4. SEE S6.01 FOR COLUMN SCHEDULES.
5. COORDINATE ALL DIMENSIONS WITH ARCHITECT, CIVIL, MEP AND OTHER PRIME CONTRACTORS.
6. COORDINATE ALL SLAB OPENINGS, SLOPES, SLEEVES, DEPRESSIONS, EDGE DIMENSIONS AND CURBS WITH ARCHITECT, CIVIL, MEP AND OTHER PRIME CONTRACTORS.

KEYNOTES

MARK	DESCRIPTION
1	THICKENED SLAB, SEE TYPICAL DETAIL.
2	FROST BLOCK WITH #4 AT 12" EACH WAY TOP AND BOTTOM. COVER ENTIRE DOORSWING. COORD. W/ ARCH. BOTTOM OF CONCRETE EXTEND BELOW GRADE -3'-6" MIN. DOWEL INTO BUILDING FOUNDATION.
3	EXTRACTOR EQUIPMENT 5'X5' CONCRETE PAD . SEE ARCH FOR LOCATION.
4	14" DIA. CONCRETE SONOTUBE WITH 5-#5 VERTICAL BARS AND #3 TIES @ 12" O.C. BOTTOM OF SONOTUBE AT -3'-6" FROM TOP OF GRADE.
5	STEPPED WALL FOOTING. SEE TYPICAL DETAIL.
6	HSS5X5X3/8 HOISTWAY STEEL COLUMNS. COORDINATE WITH ARCH AND ELEVATOR MANUFACTURER FOR LOCATION
7	TOP OF SLAB ELEV. TO MATCH CIVIL. SEE CIVIL DRWG.
9	VIBRATION ISOLATION JOINT. SEE ARCH.

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STATE OF MICHIGAN
NATHANIEL LEVRA OPPENHEIMER
ENGINEER
No. 6201052117
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMIT	08/04/23
BIDS/PERMIT	10/11/24

Drawn: AD Checked: RH

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

FIRST LEVEL STRUCTURAL PLAN

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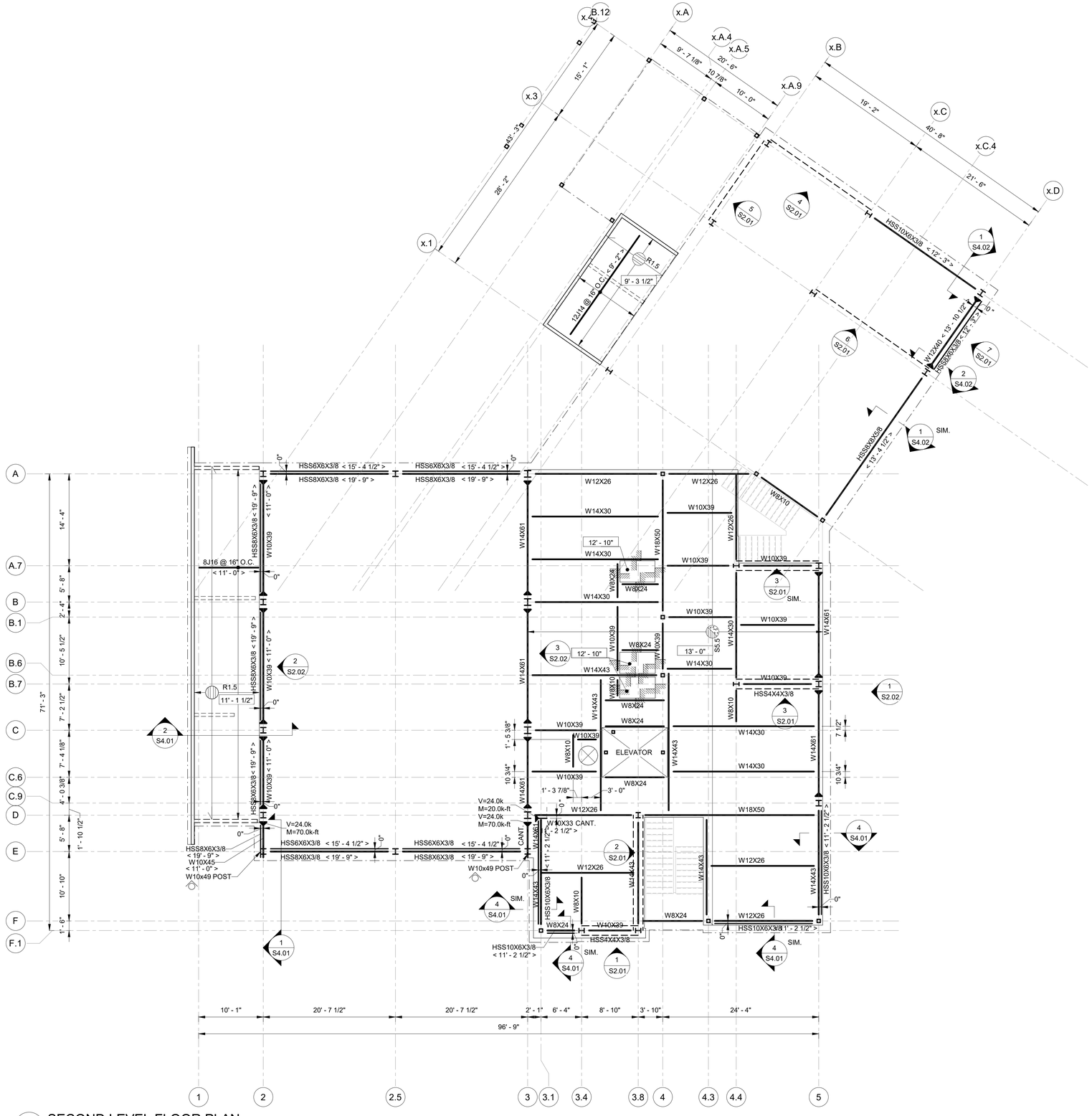

1 S1.02 SECOND LEVEL FLOOR PLAN

1/8" = 1'-0"

SHEET NOTES

1. DATUM ELEVATION 0' - 0" REFERENCES TOP OF LEVEL 1 SLAB ELEVATION 0' - 0".
2. TOP OF STEEL ELEVATION IS <12' - 6 1/2"> FROM DATUM UNLESS NOTED THUS <X' - X"> ON PLAN.
3. REFER TO S0.01 FOR GENERAL NOTES.
4. COORDINATE ALL SLAB OPENINGS, SLEEVES, SLOPES, DEPRESSIONS, EDGE DIMENSIONS AND CURBS WITH ARCHITECT, CIVIL, M.E.P. AND ALL OTHER PRIME CONTRACTORS.
5. COORDINATE ALL DIMENSIONS, LOCATIONS AND WALL OPENING WITH ARCHITECT, CIVIL, MEP, AND ALL OTHER PRIME CONTRACTORS.
6. REFER TO ARCHITECTURAL DRAWINGS FOR TOP OF MASONRY SHELF ELEVATIONS AND CONFIGURATION.

KEYNOTES

0 4' 8' 16'

39°

TRUE

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STATE OF MICHIGAN
NATHANIEL LEVRA OPPENHEIMER
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No. 6201052117
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City of Ann Arbor
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SECOND LEVEL STRUCTURAL PLAN

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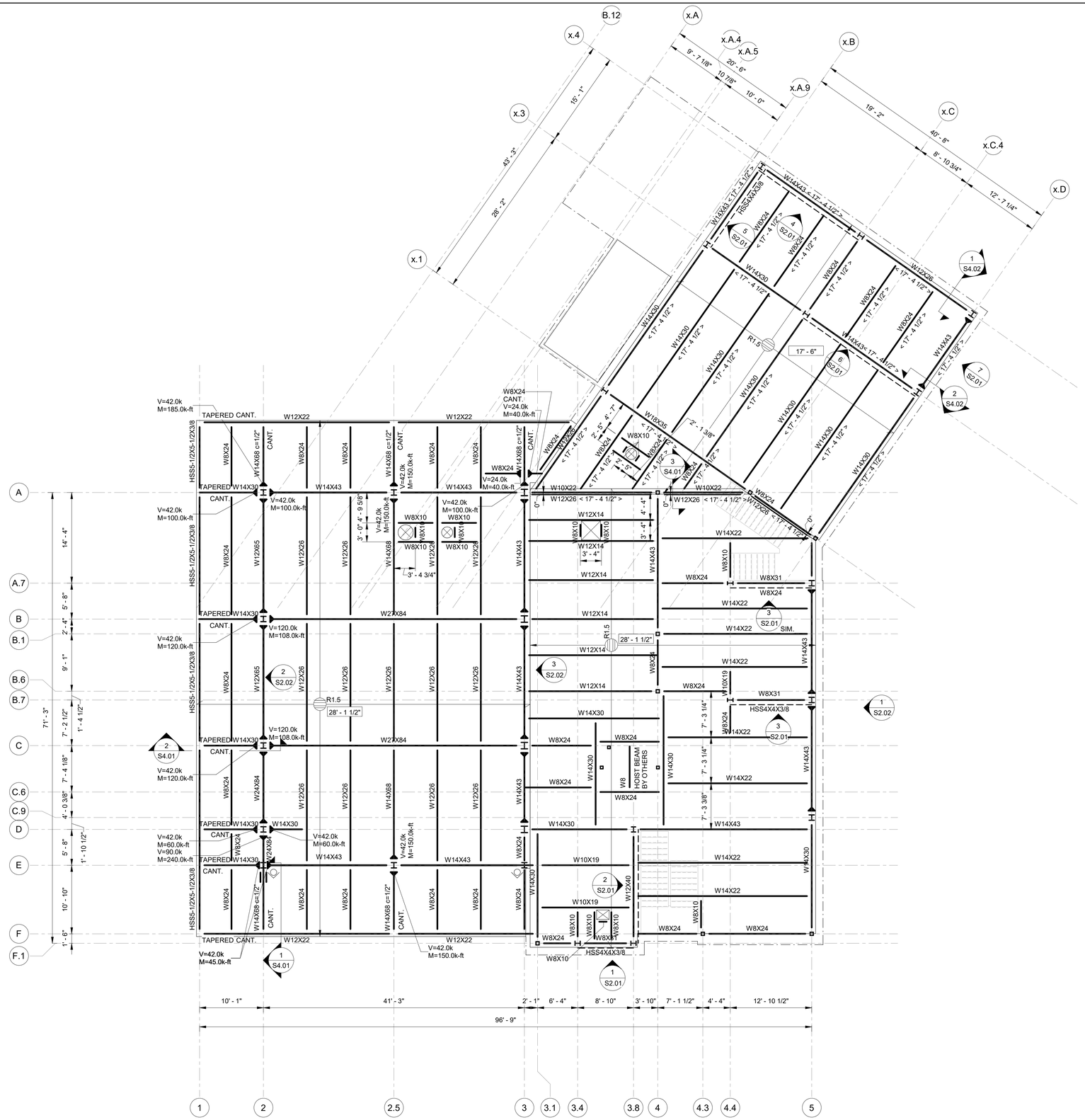

1 S1.03 ROOF PLAN
1/8" = 1'-0"

SHEET NOTES

1. DATUM ELEVATION 0' - 0" REFERENCES TOP OF LEVEL 1 SLAB ELEVATION 0' - 0".
2. TOP OF STEEL ELEVATION IS <28' - 0"> FROM DATUM UNLESS NOTED THUS <X' - X"> ON PLAN.
3. REFER TO S0.01 FOR GENERAL NOTES.
4. COORDINATE ALL SLAB OPENINGS, SLEEVES, SLOPES, DEPRESSIONS, EDGE DIMENSIONS AND CURBS WITH ARCHITECT, CIVIL, M.E.P. AND ALL OTHER PRIME CONTRACTORS.
5. COORDINATE ALL DIMENSIONS, LOCATIONS AND WALL OPENING WITH ARCHITECT, CIVIL, MEP, AND ALL OTHER PRIME CONTRACTORS.
6. REFER TO ARCHITECTURAL DRAWINGS FOR TOP OF MASONRY SHELF ELEVATIONS AND CONFIGURATION.

KEYNOTES

0 4' 8' 16'

39°
TRUE

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STATE OF MICHIGAN
NATHANIEL TERRA OPPENHEIMER
ENGINEER
No. 6201052117
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ROOF STRUCTURAL PLAN

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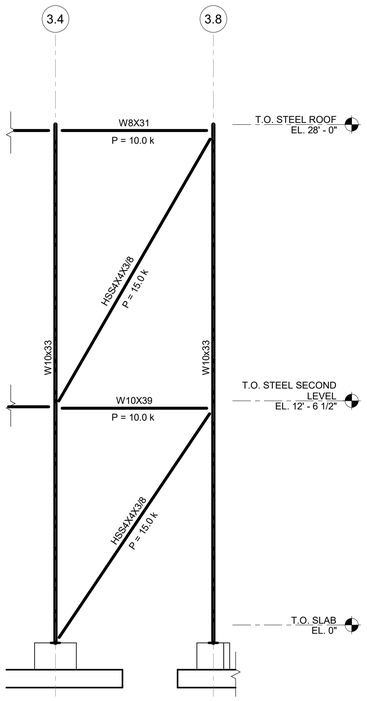
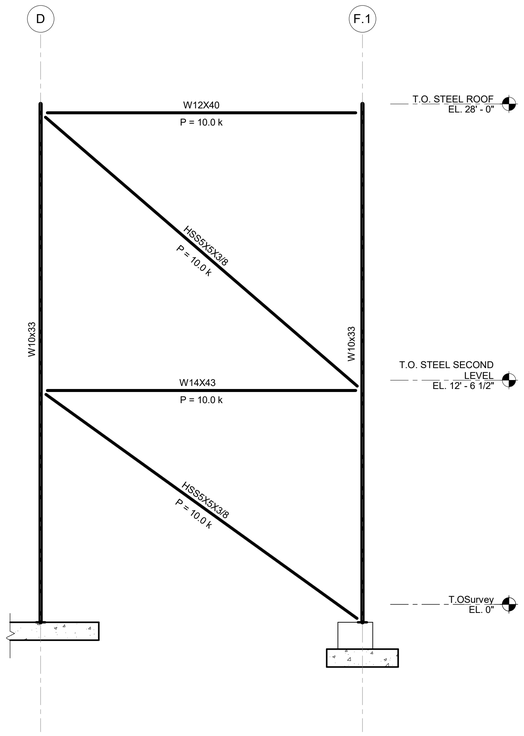


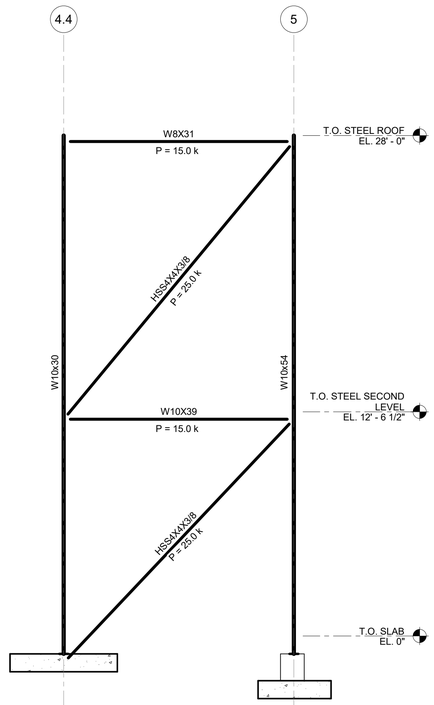
NOTE: LOADS SHOWN ARE LRFD LOADS.

1 S2.01 GRID F.1 ELEVATION
1/4" = 1'-0"



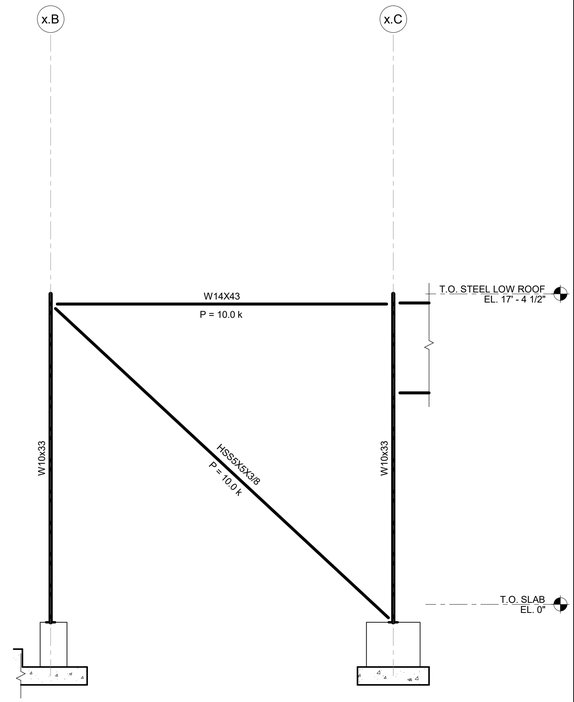
NOTE: LOADS SHOWN ARE LRFD LOADS.

2 S2.01 GRID 3.8 ELEVATION
1/4" = 1'-0"



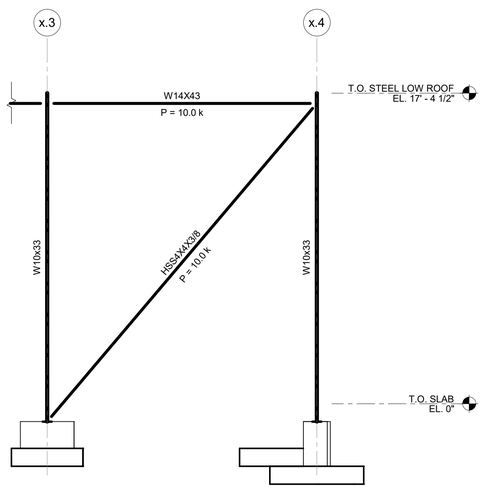
NOTE: LOADS SHOWN ARE LRFD LOADS.

3 S2.01 GRID B.7 ELEVATION
1/4" = 1'-0"



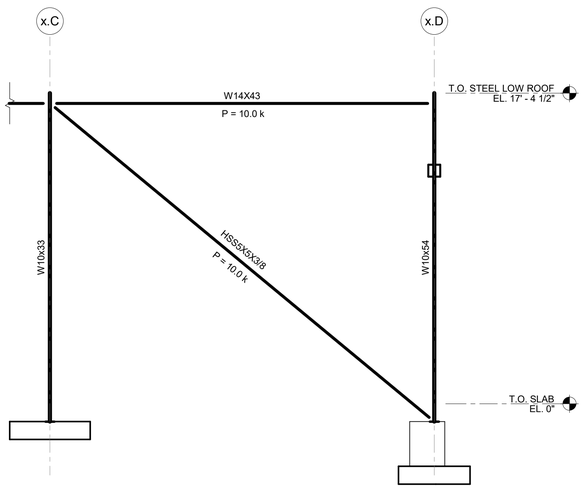
NOTE: LOADS SHOWN ARE LRFD LOADS.

4 S2.01 GRID x.4 ELEVATION
1/4" = 1'-0"



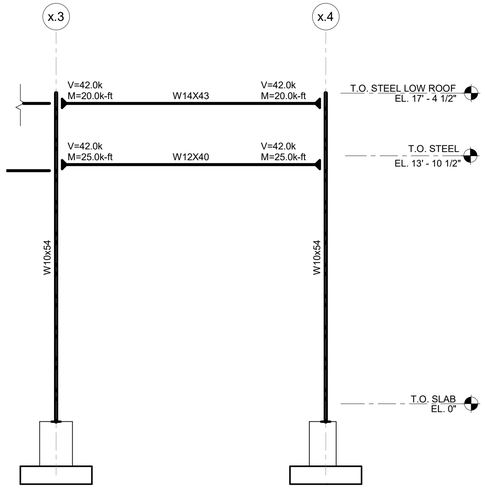
NOTE: LOADS SHOWN ARE LRFD LOADS.

5 S2.01 GRID x.B ELEVATION
1/4" = 1'-0"



NOTE: LOADS SHOWN ARE LRFD LOADS.

6 S2.01 GRID x.3 ELEVATION
1/4" = 1'-0"



NOTE: LOADS SHOWN ARE LRFD LOADS.

7 S2.01 GRID x.D ELEVATION
1/4" = 1'-0"

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NATHANIEL LEVRA OPPENHEIMER
ENGINEER
No. 6201022117
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMIT	08/04/23
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City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

ELEVATIONS

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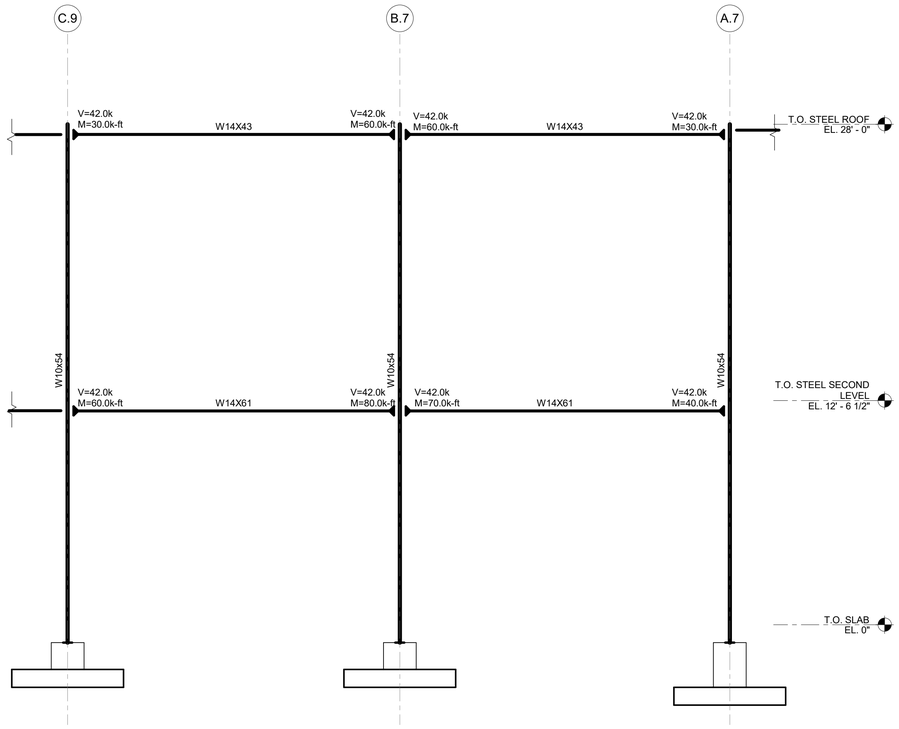
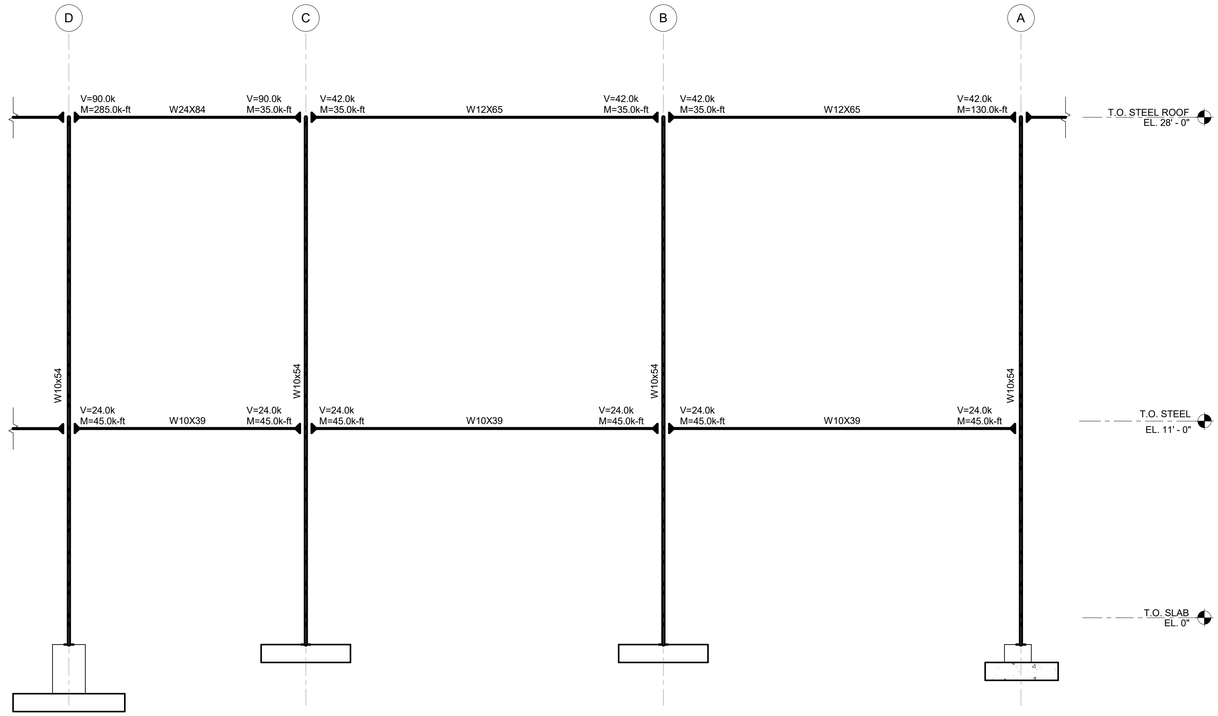


NOTE: LOADS SHOWN ARE LRFD LOADS.

1 S2.02 GRID 5 ELEVATION

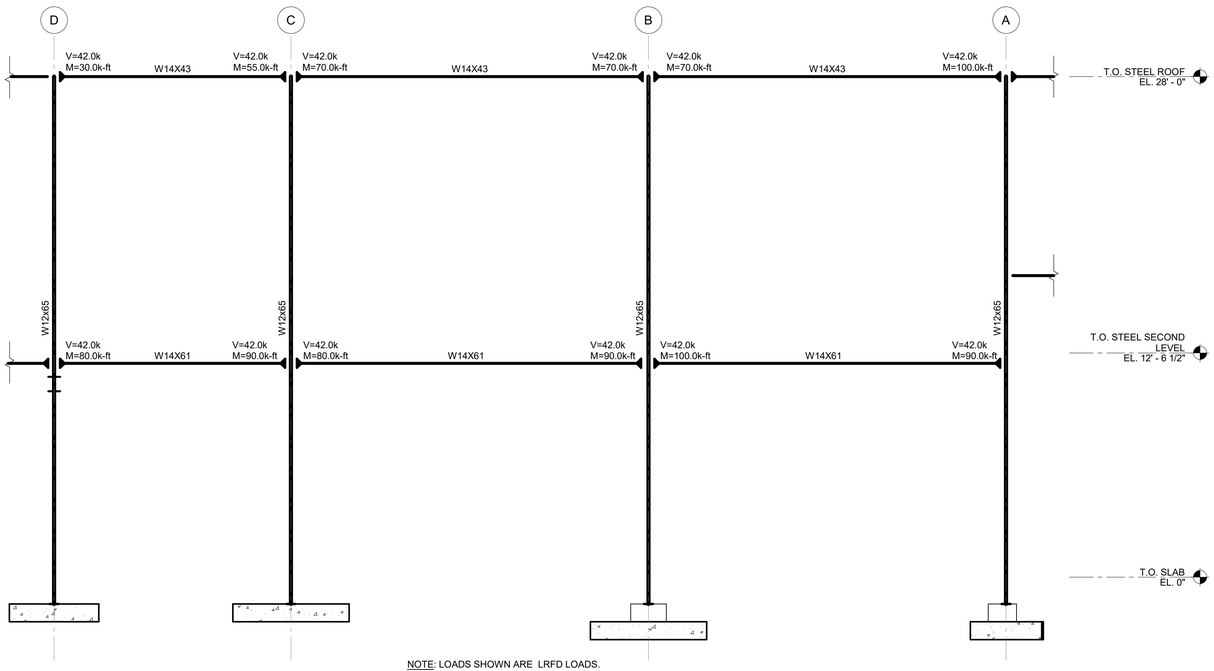
1/4" = 1'-0"



NOTE: LOADS SHOWN ARE LRFD LOADS.

2 S2.02 GRID 2 ELEVATION

1/4" = 1'-0"



NOTE: LOADS SHOWN ARE LRFD LOADS.

3 S2.02 GRID 3 ELEVATION

1/4" = 1'-0"

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LICENSED PROFESSIONAL ENGINEER

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City of Ann Arbor
NEW FIRE STATION 4
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ELEVATIONS

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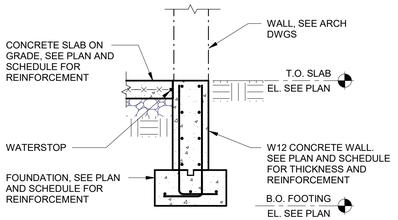
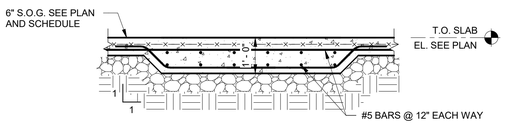
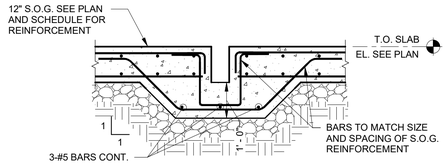


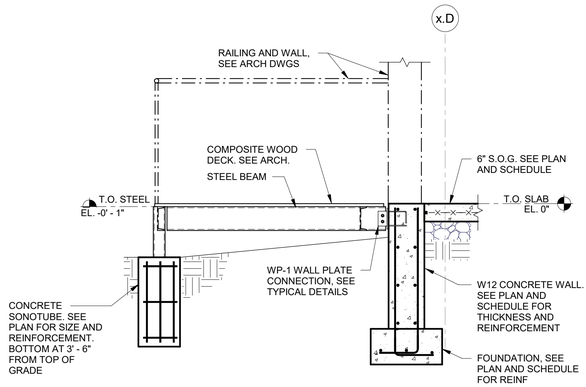
1 S3.01 SECTION
1/2" = 1'-0"



2 S3.01 EQUIPMENT PAD SECTION
1/2" = 1'-0"



3 S3.01 SECTION
1/2" = 1'-0"



4 S3.01 SECTION
1/2" = 1'-0"

5 S3.01 SECTION
1/2" = 1'-0"

6 S3.01 SECTION
3/4" = 1'-0"

7 S3.01 SECTION
1/2" = 1'-0"

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NATHANIEL OPPENHEIMER ENGINEER No. 6201052117 LICENSED PROFESSIONAL ENGINEER STATE OF MICHIGAN

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
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City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
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FOUNDATION SECTIONS

A 3 C
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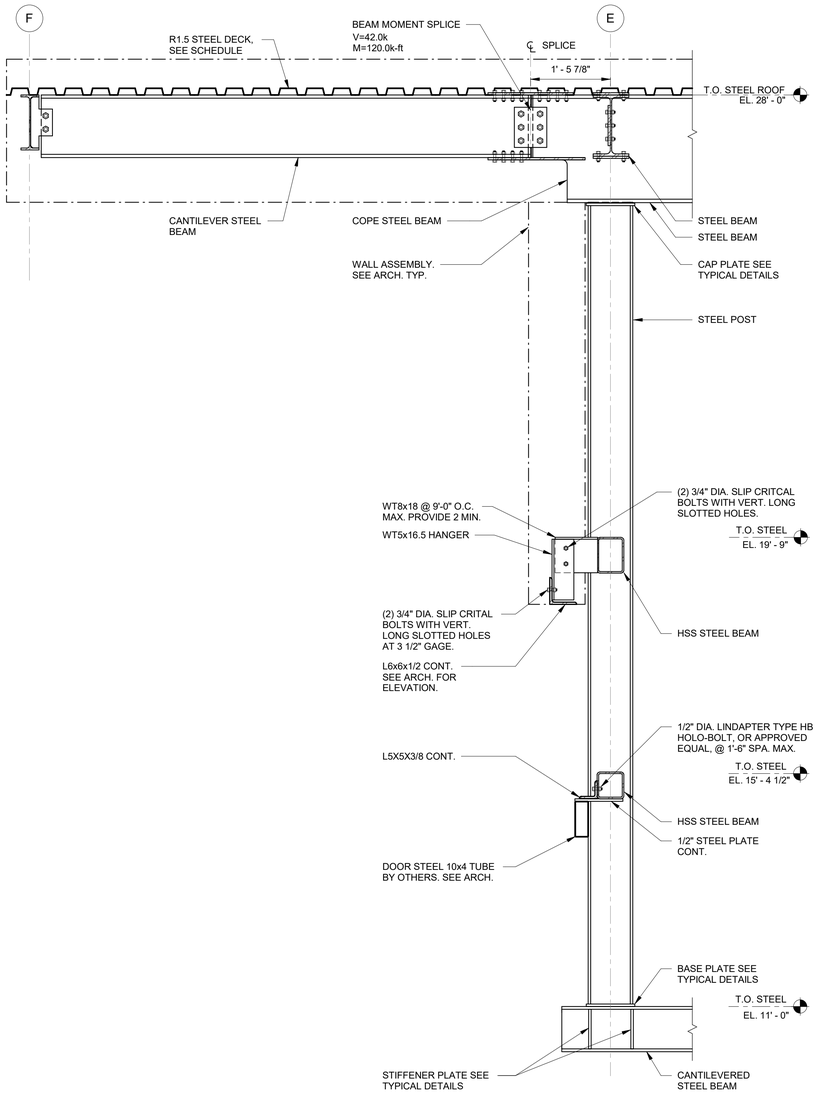
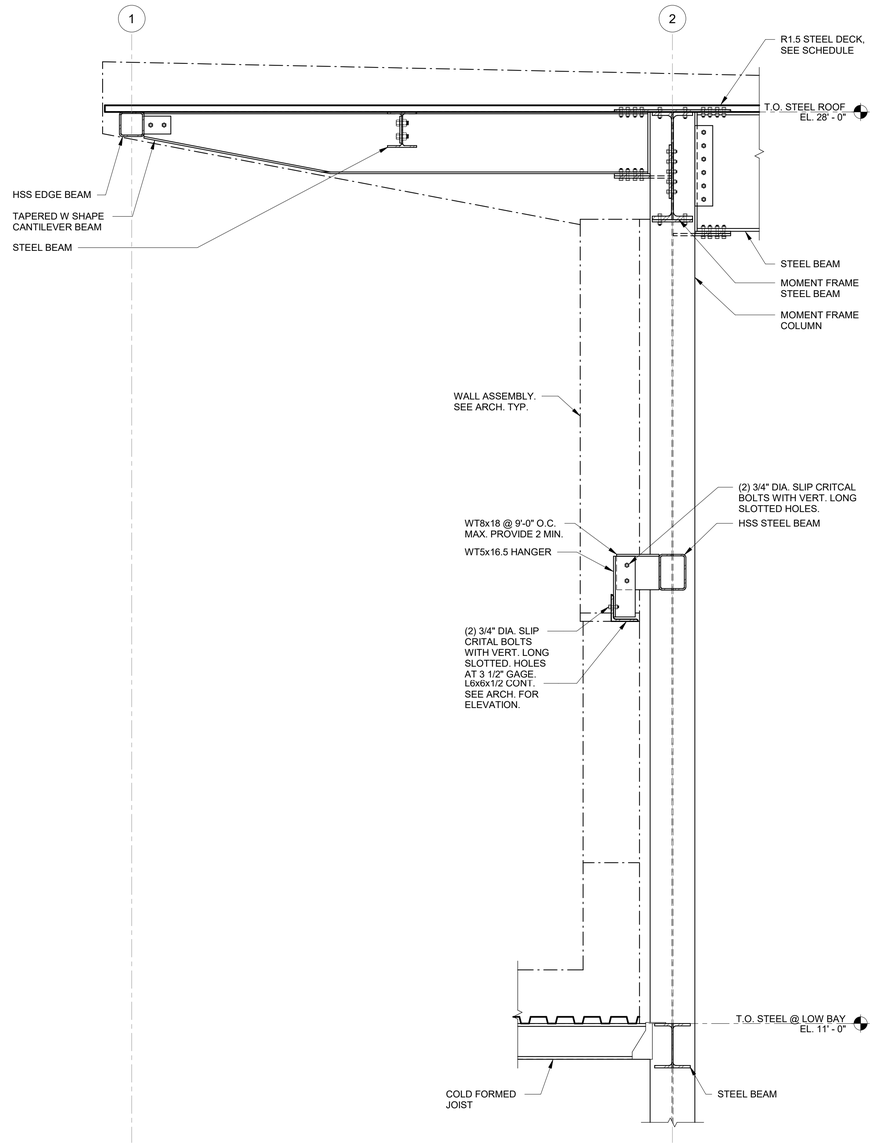
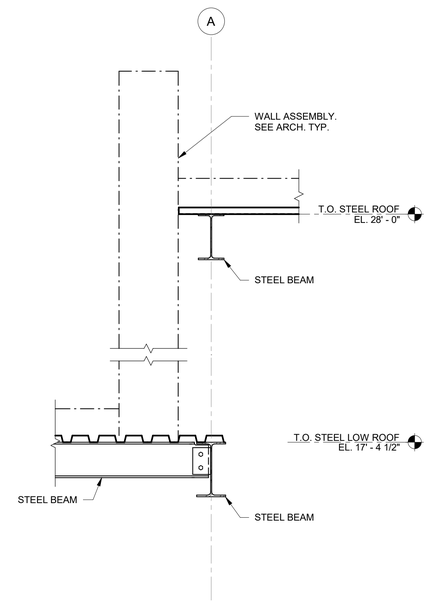


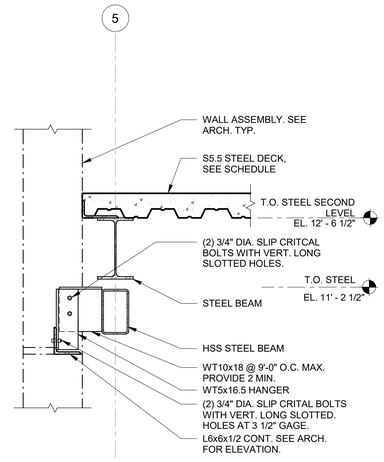
1 S4.01 SECTION
3/4" = 1'-0"



2 S4.01 SECTION
3/4" = 1'-0"



3 S4.01 SECTION
3/4" = 1'-0"



4 S4.01 SECTION
3/4" = 1'-0"

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LICENSED PROFESSIONAL ENGINEER

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City of Ann Arbor
NEW FIRE STATION 4
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SUPERSTRUCTURE SECTIONS

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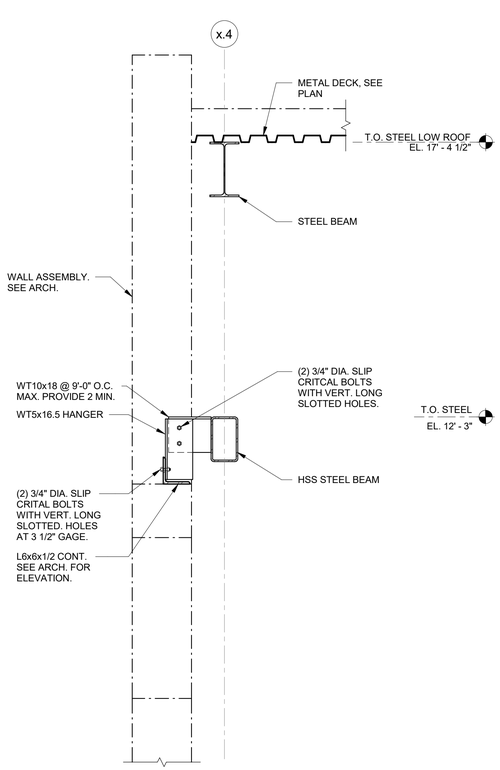
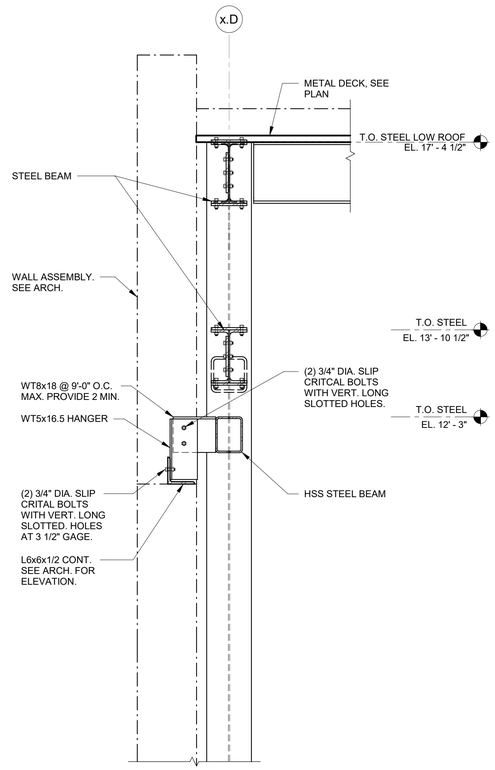


1 S4.02 SECTION

3/4" = 1'-0"



2 S4.02 SECTION

3/4" = 1'-0"

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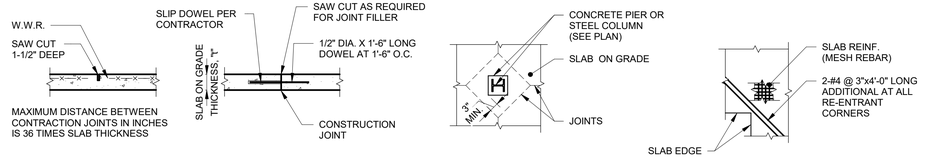
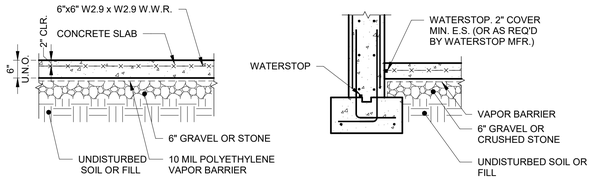


SAWED CONTRACTION JOINT | CONSTRUCTION JOINT | ISOLATION JOINT AT COLUMN | ADDITIONAL REINFORCEMENT AT ALL RE- ENTRANT CORNERS



SLAB ON GRADE

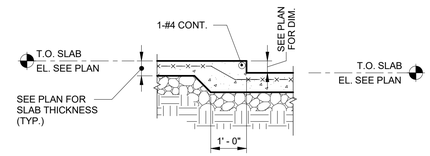
SLAB-ON-GRADE & WALL INTERFACE

NOTES:

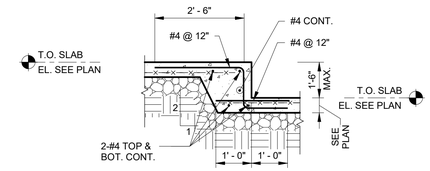
1. SLAB ON GRADE SHALL BE PLACED IN ALTERNATING STRIPS WHERE EACH SINGLE STRIP DOES NO EXCEED 36 TIMES SLAB THICKNESS WIDTH IN INCHES. ALTERNATIVELY, LARGE BLOCK PLACEMENTS WITH INTERIOR CONTRACTION JOINTS ARE ACCEPTABLE IF THE CONTRACTION JOINTS ARE MADE IN BOTH DIRECTIONS AT SPECIFIED INTERVALS IN A TIMELY MANNER.
2. SAWED CONTRACTION JOINTS SHALL BE LOCATED AT A MAXIMUM SPACING IN INCHES OF 36 TIMES THE SLAB THICKNESS. JOINTS SHALL BE SAWED NO LATER THAN 24 HOURS AFTER CONCRETE IS PLACED.
3. GRAVEL OR CRUSHED STONE BASE SHALL BE COMPACTED TO 95% OF MAXIMUM DENSITY AT OPTIMUM MOISTURE CONTENT.

TYPICAL SLAB ON GRADE

N.T.S.



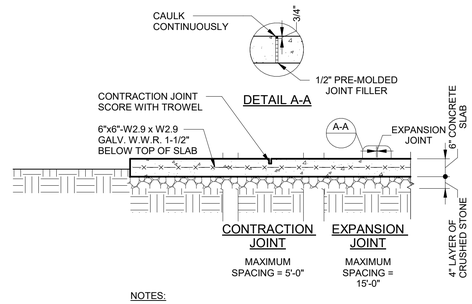
STEP LESS THAN OR EQUAL TO SLAB THICKNESS



STEP GREATER THAN SLAB THICKNESS

TYPICAL STEP IN SLAB ON GRADE

N.T.S.

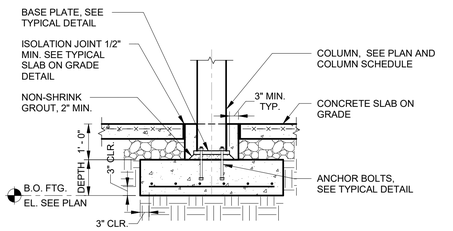


NOTES:

1. UNDISTURBED SOIL OR FILL COMPACTED TO 95% OF MAXIMUM DENSITY AT OPTIMUM MOISTURE CONTENT REMOVE ORGANIC MATERIAL.
2. BROOM FINISH UNLESS NOTED OTHERWISE.

TYPICAL EXTERIOR PAVING

N.T.S.

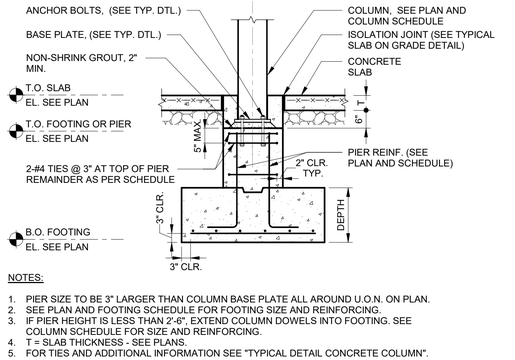


NOTES:

1. FOOTINGS SHALL BEAR ON FIRM UNDISTURBED SOIL WITH A MINIMUM BEARING CAPACITY AS SPECIFIED IN THE GENERAL NOTES.
2. FOR SIZE, DEPTH AND REINFORCING SEE FOOTING SCHEDULE.

TYPICAL SPREAD FOOTING AT STEEL COLUMN

N.T.S.

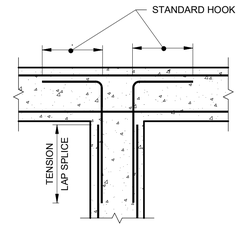


NOTES:

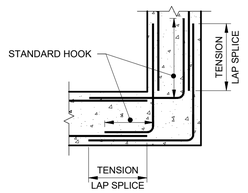
1. PIER SIZE TO BE 3" LARGER THAN COLUMN BASE PLATE ALL AROUND U.O.N. ON PLAN.
2. SEE PLAN AND FOOTING SCHEDULE FOR FOOTING SIZE AND REINFORCING.
3. IF PIER HEIGHT IS LESS THAN 2'-6", EXTEND COLUMN DOWELS INTO FOOTING. SEE COLUMN SCHEDULE FOR SIZE AND REINFORCING.
4. T = SLAB THICKNESS - SEE PLANS.
5. FOR TIES AND ADDITIONAL INFORMATION SEE "TYPICAL DETAIL CONCRETE COLUMN".

TYPICAL PIER & FOOTING AT STEEL COLUMN

N.T.S.



TEE-INTERSECTION

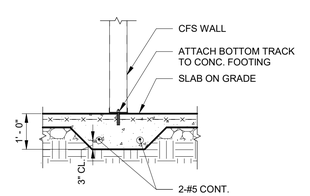


CORNER

NOTE: FOR TENSION LAP SPLICE LENGTH AND DEVELOPMENT LENGTH SEE TABLE.

TYPICAL HORIZONTAL REINFORCEMENT AT CORNERS & JUNCTIONS OF WALLS AND BEAMS

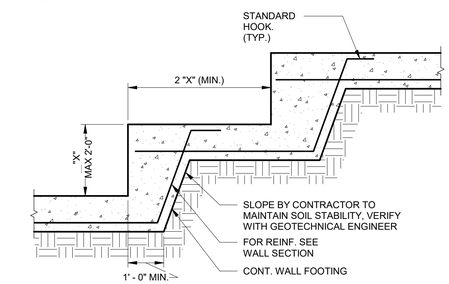
N.T.S.



NOTE: SEE TYPICAL SLAB ON GRADE DETAIL FOR ADDITIONAL INFORMATION

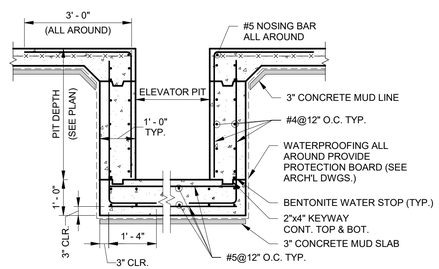
TYPICAL SUPPORT FOR CFS PARTITIONS AT SLAB ON GRADE

N.T.S.



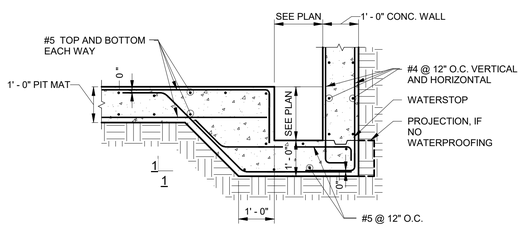
TYPICAL STEPPED WALL FOOTING

N.T.S.



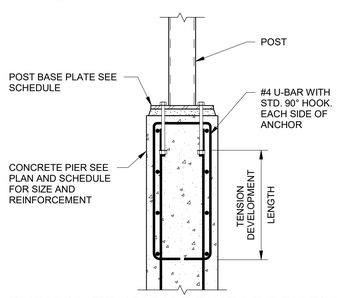
TYPICAL ELEVATOR PIT (EXTERIOR WATERPROOFING)

N.T.S.



TYPICAL ELEVATOR SUMP PIT

N.T.S.



TYPICAL TENSION REINFORCEMENT AT CONCRETE PIERS

N.T.S.

TCA
ARCHITECTURE + PLANNING + DESIGN

Silman

STATE OF MICHIGAN
NATHANIEL
TERRA
OPPENHEIMER
ENGINEER
No.
6201052117
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMIT	08/04/23
BIDS/PERMIT	10/11/24

Drawn: AD Checked: RH

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

TYPICAL DETAILS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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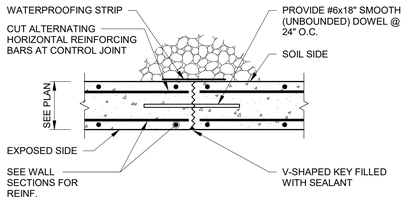
Sheet S5.01

SILMAN PROJECT # 20145

10/10/2024 11:26:34 AM

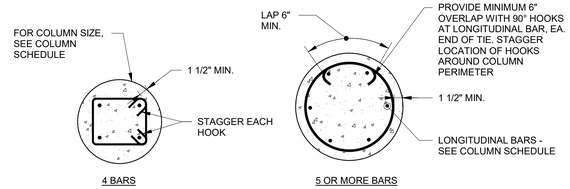


NOTE:

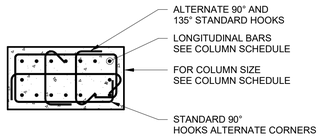
1. PROVIDE CONTROL JOINTS AT A MAXIMUM OF 20 FEET O.C. AND AT ALL CORNERS.
2. SEE TYPICAL WALL DETAIL AND ARCH. FOR WATERPROOFING AND DRAINAGE REQUIREMENTS

TYPICAL CONTROL JOINT IN CONCRETE WALL

N.T.S.



ROUND COLUMNS



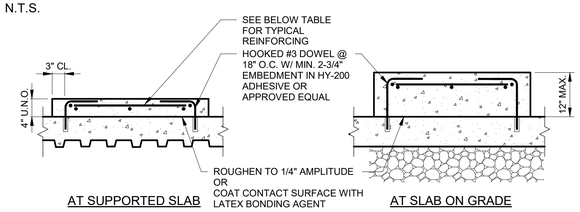
SQUARE/ RECTANGULAR COLUMNS

NOTES:

1. TIE SIZE: #3 TIES FOR LONGITUDINAL BARS UP TO #9 AND #4 TIES FOR LONGITUDINAL BARS #10, #11, #14 & #18.
2. TIE SPACING NO GREATER THAN:
   A. 16x DIAMETER OF LONGITUDINAL BARS
   B. 48x DIAMETER OF TIES
   C. MINIMUM DIMENSION OF COLUMN
3. FOR RECTANGULAR/SQUARE COLUMNS, EVERY CORNER AND ALTERNATE LONGITUDINAL BAR SHALL HAVE LATERAL SUPPORT PROVIDED BY CORNER OF A TIE HAVING AN INCLUDED ANGLE OF NOT MORE THAN 135 DEGREES. NO BAR SHALL BE MORE THAN 6" CLEAR FROM SUCH A LATERALLY SUPPORTED BAR ON EITHER SIDE.

TYPICAL CROSS-SECTION OF CONCRETE COLUMN

N.T.S.



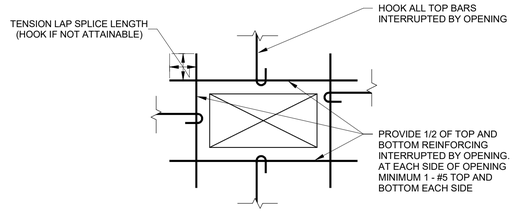
EQUIPMENT PAD TEMPERATURE AND SHRINKAGE REINFORCING	
PAD THICKNESS	REINFORCING
4"-5"	#3 @ 12" O.C. EACH WAY
6"-9"	#4 @ 12" O.C. EACH WAY
10"-12"	#5 @ 12" O.C. EACH WAY

NOTES:

1. FOR SIZE AND LOCATION SEE ARCHITECTURAL AND MECHANICAL DRAWINGS.
2. CONCRETE FOR PADS SHALL BE NORMAL WEIGHT WITH f'c = 4,000 PSI.

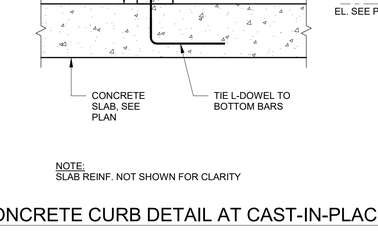
TYPICAL EQUIPMENT PAD

N.T.S.



TYPICAL ADDITIONAL REINFORCEMENT AT OPENING IN FRAMED SLAB

N.T.S.

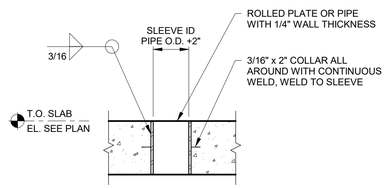


NOTE:
SPACE ADJACENT PIPE SLEEVES AS FOLLOWS:

PIPE DIAMETER (OUTSIDE DIA.)	CLEAR DISTANCE BETWEEN EDGES OF PIPE OPENINGS
DIA. ≤ 6"	CLEAR DIST. = PIPE DIA.
6" < DIA. ≤ 12"	CLEAR DIST. = 6"
12"<DIA. ≤ 24"	CLEAR DIST. = WALL THICKNESS

TYPICAL PIPE SLEEVE IN CONCRETE WALL

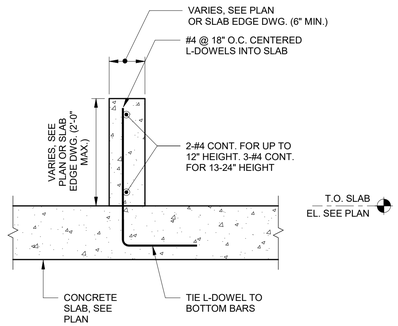
N.T.S.



NOTE: PROVIDE CLEAR SPACE BETWEEN PIPE AND/ OR OPENINGS A MINIMUM 6" OR PIPE SLEEVE DIAMETER APART (WHICHEVER IS GREATER.)

TYPICAL PIPE SLEEVE IN CONCRETE SLAB

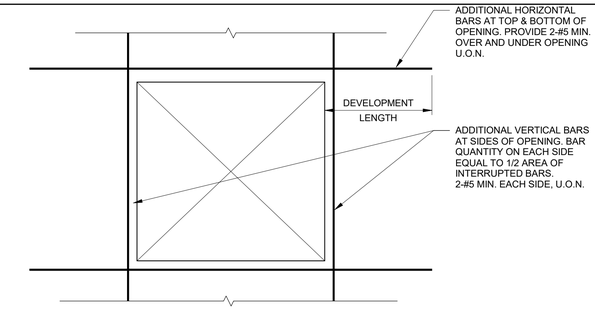
N.T.S.



NOTE:
SLAB REINF. NOT SHOWN FOR CLARITY

TYPICAL CONCRETE CURB DETAIL AT CAST-IN-PLACE CONCRETE SLAB

N.T.S.

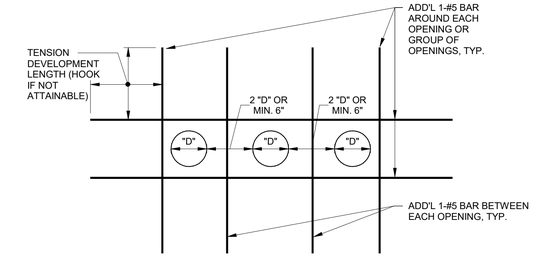


NOTES:

1. HOOK ALL BARS INTERRUPTED BY OPENING.
2. HORIZONTAL BARS TO EXTEND DEVELOPMENT LENGTH BEYOND OPENING, VERTICAL BARS TO BE FULL STORY HEIGHT.
3. PROVIDE REINFORCING SHOWN IN THIS DETAIL U.O.N. IN SHEAR WALL SCHEDULE, SHEAR WALL DETAILS, SHEAR WALL ELEVATIONS ETC.

TYPICAL OPENING IN CONCRETE WALL

N.T.S.

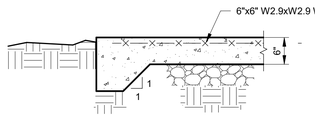


NOTES:

1. LIMIT 3 PENETRATIONS IN A ROW IN ANY DIRECTION.
2. COORDINATE WITH TYPICAL DETAIL FOR FORMED CONCRETE SLAB PIPE SLEEVE
3. SHOULD PENETRATIONS BE CUT AFTER CONCRETE IS POURED, CONTRACTOR TO SUBMIT PLAN SHOWING ALL PROPOSED CORE DRILLING LOCATIONS TO E.O.R. FOR APPROVAL. CONTRACTOR TO USE NDE METHODS TO LOCATE REBAR PRIOR TO CUTTING SLAB.

TYPICAL SLAB PENETRATION WITH SLEEVE DIAMETER LESS THAN 6"

N.T.S.



NOTES:

1. FOR SIZE AND LOCATION SEE ARCHITECTURAL AND MECHANICAL DRAWINGS.
2. CONCRETE FOR PADS SHALL BE NORMAL WEIGHT WITH f'c = 4000 PSI
3. THREADED RODS TO BE 3/8" Ø A-36 STEEL IN EXPANSION INSERTS @ 18" O.C. HY-200 ADHESIVE OR APPROVED EQUAL.

TYPICAL EQUIPMENT PAD ON GRADE (EXTERIOR)

N.T.S.

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Silman

Project Number 21018

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Drawn: AD Checked: RH

City of Ann Arbor
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115 1/2 E. LIBERTY STREET
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T: (734) 663 - 1910
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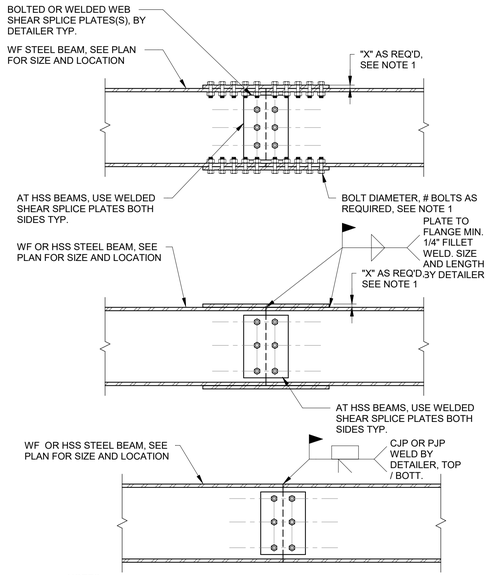
SILMAN PROJECT # 20145

10/10/2024 11:26:35 AM

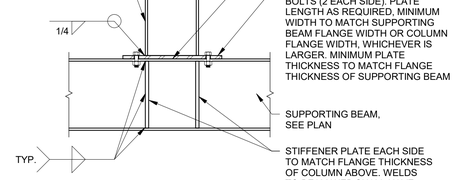


NOTES:

1. FLANGE AND WEB SPLICE CONNECTIONS TO BE SELECTED OR ENGINEERED BY DETAILER TO DEVELOP THE FULL CAPACITY OF THOSE BEAM ELEMENTS SIDE OF JOINT.
2. COORDINATE AND SUBMIT SPLICE LOCATIONS TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO FABRICATION.
3. ALL STEEL CONNECTIONS ARE SUBJECT TO SPECIAL INSPECTION INCLUDING ULTRASONIC TESTING OF PJP OR CJP GROOVE WELDS.

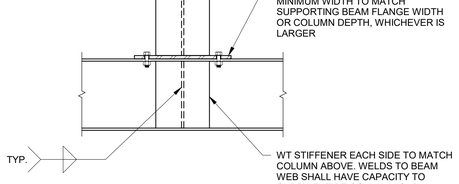
TYPICAL STEEL BEAM SPLICE

N.T.S.



PARALLEL WEB CONDITION

SEE PERPENDICULAR CONDITION FOR BALANCE OF INFORMATION

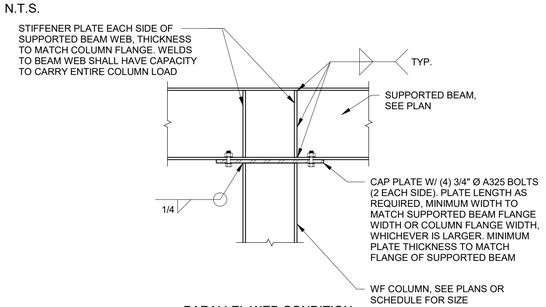


PERPENDICULAR WEB CONDITION

SEE PARALLEL CONDITION FOR BALANCE OF INFORMATION

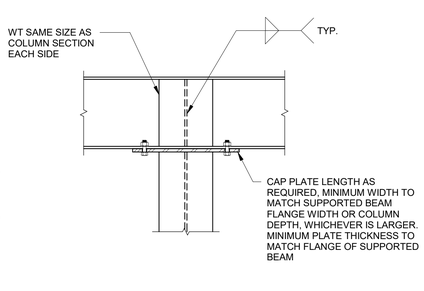
TYPICAL BEAM-SUPPORTED WIDE FLANGE COLUMN

N.T.S.



PARALLEL WEB CONDITION

SEE PERPENDICULAR CONDITION FOR BALANCE OF INFORMATION

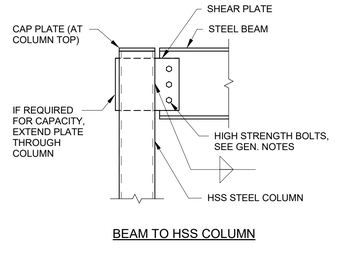


PERPENDICULAR WEB CONDITION

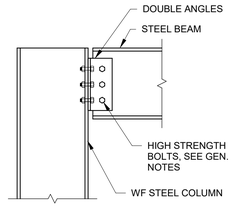
SEE PARALLEL CONDITION FOR BALANCE OF INFORMATION

TYPICAL BEAM CONTINUOUS OVER WIDE FLANGE COLUMN

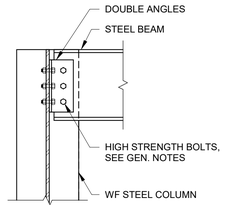
N.T.S.



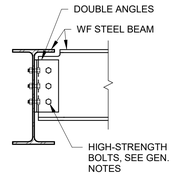
BEAM TO HSS COLUMN



BEAM TO WF COLUMN FLANGE



BEAM TO WF COLUMN WEB



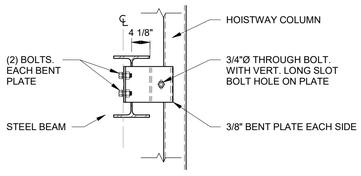
WF BEAM TO WF BEAM

NOTES:

1. CONNECTION DETAILS SHOWN ABOVE ARE SCHEMATIC ONLY. THE CONTRACTOR MAY SUBMIT ALTERNATE DETAILS FROM THOSE SHOWN ABOVE, BUT IN ANY CASE THE CONTRACTOR IS RESPONSIBLE FOR PRODUCING STEEL SHOP DRAWINGS IN ACCORDANCE WITH THE PROJECT GENERAL NOTES AND AISC GUIDELINES. CALCULATIONS SHALL BE SUBMITTED AS REQUIRED IN THE GENERAL NOTES AND ELSEWHERE IN THE CONTRACT DOCUMENTS.
2. THE CONTRACTOR SHALL DETAIL THE PROJECT CONNECTIONS FOR THE LOADS AS INDICATED IN THE CONTRACT DOCUMENTS, PER AISC GUIDELINES. THE SCHEMATIC DETAILS ABOVE ARE NOT SUGGESTIVE OF SPECIFIC CAPACITIES. THE NUMBER AND SIZE OF BOLTS, SIZE AND LENGTH OF WELDS, AND SIZE OF STEEL PIECES MUST BE DETERMINED PER AISC GUIDELINES AND THE CONTRACT DOCUMENTS.
3. PROVIDE FULL DEPTH CONNECTIONS AT ALL PERIMETER BEAM CONNECTIONS AND AT BEAM CONNECTIONS TO PERIMETER BEAMS, UNLESS OTHERWISE NOTED.

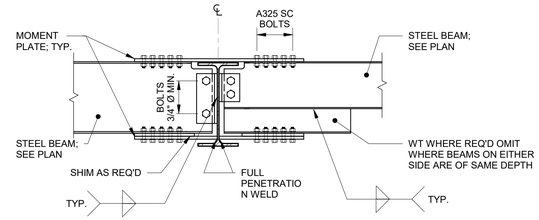
TYPICAL SUGGESTED SHEAR CONNECTIONS AT GRAVITY LOADS ONLY

N.T.S.



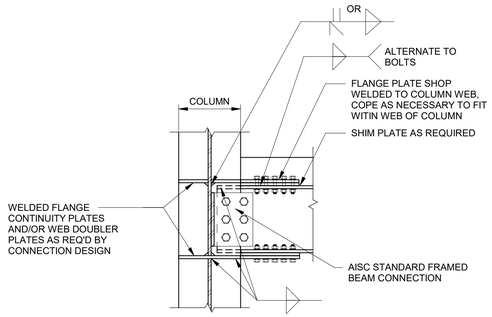
TYPICAL CONNECTION FOR HOISTWAY COLUMNS

N.T.S.



TYPICAL BEAM-TO-BEAM MOMENT CONNECTION

N.T.S.

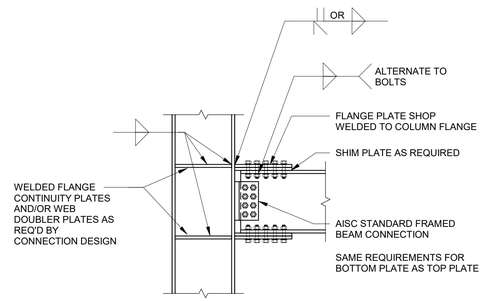


NOTE:

1. CONNECTION DETAILS SHOWN ABOVE ARE SCHEMATIC DETAILS ONLY. CONTRACTOR SHALL DETAIL MOMENT CONNECTIONS BASED ON NOTE 4, IN ACCORDANCE WITH CODES AND "R" VALUE GIVEN HEREIN, AND SHALL PROVIDE SIGNED AND SEALED CALCULATIONS FOR FULL CONNECTIONS PRIOR TO SUBMITTAL OF SHOP DRAWINGS.
2. ALL BOLTS TO BE PRE TENSIONED HIGH STRENGTH BOLTS. ALL FAYING SURFACES SHALL BE PREPARED AS REQUIRED FOR CLASS A OR BETTER SLIP CRITICAL JOINTS. THE DESIGN SHEAR STRENGTH OF BOLTED JOINTS IS PERMITTED TO BE CALCULATED AS THAT FOR BEARING TYPE JOINTS.
3. PROVIDE BOLTED CONNECTION IN WEB FOR BEAM REACTION PER GENERAL NOTES OR FRAME ELEVATIONS OF PLAN.
4. 4A - SEE TYPICAL LATERAL FRAME ELEVATION LEGEND FOR INFORMATION ON CONNECTION DESIGN FORCES. PROVIDE CONTINUITY AND/OR DOUBLER PLATES IF NECESSARY.
5. 4B - DESIGN CONNECTION FOR FULL PLASTIC CAPACITY OF BEAM AND VERIFY PANEL ZONE STRENGTH OF COLUMN IS NOT EXCEEDED. PROVIDE CONTINUITY AND/OR DOUBLER PLATES IF NECESSARY.

TYPICAL COLUMN WEB MOMENT CONNECTION (R=3)

N.T.S.



NOTES:

1. CONNECTION DETAILS SHOWN ABOVE ARE SCHEMATIC DETAILS ONLY. CONTRACTOR SHALL DETAIL MOMENT CONNECTIONS BASED ON NOTE 4, IN ACCORDANCE WITH CODES AND "R" VALUE GIVEN HEREIN, AND SHALL PROVIDE SIGNED AND SEALED CALCULATIONS FOR FULL CONNECTIONS PRIOR TO SUBMITTAL OF SHOP DRAWINGS.
2. REFER TO GENERAL NOTES FOR BOLTED CONNECTION STANDARDS.
3. PROVIDE BOLTED SHEAR CONNECTION IN WEB FOR BEAM SHEAR REACTION PER GENERAL NOTES OR FRAME ELEVATIONS OR PLAN.
4. 4A - SEE TYPICAL LATERAL FRAME ELEVATION LEGEND FOR INFORMATION ON MOMENT CONNECTION DESIGN FORCES. PROVIDE CONTINUITY AND/OR DOUBLER PLATES IF NECESSARY.
5. 4B - DESIGN CONNECTION FOR FULL PLASTIC CAPACITY OF BEAM AND VERIFY PANEL ZONE STRENGTH OF COLUMN IS NOT EXCEEDED. PROVIDE CONTINUITY AND/OR DOUBLER PLATES IF NECESSARY.

TYPICAL COLUMN FLANGE MOMENT CONNECTION (R=3)

N.T.S.

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Silman

STATE OF MICHIGAN
NATHANIEL LEVI OPPENHEIMER
ENGINEER
No. 6201052117
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

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Drawn: AD Checked: RH

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

TYPICAL DETAILS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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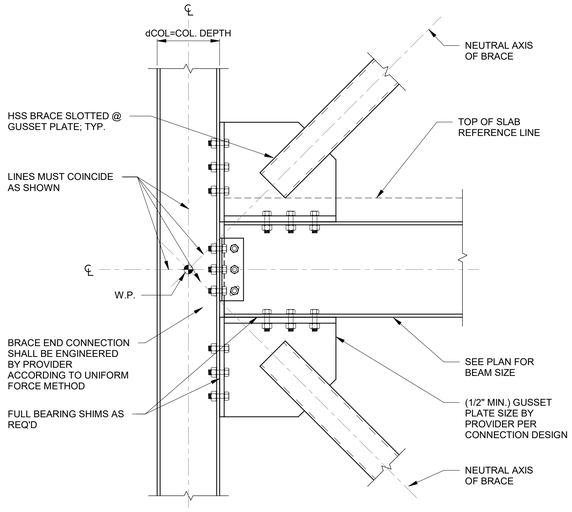
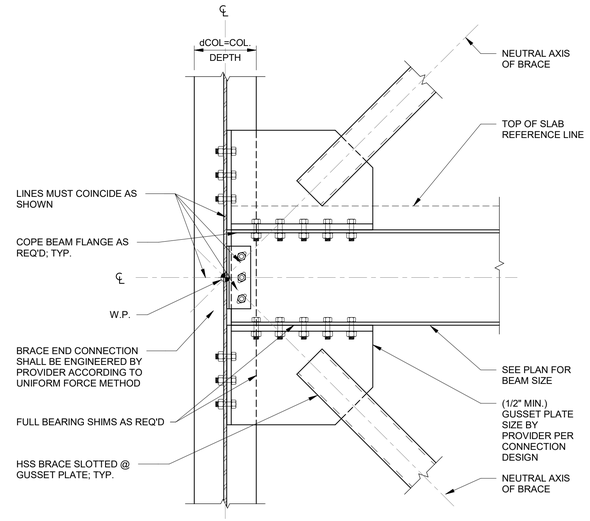


NOTE: CONNECTION DETAILS SHOWN ABOVE ARE SCHEMATIC DETAILS ONLY. CONTRACTOR SHALL DETAIL BRACE CONNECTIONS BASED ON AXIAL LOADS INDICATED IN LATERAL FRAME ELEVATIONS AND SHALL PROVIDE SIGNED AND SEALED CALCULATIONS PRIOR TO SUBMISSION OF SHOP DRAWINGS.

TYPICAL HSS LATERAL BRACE CONNECTION AT COLUMN FLANGE

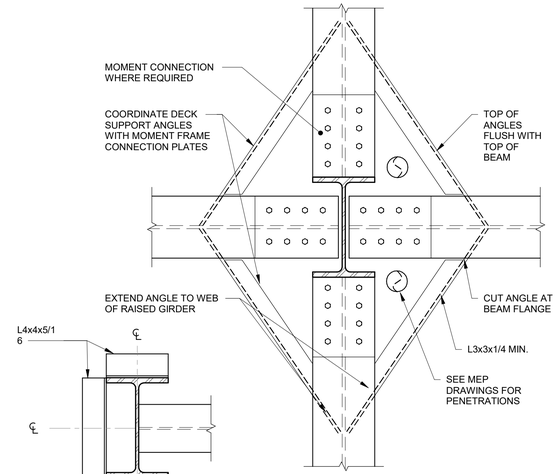
N.T.S.



NOTE: CONNECTION DETAILS SHOWN ABOVE ARE SCHEMATIC DETAILS ONLY. CONTRACTOR SHALL DETAIL BRACE CONNECTIONS BASED ON AXIAL LOADS INDICATED IN LATERAL FRAME ELEVATIONS AND SHALL PROVIDE SIGNED AND SEALED CALCULATIONS PRIOR TO SUBMISSION OF SHOP DRAWINGS.

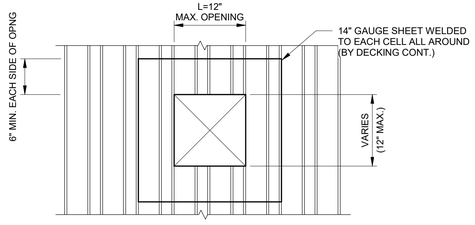
TYPICAL HSS LATERAL BRACE CONNECTION AT COLUMN WEB

N.T.S.



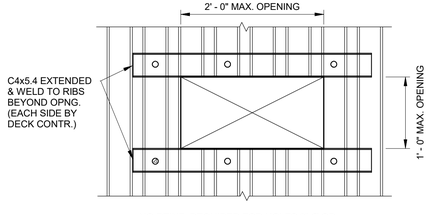
TYPICAL DECK SUPPORT AT COLUMNS (SMALL MEP PENETRATIONS)

N.T.S.



NO REINF. REQUIRED WHERE "L" IS 6" OR LESS IN DIRECTION PERPENDICULAR TO DECK.

FOR OPENINGS UP TO 12" PERPENDICULAR TO DECK



NO REINF. REQUIRED FOR HOLES 6" Ø OR LESS.

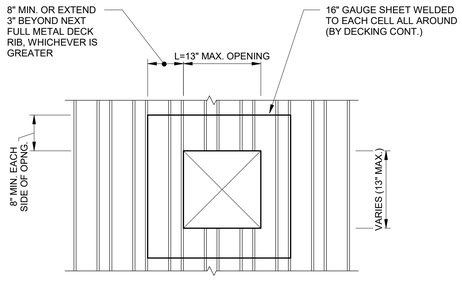
FOR OPENINGS UP TO 2'-0" PERPENDICULAR TO DECK

NOTES:

1. SEE MECHANICAL AND ARCHITECTURAL DRAWINGS FOR OPENING SIZE AND LOCATION.
2. WHERE POSSIBLE; EXTEND DECK CONTINUOUSLY OVER OPENING REINFORCE, BLOCK/BOX OUT CONCRETE, AND CUT DECK WHEN OPENING IS REQUIRED.

TYPICAL REINFORCEMENT FOR UNFRAMED OPENINGS IN COMPOSITE FLOOR DECK

N.T.S.



NO REINF. REQUIRED WHERE "L" IS 2" OR LESS IN DIRECTION PERPENDICULAR TO DECK.

FOR OPENINGS UP TO 13" PERPENDICULAR TO DECK

NOTES:

1. SEE MECHANICAL AND ARCHITECTURAL DRAWINGS FOR OPENING SIZE AND LOCATION.
2. WHERE POSSIBLE; EXTEND DECK CONTINUOUSLY OVER OPENING, REINFORCE AND CUT DECK WHEN OPENING IS REQUIRED.

TYPICAL REINFORCEMENT FOR UNFRAMED OPENINGS IN ROOF DECK

N.T.S.

10/10/2024 11:26:37 AM

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ARCHITECTURE + PLANNING + DESIGN

Silman

STATE OF MICHIGAN
NATHANIEL EZRA OPPENHEIMER
ENGINEER
No. 6201052117
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
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City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

TYPICAL DETAILS

A3C COLLABORATIVE ARCHITECTURE
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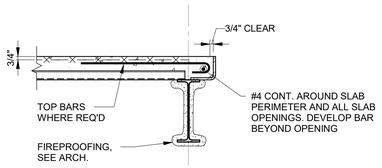
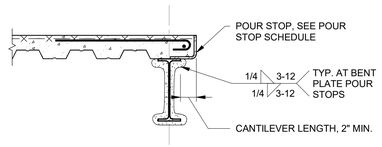


SEE PARALLEL CONDITION FOR BALANCE OF INFORMATION

DECK PERPENDICULAR TO EDGE



SEE PERPENDICULAR CONDITION FOR BALANCE OF INFORMATION

DECK PARALLEL TO EDGE

POUR STOP SCHEDULE				
SLAB CANTILEVER	BENT PLATE THICKNESS	BAR SIZE	SPACING	Ld
LESS THAN 6"	POUR STOP BY DECK MANUFACTURER	- -	- -	- -
0'-6" - 0'-11"		#4	12"	2'-0"
1'-0" - 1'-6"	5/16"	#4	12"	3'-0"
1'-7" - 1'-11"	3/8"	#5	12"	4'-0"
2'-0" - 2'-6"	1/2"	#5	12"	4'-6"

NOTES:
1. SEE ARCHITECTURAL SLAB EDGE DRAWINGS FOR TYPICAL CANTILEVER DIMENSIONS.
2. CONFIRM SLAB CANTILEVERS LARGER THAN 2'-6" WITH E.O.R.
3. BAR SIZE AND SPACING ABOVE APPLY U.O.N. IN SECTIONS
4. SLAB EDGE IS DESIGNED TO SUPPORT ONE STORY OF FACADE LOADING.
5. POUR STOP IS SIZED FOR WET WEIGHT OF CONCRETE ONLY. SLAB CANTILEVER PROVIDES BALANCE OF STRUCTURAL CAPACITY FOR PERIMETER WALLS OR FACADE. F'c NEEDS TO BE ACHIEVED BEFORE FACADE LOAD CAN BE INSTALLED.

TYPICAL CONCRETE SLAB ON METAL DECK SLAB EDGE CONDITION

N.T.S.

DEFORMED BAR TENSION DEVELOPMENT LENGTH (Ld)										
FOR NORMAL WEIGHT STONE CONCRETE & UNCOATED BARS										
BAR SIZE	3000 PSI CONCRETE		4000 PSI CONCRETE		5000 PSI CONCRETE		6000 PSI CONCRETE		8000 PSI CONCRETE	
	CASE I	CASE II	CASE I	CASE II	CASE I	CASE II	CASE I	CASE II	CASE I	CASE II
#3	17	25	15	22	13	20	12	18	12	16
#4	22	33	19	29	17	26	16	24	14	21
#5	28	42	24	36	22	32	20	30	17	26
#6	33	50	29	43	26	39	24	35	21	31
#7	48	72	42	63	38	56	34	51	30	45
#8	55	83	48	72	43	64	39	59	34	51
#9	62	93	54	81	48	72	44	66	38	57
#10	70	105	61	91	54	81	50	74	43	64
#11	78	116	67	101	60	90	55	82	48	71

DEFORMED TENSION BAR NOTES:

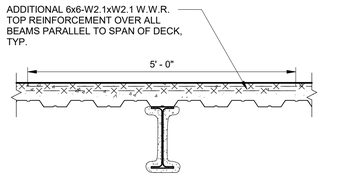
1. FOR HORIZONTAL REINFORCEMENT WITH 12 INCH OR MORE FRESH CONCRETE CAST BELOW IT, TENSION DEVELOPMENT LENGTH/ TENSION LAP SPLICE LENGTH SHALL BE 1.3x THE VALUES GIVEN.
2. FOR REINFORCEMENT IN LIGHTWEIGHT CONCRETE, TENSION DEVELOPMENT LENGTH/TENSION LAP LENGTH SHALL BE 1.3x THE VALUES GIVEN.
3. FOR EPOXY-COATED BARS:
   A. WHERE CONCRETE COVER IS LESS THAN 3x BAR DIAMETER, OR CLEAR SPACING IS LESS THAN 6x BAR DIAMETER, TENSION DEVELOPMENT LENGTH/ TENSION LAP SPLICE LENGTH SHALL BE 1.5x THE VALUES GIVEN.
   B. WHERE CONCRETE COVER IS EQUAL TO OR GREATER THAN 3x BAR DIAMETER AND CLEAR SPACING IS GREATER THAN 6x BAR DIAMETER, TENSION DEVELOPMENT LENGTH/ TENSION LAP SPLICE LENGTH SHALL BE 1.2x THE VALUES GIVEN.
4. CASE I APPLIES WHEN EITHER OF THE FOLLOWING SETS OF CONDITIONS ARE MET:
   A. ALL THREE OF THESE:
      a. CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED IS NOT LESS THAN DB AND
      b. CLEAR COVER IS NOT LESS THAN DB AND
      c. STIRRUPS OR TIES ARE PROVIDED THROUGHOUT THE DEVELOPMENT LENGTH AND THE QUANTITY IS NOT LESS THAN THE CODE MINIMUM.
   B. OR BOTH OF THESE:
      a. CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED IS NOT LESS THAN 2DB AND
      b. CLEAR COVER IS NOT LESS THAN DB.

   CASE II APPLIES TO ALL OTHER CONDITIONS NOT DESCRIBED IN CASE I

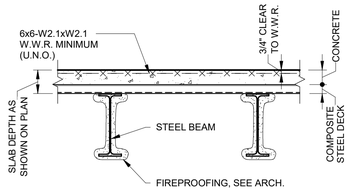
DEFORMED BAR TENSION LAP SPLICE - CLASS B										
FOR NORMAL WEIGHT STONE CONCRETE & UNCOATED BARS										
BAR SIZE	3000 PSI CONCRETE		4000 PSI CONCRETE		5000 PSI CONCRETE		6000 PSI CONCRETE		8000 PSI CONCRETE	
	CASE I	CASE II	CASE I	CASE II	CASE I	CASE II	CASE I	CASE II	CASE I	CASE II
#3	22	33	19	28	17	25	16	23	14	20
#4	29	43	25	37	23	34	21	31	18	27
#5	36	54	31	47	28	42	26	38	22	33
#6	43	65	37	56	34	50	31	46	27	40
#7	63	94	54	81	49	73	45	67	39	58
#8	72	107	62	93	56	83	51	76	44	66
#9	81	121	70	105	63	94	57	86	50	74
#10	91	136	79	118	71	106	64	96	56	84
#11	101	151	87	131	78	117	71	107	62	93

DEFORMED BAR COMPRESSION DEVELOPMENT LENGTH (Ldc)					
FOR NORMAL WEIGHT STONE CONCRETE & UNCOATED BARS					
BAR SIZE	3000 PSI CONCRETE	4000 PSI CONCRETE	5000 PSI CONCRETE	6000 PSI CONCRETE	8000 PSI CONCRETE
#3	9	8	8	8	8
#4	11	10	9	9	9
#5	14	12	12	12	12
#6	17	15	14	14	14
#7	20	17	16	16	16
#8	22	19	18	18	18
#9	25	22	21	21	21
#10	28	25	23	23	23
#11	31	27	26	26	26

DEFORMED BAR COMPRESSION LAP SPLICE					
FOR NORMAL WEIGHT STONE CONCRETE & UNCOATED BARS					
BAR SIZE	3000 PSI CONCRETE	4000 PSI CONCRETE	5000 PSI CONCRETE	6000 PSI CONCRETE	8000 PSI CONCRETE
#3	12	12	12	12	12
#4	15	15	15	15	15
#5	19	19	19	19	19
#6	23	23	23	23	23
#7	27	27	27	27	27
#8	30	30	30	30	30
#9	34	34	34	34	34
#10	39	39	39	39	39
#11	43	43	43	43	43



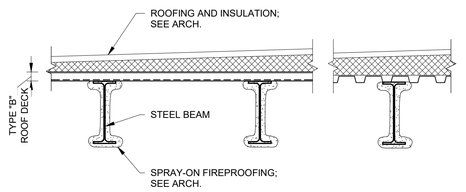
AT BEAM PARALLEL TO SPAN OF DECK



AT BEAM PERPENDICULAR TO SPAN OF DECK

TYPICAL CONCRETE SLAB ON METAL DECK CONSTRUCTION

N.T.S.

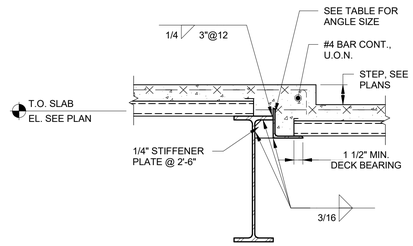


AT BEAM PERPENDICULAR TO SPAN OF DECK

AT BEAM PARALLEL TO SPAN OF DECK

TYPICAL METAL ROOF DECK CONSTRUCTION

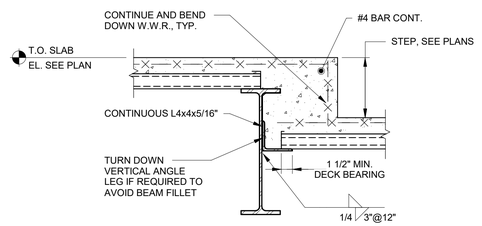
N.T.S.



STEP	ANGLE SIZE
1"	L3X3X5/16"
2"	
3"	L4X4X5/16"
4"	L5X3 1/2"X5/16"
5"	L6X4X5/16"

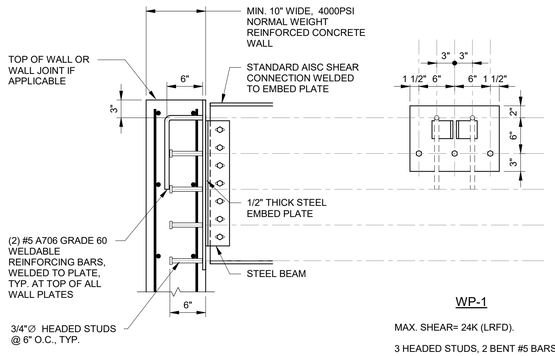
NOTE - LONG LEG VERTICAL

DETAIL AT SLAB STEP 5" OR LESS



DETAIL AT SLAB STEP GREATER THAN 5"

NOTE: FOR NOTES AND INFORMATION NOT SHOWN SEE TYPICAL FLOOR CONSTRUCTION



SECTION VIEW

WP-1

MAX. SHEAR= 24K (LRFD).

3 HEADED STUDS, 2 BENT #5 BARS

NOTE: CONNECTIONS SHALL BE DESIGNED FOR SHEAR AND ECCENTRICITY, CONSIDERING THAT THE CONNECTION IS AN EXTENSION OF THE BEAMS AND GIRDERS.

TYPICAL DETAIL OF STEEL BEAM TO CONCRETE WALL CONNECTION

N.T.S.

TYPICAL STEP IN SLAB ON METAL DECK

N.T.S.

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STATE OF MICHIGAN
NATHANIEL ZEBRA OPPENHEIMER
ENGINEER
No. 6201062117
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
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City of Ann Arbor
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ANN ARBOR, MI 48104

TYPICAL DETAILS

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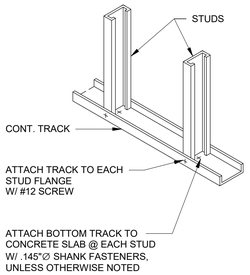
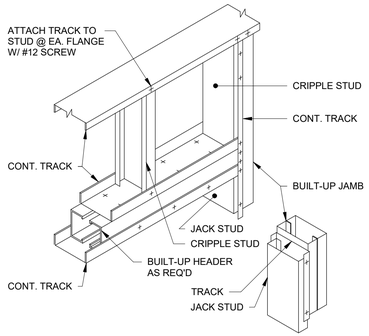


LIGHT GAUGE BOTTOM TRACK TYPICAL HORIZONTAL BRIDGING DETAIL

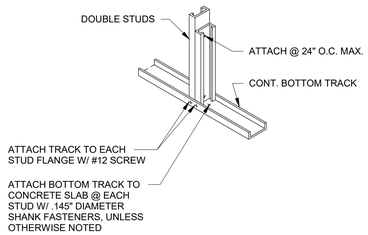
N.T.S.



NOTE: FASTEN BUILT-UP MEMBERS TOGETHER AT 12" O.C. MAX.

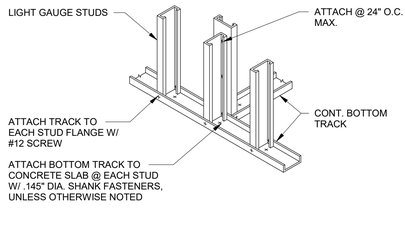
TYPICAL BOTTOM CONNECTION AT DOOR/WINDOW OPENING

N.T.S.



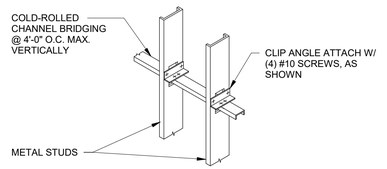
TYPICAL BOTTOM CONNECTION AT DOUBLE LIGHT GAUGE STUDS

N.T.S.



TYPICAL BOTTOM CONNECTION AT LIGHT GAUGE PARTITION INTERSECTION

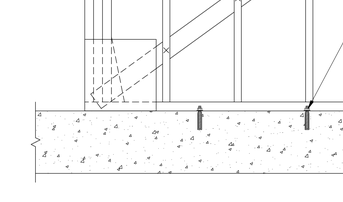
N.T.S.



NOTE: BRIDGING TO BE INSTALLED PRIOR TO LOADING OF WALL MIN. 1"x1" CLIP ANGLE REQUIRED WITH STUD WIDTHS OVER 4"

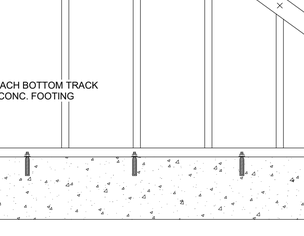
TYPICAL HORIZONTAL BRIDGING DETAIL

N.T.S.



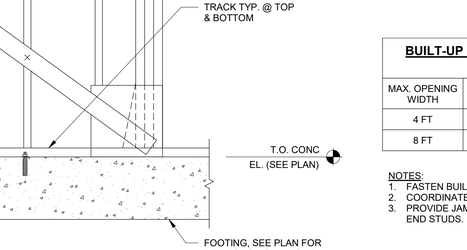
TYPICAL BOTTOM CONNECTION AT LIGHT GAUGE WALL CORNER

N.T.S.



TYPICAL CONNECTION AT LIGHT GAUGE BOTTOM TRACK

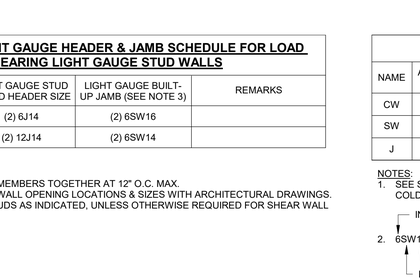
N.T.S.



NOTE: FASTEN BUILT-UP MEMBERS TOGETHER AT 12" O.C. MAX.

TYPICAL SILL DETAIL AT EXTERIOR WINDOW OPENINGS

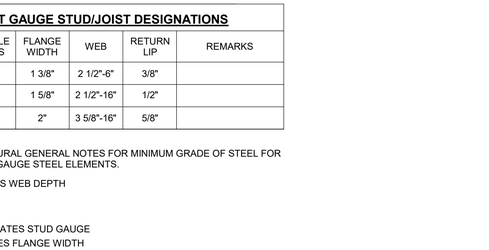
N.T.S.



NOTE: FASTEN BUILT-UP MEMBERS TOGETHER AT 12" O.C. MAX.

TYPICAL HEADER DETAIL AT DOOR/WINDOW OPENING

N.T.S.



TYPICAL LIGHT GAUGE BUILT-UP MEMBER DETAIL

N.T.S.

NOTE: ALL CFS TO BE DESIGNED BY CFS FABRICATOR.

TYPICAL DETAIL CFS SHEAR WALLS

N.T.S.

BUILT-UP LIGHT GAUGE HEADER & JAMB SCHEDULE FOR LOAD BEARING LIGHT GAUGE STUD WALLS

MAX. OPENING WIDTH	LIGHT GAUGE STUD BOXED HEADER SIZE	LIGHT GAUGE BUILT-UP JAMB (SEE NOTE 3)	REMARKS
4 FT	(2) 6J14	(2) 6SW16	
8 FT	(2) 12J14	(2) 6SW14	

NOTES:
1. FASTEN BUILT-UP MEMBERS TOGETHER AT 12" O.C. MAX.
2. COORDINATE ALL WALL OPENING LOCATIONS & SIZES WITH ARCHITECTURAL DRAWINGS.
3. PROVIDE JAMB STUDS AS INDICATED, UNLESS OTHERWISE REQUIRED FOR SHEAR WALL END STUDS.

LIGHT GAUGE STUD/JOIST DESIGNATIONS

NAME	AVAILABLE GAUGES	FLANGE WIDTH	WEB	RETURN LIP	REMARKS
CW	20-14	1 3/8"	2 1/2"-6"	3/8"	
SW	20-10	1 5/8"	2 1/2"-16"	1/2"	
J	20-10	2"	3 5/8"-16"	5/8"	

NOTES:
1. SEE STRUCTURAL GENERAL NOTES FOR MINIMUM GRADE OF STEEL FOR COLD LIGHT GAUGE STEEL ELEMENTS.

2. 6SW18
   - 6SW18: INDICATES WEB DEPTH
   - 6SW18: INDICATES STUD GAUGE
   - 6SW18: INDICATES FLANGE WIDTH

LIGHT GAUGE TABLES

N.T.S.

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ARCHITECTURE + PLANNING + DESIGN

Silman

STATE OF MICHIGAN
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Sheet S5.06

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GRAPHICAL COLUMN SCHEDULE

T.O. STEEL ROOF																																	T.O. STEEL ROOF
28' - 0" T.O. STEEL LOW ROOF																						W10x49 POST			W10x49 POST								28' - 0" T.O. STEEL LOW ROOF
17' - 4 1/2" T.O. STEEL @ LOW BAY	W10x54	W10x54	W12x65	HSS6X6X3/8	W10x30	W10x54	W10x54	W12x65	HSS6X6X3/8	HSS6X6X3/8	W10x30	W10x54	W10x54	W12x65	HSS5X5X3/8	HSS5X5X3/8	HSS5X5X3/8	W10x54	W10x54	W12x65	W10x33		W10x54		HSS6X6X3/8	HSS6X6X3/8	HSS6X6X3/8	HSS6X6X3/8	W10x33	W10x33	HSS6X6X3/8					17' - 4 1/2" T.O. STEEL @ LOW BAY
11' - 0" T.O. SLAB																												HSS6X6X3/8	HSS6X6X3/8	HSS6X6X3/8	W10x33	HSS6X6X3/8	11' - 0" T.O. SLAB
0"																																	0"
Column Locations	A-2	A-2.5	A-3	A-4	A.7-4.4	A.7-5	B-2	B-3	B.1-4	B.6-4	B.7-4.4	B.7-5	C-2	C-3	HOISTWAY COLUMN	HOISTWAY COLUMN	HOISTWAY COLUMN	C.9-5	D-2	D-3	D-3.8	E-2	E-2.5	E-3	F-4.3	F-5	F.1-3.1	F.1-3.4	F.1-3.8	A-x.1	B.12-x.3(11' - 1")	B.12-x.3(-4' - 8")	B.12-x.3(-8' - 8")	x.1-x.B	x.1-x.D	

GRAPHICAL COLUMN SCHEDULE

T.O. STEEL ROOF													T.O. STEEL ROOF
28' - 0" T.O. STEEL LOW ROOF													28' - 0" T.O. STEEL LOW ROOF
17' - 4 1/2" T.O. STEEL @ LOW BAY													17' - 4 1/2" T.O. STEEL @ LOW BAY
11' - 0" T.O. SLAB		HSS6X6X3/8	W10x33	W10x33	W10x54		HSS6X6X3/8	HSS6X6X3/8	HSS6X6X3/8	W10x33	W10x33	W10x54	11' - 0" T.O. SLAB
0"													0"
Column Locations	x.3(-8' - 8")-x.A	x.3(-8' - 8")-x.A.4	x.3-x.B	x.3-x.C	x.3-x.D	x.4-x.A	x.4-x.A(-10' - 5 3/4")	x.4-x.A.5	x.4-x.A.9	x.4-x.B	x.4-x.C	x.4-x.D	

CONCRETE WALL FOOTING SCHEDULE

MARK	SIZE		REINFORCEMENT				
			TOP		BOTTOM		
	WIDTH	DEPTH	LONG WAY	SHORT WAY	LONG WAY	SHORT WAY	REMARKS
WF1	2' - 0"	1' - 0"			3-#4 CONT. BARS		

CONCRETE WALL SCHEDULE

MARK	WIDTH	REINFORCEMENT		REMARKS
		VERTICAL	HORIZONTAL	
W8	8"	#4@12" O.C.	#4@12" O.C.	
W12	12"	#4@12" O.C. & E.S.	#4@12" O.C. & E.S.	

FOOTING SCHEDULE

MARK	SIZE			REINFORCEMENT				REMARKS
				BOTTOM		TOP		
	LENGTH	WIDTH	THICKNESS	LONG WAY	SHORT WAY	LONG WAY	SHORT WAY	
F4.0	4' - 0"	4' - 0"	1' - 0"	#5@12" O.C.	#5@12" O.C.			
F4.0x5.25	5' - 3"	4' - 0"	1' - 0"	#5@12" O.C.	#5@12" O.C.			
F4.0x6.25	6' - 3"	4' - 0"	1' - 0"	#5@12" O.C.	#5@12" O.C.			
F4.0x6.25A	6' - 3"	4' - 0"	1' - 0"	#5@12" O.C.	#5@12" O.C.	#5@12" O.C.	#5@12" O.C.	
F4.0x7.5	7' - 6"	4' - 0"	1' - 0"	#5@12" O.C.	#5@12" O.C.	#5@12" O.C.	#5@12" O.C.	
F4.5	4' - 6"	4' - 6"	1' - 0"	#5@12" O.C.	#5@12" O.C.			
F5.0	5' - 0"	5' - 0"	1' - 0"	#5@12" O.C.	#5@12" O.C.			
F5.0x3.5	3' - 6"	5' - 0"	1' - 0"	#5@12" O.C.	#5@12" O.C.			
F5.25x6.25	6' - 3"	5' - 3"	1' - 0"	#5@12" O.C.	#5@12" O.C.			
F6.0	6' - 0"	6' - 0"	1' - 0"	#5@12" O.C.	#5@12" O.C.	#5@12" O.C.	#5@12" O.C.	
F6.5	6' - 6"	6' - 6"	1' - 0"	#5@12" O.C.	#5@12" O.C.			
F8.0x4.0	8' - 0"	4' - 0"	1' - 0"	#5@12" O.C.	#5@12" O.C.			

PIER SCHEDULE

MARK	SIZE		REINFORCEMENT			REMARKS
	WIDTH	LENGTH	VERTICAL BARS	CLOSED TIES	DOWEL EMBEDMENT	
P1	20"	24"	16-#5	#3@8" O.C.		
P2	18"	22"	16-#5	#3@8" O.C.		
P3	22"	33"	24-#5	#3@10" O.C.		
P4	16"	16"	10-#5	#3@6" O.C.		
P5	18"	18"	12-#5	#3@8" O.C.		SEE TYPICAL TENSION REINFORCEMENT AT CONCRETE PIER DETAIL
P6	20"	28"	18-#5	#3@8" O.C.		
P7	20"	36"	24-#5	#3@8" O.C.		

SLAB/DECK SCHEDULE

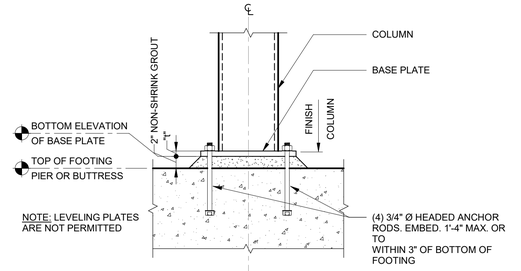
MARK	TOTAL DEPTH	COMPOSITION/REINFORCEMENT
R1.5	1 1/2"	1.5" 18 GA. GALV. TYPE B ROOF DECK.
S5.5	5 1/2"	3.5" LW CONCRETE ON 2" - 18GA VLI DECK REINFORCE W/ 6X6 W2.1 X W2.1.
S.O.G.12	12"	12" THICK NW INTERIOR CONCRETE SLAB ON GRADE REINFORCED WITH #6 BARS @ 12" O.C. TOP AND BOT.
S.O.G. 6	6"	6" THICK NW INTERIOR CONCRETE SLAB ON GRADE. SEE TYPICAL DETAIL.
S.O.G. 6 EXTERIOR	6"	6" THICK NW EXTERIOR CONCRETE SLAB ON GRADE. SEE TYPICAL DETAIL.

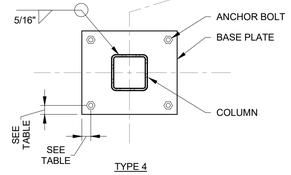
BASE PLATE SCHEDULE

LOCATION MARK	COLUMN SECTION	BASE PLATE TYPE	BOTTOM OF BASE PLATE	REMARKS
A-2	W10x54	BP2	-1' - 4"	
A-2.5	W10x54	BP2	-1' - 4"	
A-3	W12x65	BP1	-1' - 4"	
A-4	HSS6X6X3/8	BP7	-0' - 10"	
A-x.1	HSS6X6X3/8	BP7	-0' - 10"	
A.7-4.4	W10x30	BP6	-1' - 10"	
A.7-5	W10x54	BP2	-0' - 10"	
B-2	W10x54	BP2	-1' - 4"	
B-3	W12x65	BP1	-1' - 4"	
B.1-4	HSS6X6X3/8	BP7	-1' - 10"	
B.6-4	HSS6X6X3/8	BP7	-1' - 10"	
B.7-4.4	W10x30	BP6	-0' - 10"	
B.7-5	W10x54	BP2	-0' - 10"	
B.12-x.3(11' - 1")	HSS6X6X3/8	BP8	-0' - 10"	
B.12-x.3(-4' - 8")	HSS6X6X3/8	BP8	-0' - 10"	
B.12-x.3(-8' - 8")	HSS6X6X3/8	BP8	-0' - 10"	
C-2	W10x54	BP2	-1' - 4"	
C-3	W12x65	BP1	-1' - 4"	
C.9-5	W10x54	BP2	-0' - 10"	
D-2	W10x54	BP2	-1' - 4"	
D-3	W12x65	BP1	-1' - 4"	
D-3.8	W10x33	BP3	-0' - 10"	
E-2.5	W10x54	BP2	-1' - 4"	
F-4.3	HSS6X6X3/8	BP7	-0' - 10"	
F-5	HSS6X6X3/8	BP7	-0' - 10"	
F.1-3.1	HSS6X6X3/8	BP7	-0' - 10"	
F.1-3.4	W10x33	BP5	-0' - 10"	
F.1-3.8	W10x33	BP4	-0' - 10"	
x.1-x.B	W10x33	BP2	-0' - 10"	
x.1-x.D	HSS6X6X3/8	BP7	-0' - 10"	
x.3(-8' - 8")-x.A	HSS6X6X3/8	BP8	-0' - 10"	
x.3(-8' - 8")-x.A.4	HSS6X6X3/8	BP8	-0' - 10"	
x.3-x.B	W10x33	BP6	-0' - 10"	
x.3-x.C	W10x33	BP2	-0' - 10"	
x.3-x.D	W10x54	BP4	-0' - 10"	
x.4-x.A	HSS6X6X3/8	BP8	-0' - 10"	
x.4-x.A(-10' - 5 3/4")	HSS6X6X3/8	BP8	-0' - 10"	
x.4-x.A.5	HSS6X6X3/8	BP8	-0' - 10"	
x.4-x.A.9	HSS6X6X3/8	BP8	-0' - 10"	
x.4-x.B	W10x33	BP6	-0' - 10"	
HOISTWAY COLUMN	HSS5X5X3/8	BP8	-0' - 10"	
HOISTWAY COLUMN	W10x54	BP2	-0' - 10"	
HOISTWAY COLUMN	HSS5X5X3/8	BP9	-0' - 10"	
HOISTWAY COLUMN	HSS5X5X3/8	BP9	-0' - 10"	

BASE PLATE TYPE SCHEDULE

MARK	SIZE		THICKNESS	GRADE	BOLTS	LAYOUT	REMARKS
	WIDTH	LENGTH					
BP1	16"	20"	3/4"	36 KSI	(4) 3/4" DIA.	TYPE 1	
BP2	14"	18"	3/4"	36 KSI	(4) 3/4" DIA.	TYPE 1	
BP3	14"	18"	7/8"	36 KSI	(4) 3/4" DIA.	TYPE 1	
BP4	18"	29"	3/4"	36 KSI	(6) 3/4" DIA.	TYPE 2	
BP5	16"	24"	3/4"	36 KSI	(6) 3/4" DIA.	TYPE 3	
BP6	16"	32"	3/4"	36 KSI	(6) 3/4" DIA.	TYPE 3	
BP7	12"	12"	3/4"	36 KSI	(4) 3/4" DIA.	TYPE 4	
BP8	14"	14"	3/4"	36 KSI	(4) 3/4" DIA.	TYPE 4	
BP9	9"	12"	3/4"	36 KSI	(4) 3/4" DIA.	TYPE 4	





TYPE 4

ANCHOR BOLT SIZE	HOLE Ø IN BASE PL	EDGE DISTANCE FROM CENTER LINE OF BOLT HOLE
3/4" Ø	1-5/16" Ø	2"
7/8" Ø	1-9/16" Ø	2"
1" Ø	1-7/8" Ø	2"
1-1/4" Ø	2-1/8" Ø	2-1/2"
1-1/2" Ø	2-3/8" Ø	2-1/2"

TYPICAL COLUMN BASE PLATE AT PIPE OR TUBE COLUMN

N.T.S.

TYPE 1

ANCHOR BOLT SIZE	HOLE Ø IN BASE PL	EDGE DISTANCE FROM CENTER LINE OF BOLT HOLE
3/4" Ø	1-5/16" Ø	2"
7/8" Ø	1-9/16" Ø	2"
1" Ø	1-7/8" Ø	2"
1-1/4" Ø	2-1/8" Ø	2-1/2"
1-1/2" Ø	2-3/8" Ø	2-1/2"

TYPE 2

TYPE 3

TYPICAL COLUMN BASE PLATE AT WIDE FLANGE COLUMN

N.T.S.

TCA
ARCHITECTURE + PLANNING + DESIGN

Silman

NATHANIEL ZERRA OPPENHEIMER ENGINEER No. 6201052117 STATE OF MICHIGAN LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMIT	08/04/23
BIDS/PERMIT	10/11/24

Drawn: AD Checked: RH

City of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

SCHEDULES

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet S6.01

SILMAN PROJECT # 20145

10/10/2024 11:26:40 AM

MECHANICAL ABBREVIATION LIST

ABBREVIATION	DESCRIPTION
A	COMPRESSED AIR
A(___#)	COMPRESSED AIR (SPECIFIC PSIG)
AAV	AUTOMATIC AIR VENT
ACC	AIR COOLED CONDENSER
ACCU	AIR COOLED CONDENSER UNIT
AD	ACCESS DOOR
AD	AREA DRAIN
AE	AIR EXTRACTOR
AFF	ABOVE FINISHED FLOOR
AHR	AIR HANDLING UNIT
AHU	ALTERNATE
ALT	AMPERE
AMP	AIR PRESSURE DROP
APD	ARGON
AR	AMERICAN SOCIETY OF HEATING, REFRIGERATION
ASHRAE	AND AIR-CONDITIONING ENGINEERS
	AUTOMATIC SPRINKLER RISER
ASR	AIR TRANSFER DUCT
ATD	AUXILIARY
AUX	ACID VENT
AV	ACID VENT THROUGH ROOF
AVTR	ACID WASTE
AW	
	BUILDING AUTOMATION SYSTEM
BAS	BLOWER COIL UNIT
BCU	BACK DRAFT DAMPER
BDD	BELOW FINISHED FLOOR
BFF	BACKFLOW PREVENTER
BFP	BRAKE HORSEPOWER
BHP	BOTTOM OF DUCT
BOD	BOTTOM OF PIPE
BOP	BRITISH THERMAL UNIT
BTU	BRITISH THERMAL UNIT PER HOUR
BTUH	BEVERAGE CONDUIT
BVC	BACKWATER VALVE
BWV	
	COMMON
C	CAPACITY
CAP	CONSTANT AIR VOLUME
CAHR	COMPRESSED AIR HOSE REEL
CAV	CATCH BASIN
CB	COOLING COIL
CC	COLD DECK
CD	CONDENSATE DRAIN
CD	CONTRACTOR FURNISHED, CONTRACTOR INSTALLED
CFCI	CUBIC FEET PER HOUR
CFH	CUBIC FEET PER MINUTE
CFM	CHILLER
CH	CHILLED WATER
CHW	CHILLED WATER RETURN
CHWR	CHILLED WATER SUPPLY
CHWS	COOLING
CLG	CONDENSATE
CNDS	CONDENSATE (SPECIFIC PSIG)
CNDS (__#)	CLEAN OUT
CO	CARBON DIOXIDE
CO2	CONTINUATION OR CONTINUED
CONT	CONTRACTOR
CONTR	CONVECTOR
CONV	COEFFICIENT OF PERFORMANCE
COP	CLEAN OUT TO GRADE
COTG	CIRCULATING PUMP
CP	CONDENSATE RETURN UNIT
CRU	CLINICAL SERVICE SINK
CSS	COOLING TOWER
CT	CABINET UNIT HEATER
CUH	DOMESTIC COLD WATER
CW	DOMESTIC COLD WATER - FILTERED
CWF	CONDENSER WATER RETURN
CWR	CONDENSER WATER SUPPLY
CWS	
	DRIP AND TRAP
D&T	DISCHARGE AIR
DA	DISCHARGE AIR TEMPERATURE
DAT	DRY BULB
DB	DIRECT DIGITAL CONTROL
DDC	DEGREE
DEG	DRAINAGE FIXTURE UNITS
DFU	DIAMETER
DIA	DAMPER
DMPR	DAY/NIGHT
D/N	DOWN
DN	DOWNSPOUT NOZZLE
DNZ	DUCT SILENCER
DS	DRAIN TILE
DT	DRAIN TILE CONNECTION
DTC	DOMESTIC WATER HEATER
DWH	DRAWING
DWG	
	EXISTING
(E)	EXHAUST GRILLE OR REGISTER
E	EACH
EA	EXHAUST AIR
EA	ENTERING AIR TEMPERATURE
EAT	EXPANSION COMPENSATOR
EC	ELECTRIC CABINET UNIT HEATER
ECUH	ENTERING DRY BULB
EDB	ENERGY EFFICIENCY RATIO
EER	EMERGENCY EYE WASH / SHOWER
EES	EMERGENCY EYE WASH
EEW	EXHAUST FAN
EF	EFFICIENCY
EFF	ELECTRIC HEATING COIL
EHC	EXPANSION JOINT
EJ	ELEVATION
EL	ELECTRICAL
ELEC	ENERGY MANAGEMENT SYSTEM
EMS	ENERGY RECOVERY LOOP
ERL	ENERGY RECOVERY LOOP RETURN
ERLR	ENERGY RECOVERY LOOP SUPPLY
ERLS	ENERGY RECOVERY UNIT
ERU	EMERGENCY SHOWER
ESH	EXTERNAL STATIC PRESSURE
ESP	ELECTRIC UNIT HEATER
EUH	ENTERING WET BULB
EWB	ELECTRIC WATER COOLER
EWC	ENTERING WATER TEMPERATURE
EWT	EXHAUST
EXH	
	FIRE PROTECTION
F	DEGREES FAHRENHEIT
°F	FACE AND BYPASS
F&B	FLOAT AND THERMOSTATIC
F&T	FACE AREA
FA	FAN COIL UNIT
FCU	

ABBREVIATION	DESCRIPTION
FD	FLOOR DRAIN
FFD	FUNNEL FLOOR DRAIN
FH	FIRE HYDRANT
FHC	FIRE HOSE CABINET
FHR	FIRE HOSE RACK
FHV	FIRE HOSE VALVE
FLA	FULL LOAD AMPS
FLR	FLOOR
FM	FLOW METER
FMS	FLOW MEASURING STATION
FPM	FEET PER MINUTE
FP	FIRE PUMP
FPTU	FAN POWERED (AIR) TERMINAL UNIT
FS	FLOOR SINK
FSEC	FOOD SERVICE EQUIPMENT CONTRACTOR
FT	FEET
FTR	FINNED TUBE RADIATION
FV	FACE VELOCITY
G	NATURAL GAS
GA	GAUGE
GAL	GALLON
GRH	GRAVITY RELIEF HOOD
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GSAN	GREASE SANITARY WASTE
H	HYDROGEN
HB	HOSE BIBB
HC	HEATING COIL
HD	HOT DECK
HEPA	HIGH EFFICIENCY PARTICULATE ARRESTANCE
HL	HIGH LIMIT
HOA	HAND/OFF/AUTO
HP	HEAT PUMP
HP	HORSEPOWER
HPCW	HIGH PRESSURE DOMESTIC COLD WATER
HPHW	HIGH PRESSURE DOMESTIC HOT WATER
HPHWR	HIGH PRESSURE DOMESTIC HOT WATER RETURN
HPL	HEAT PUMP LOOP
HPLR	HEAT PUMP LOOP RETURN
HPLS	HEAT PUMP LOOP SUPPLY
HR	HOUR
HS	HOSE STATION
HTG	HEATING
HV	HEATING VENTILATING
HVAC	HEATING, VENTILATING, AIR CONDITIONING
HWH	HOT WATER HEATING
HWHR	HOT WATER HEATING RETURN
HWHS	HOT WATER HEATING SUPPLY
HW	DOMESTIC HOT WATER
HW(__)	DOMESTIC HOT WATER (SPECIFIC TEMP °F)
HWR	DOMESTIC HOT WATER RETURN
HX	HEAT EXCHANGER
HZ	HERTZ
IAQ	INDOOR AIR QUALITY
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IH	INTAKE HOOD
IN	INCHES
IR	INFRARED HEATER
IW	INDIRECT WASTE
JC	JANITOR'S CLOSET
JP	JOCKEY PUMP
KA	THOUSAND AMP
KW	KILOWATT
KWH	KILOWATT-HOUR
LAT	LEAVING AIR TEMPERATURE
LAB	LABORATORY
LAV	LAVATORY
LBS	POUNDS
LDB	LEAVING DRY BULB
LL	LOW LIMIT
LPC	LOW PRESSURE CONDENSATE
LPG	LIQUIFIED PETROLEUM GAS (PROPANE)
LPS	LOW PRESSURE STEAM
LRA	LOCKED ROTOR AMPS
LWB	LEAVING WET BULB
LWT	LEAVING WATER TEMPERATURE
MA	MIXED AIR
MAT	MIXED AIR TEMPERATURE
MAU	MAKE-UP AIR UNIT
MAX	MAXIMUM
MBH	THOUSAND BRITISH THERMAL UNITS PER HOUR
MCA	MEDICAL COMPRESSED AIR
MCA	MINIMUM CIRCUIT AMPACITY
MCC	MOTOR CONTROL CENTER
MECH	MECHANICAL
MEZZ	MEZZANINE
MFR	MANUFACTURER
MH	MANHOLE
MIL	1/1000th INCH
MIN	MINIMUM
MISC	MISCELLANEOUS
MMBH	MILLION BRITISH THERMAL UNITS PER HOUR
MOP	MAXIMUM OVERCURRENT PROTECTION
M/S	MOTOR STARTER
MTD	MOUNTED
MTR	MOTOR
MV	MANUAL AIR VENT
MVAC	MEDICAL VACUUM
N	NITROGEN
N2O	NITROUS OXIDE
NC	NOISE CRITERIA
NC	NORMALLY CLOSED
NCTC	NORMALLY CLOSED TIMED CLOSED
NCTO	NORMALLY CLOSED TIMED OPEN
NFPA	NATIONAL FIRE PROTECTION AGENCY
NOTC	NORMALLY OPEN TIMED CLOSED
NOTO	NORMALLY OPEN TIMED OPEN
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NOM	NOMINAL
NPCW	NON POTABLE COLD WATER

ABBREVIATION	DESCRIPTION
O	OXYGEN
OA	OUTSIDE AIR
OAT	OUTSIDE AIR TEMPERATURE
OB	OUTLET BOX
OBD	OPPOSED BLADE DAMPER
OC	ON CENTER/CENTER TO CENTER
OD	OUTSIDE DIAMETER
OED	OPEN ENDED DUCT
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED, OWNER INSTALLED
OL	OVERLOAD
ORC	OVERFLOW RAIN CONDUCTOR
ORD	OVERFLOW ROOF DRAIN
OSAN	OIL SANITARY WASTE
OS&Y	OUTSIDE SCREW AND YOKE
OV	OUTLET VELOCITY
OWS	OPERATOR WORKSTATION
PACU	PACKAGED AIR CONDITIONING UNIT
PBD	PARALLEL BLADE DAMPER
PC	PUMPED CONDENSATE
PCW	PROCESS COOLING WATER
PCWR	PROCESS COOLING WATER RETURN
PCWS	PROCESS COOLING WATER SUPPLY
PD	PRESSURE DROP (FEET OF WATER)
PH	PERIMETER HEAT
PHR	PERIMETER HEAT RETURN
PHS	PERIMETER HEAT SUPPLY
PNL	PANEL
PPM	PARTS PER MILLION
PRESS	PRESSURE
PRV	PRESSURE REDUCING VALVE
PSAN	PUMPED SANITARY
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH - ABSOLUTE
PSIG	POUNDS PER SQUARE INCH - GAUGE
PST	PUMPED STORM
PW	PURIFIED WATER
PWR	PURIFIED WATER RETURN
PWS	PURIFIED WATER SUPPLY
(R)	RELOCATED
R	RETURN GRILLE OR REGISTER
RA	RETURN AIR
RAT	RETURN AIR TEMPERATURE
RC	RAIN CONDUCTOR
RCP	RADIANT CEILING PANEL
RD	ROOF DRAIN
REQD	REQUIRED
REF	ROOF EXHAUST FAN
RF	RETURN FAN
RH	RELATIVE HUMIDITY
RL	REFRIGERANT LIQUID
RLFA	RELIEF AIR
RPM	REVOLUTIONS PER MINUTE
RPDA	REDUCED PRESSURE BACKFLOW DETECTION ASSY
RPZA	REDUCED PRESSURE BACKFLOW ZONE ASSY
RS	REFRIGERANT SUCTION
RTU	ROOFTOP UNIT
S	SUPPLY AIR DIFFUSER OR GRILLE
SA	SOUND ATTENUATOR
SA	SUPPLY AIR
SAN	SANITARY WASTE
SAT	SUPPLY AIR TEMPERATURE
SCCR	SHORT CIRCUIT CURRENT RATING
SECT	SECTION
SF	SUPPLY FAN
SH	SHOWER
SK	SINK
SMR	SNOW MELT RETURN
SMS	SNOW MELT SUPPLY
SP	STATIC PRESSURE
SPEC	SPECIFICATION
SPKLR	SPRINKLER
SQFT	SQUARE FOOT/SQUARE FEET
S/S	START/STOP
SS	SERVICE SINK
ST	STORM
STD	STANDARD
STK	STACK
STM	STEAM
STM(__#)	STEAM (SPECIFIC PSIG)
S/W	SUMMER/WINTER
SW	SWITCH
T	TRANSFER GRILLE
TC	TEMPERATURE CONTROL
TC	TEMPERING COIL
TCP	TEMPERATURE CONTROL PANEL
TD	TRENCH DRAIN
TEMP	TEMPERATURE
TEMP	TEMPORARY
TH	TERMINAL HEATING
THA	TOTAL HEAT ABSORBED
THR	TERMINAL HEATING RETURN
THR	TOTAL HEAT REJECTED
THS	TERMINAL HEATING SUPPLY
TMR	TIMER SWITCH
TPD	TEPID WATER
TSP	TOTAL STATIC PRESSURE
TU	(AIR) TERMINAL UNIT
TV	TURNING VANES
TW	TEMPERED WATER
TYP	TYPICAL
UH	UNIT HEATER
UL	UNDERWRITER'S LABORATORY
UON	UNLESS OTHERWISE NOTED
UR	URINAL
UV	UNIT VENTILATOR
V	VALVE
V	VENT
VAC	VACUUM
VAV	VARIABLE AIR VOLUME
VB	VACUUM BREAKER
VD	VOLUME DAMPER (MANUALLY ADJUSTABLE)
VOL	VOLUME
VFC	VARIABLE FREQUENCY CONTROLLER
VTR	VENT THROUGH ROOF
VTU	VENTURI TERMINAL UNIT
VUV	VERTICAL UNIT VENTILATOR
W	WASTE
W&V	WASTE AND VENT
WAGD	WASTE ANESTHETIC GAS DISPOSAL
WB	WET BULB
WC	WATER CLOSET
WC	WATER COLUMN
WG	WATER GAUGE
WH	WALL HYDRANT
WMSD	WASHING MACHINE SUPPLY AND DRAIN BOX
WPD	WATER PRESSURE DROP
WT	WEIGHT
XFMR	TRANSFORMER
ZVB	ZONE VALVE BOX

TEMPERATURE CONTROL - PARTIAL SYMBOLS LIST

SYMBOL	DESCRIPTION
CO2	CARBON DIOXIDE SENSOR
CO	CARBON MONOXIDE SENSOR
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
FM	FLOW METER
	GUARD FOR STAT OR SENSOR
H	HUMIDISTAT OR HUMIDITY SENSOR (AS DEFINED ON TC DRAWINGS)

SYMBOL	DESCRIPTION
OS	OCCUPANCY SENSOR
PT	PRESSURE TRANSMITTER
SP	STATIC PRESSURE SENSOR OR PROBE
	VALVE - 2 WAY CONTROL VALVE
	VALVE - 3 WAY CONTROL VALVE
T	THERMOSTAT OR TEMPERATURE SENSOR (AS DEFINED ON TC DRAWINGS)

NOTE: LIST OF ADDITIONAL SYMBOLS & ABBREVIATIONS ASSOCIATED WITH TEMPERATURE CONTROLS ARE IDENTIFIED ON TC DRAWINGS.

MECHANICAL SYMBOL LIST

PIPING SYMBOLS

SYMBOL	DESCRIPTION
AV	AIR VENT - AUTOMATIC
MV	AIR VENT - MANUAL
BFP	BACKFLOW PREVENTER
	CATCH BASIN
	CIRCULATING PUMP
CO	CLEAN OUT - IN FLOOR
CO	CLEAN OUT - FLANGE
	DIRECTION OF FLOW
	DIRECTION OF PITCH - DOWN
	FINNED TUBE RADIATION
	FIRE PROTECTION - SIAMESE CONNECTION - FREE STANDING
	FIRE PROTECTION - SIAMESE CONNECTION - WALL MOUNTED
	FIRE PROTECTION - SPRINKLER HEAD, CONCEALED
	FIRE PROTECTION - SPRINKLER HEAD, PENDANT
	FIRE PROTECTION - SPRINKLER HEAD, UPRIGHT
	FIRE PROTECTION - SPRINKLER HEAD, SIDEWALL
	FLOOR DRAIN
	FLOOR DRAIN - ELEVATION
	FLOOR DRAIN - FUNNEL
	FLOOR DRAIN - FUNNEL, ELEVATION
	FLOW MEASURING DEVICE (FOR TEST AND BALANCING)
FS	FLOW SWITCH
FM	FLOW METER
HB	HOSE BIBB
MH	MANHOLE
	OPEN SITE DRAIN
	PIPE - ANCHOR
	PIPE - CAP OR PLUG
	PIPE - ELBOW DOWN
	PIPE - ELBOW UP
	PIPE - EXPANSION JOINT OR COMPENSATOR
	PIPE - FLANGE
	PIPE - HOSE AND BRAID FLEXIBLE CONNECTION
	PIPE - RUBBER FLEXIBLE CONNECTION
	PIPE - GUIDE
	PIPE - TEE DOWN
	PIPE - TEE UP
	PIPE - UNION
P/T	PRESSURE AND TEMPERATURE TEST PLUG
	PRESSURE GAUGE AND COCK
	REDUCER - CONCENTRIC
	REDUCER - ECCENTRIC
	ROOF/OVERFLOW DRAIN
	STEAM TRAP - FLOAT AND THERMOSTATIC
	STRAINER
	STRAINER WITH VALVE AND BLOW-OFF
	THERMOMETER
	TRAP
	VALVE - ANGLE
	VALVE - BALL
0.5	VALVE - BALANCE (i.e. BALANCE VALVE TO 0.5 GPM)
0.5	VALVE - COMBINATION BALANCE & FLOW MEASURING (i.e. BALANCE VALVE TO 0.5 GPM)
	VALVE - BUTTERFLY
	VALVE - CHECK
	VALVE - SPRING CHECK
	VALVE - GAS (MANUAL)
	VALVE - GLOBE
	VALVE - ISOLATION
	VALVE - NEEDLE
	VALVE - OS&Y
	VALVE - PLUG
	VALVE - PRESSURE REGULATING
	VALVE - PRESSURE REDUCING
	VALVE - PRESSURE RELIEF
	VALVE - PRESSURE & TEMPERATURE RELIEF
VTR	VENT THROUGH ROOF
WH	WALL HYDRANT

DUCTWORK SYMBOLS

SYMBOL	DESCRIPTION
TU-101	AIR TERMINAL UNIT
TU-101	AIR TERMINAL UNIT WITH HEATING COIL
VTU-101	VENTURI AIR TERMINAL UNIT
VTU-101	VENTURI AIR TERMINAL UNIT WITH HEATING COIL
	DAMPER - HORIZONTAL FIRE (EXISTING, NEW)
	DAMPER - HORIZONTAL FIRE / SMOKE (EXISTING, NEW)
	DAMPER - SMOKE (EXISTING, NEW)
	DAMPER - VERTICAL FIRE (EXISTING, NEW)
	DAMPER - VERTICAL FIRE / SMOKE (EXISTING, NEW)
BDD	DAMPER - BACK DRAFT
M	DAMPER - MOTORIZED
	DAMPER - VOLUME (MANUALLY ADJUSTABLE)
	DIFFUSER - BLANK OFF
	DIFFUSER - LINEAR SLOT
	DIFFUSER - SQUARE OR RECTANGULAR
	DUCT CROSS SECTION - SUPPLY
	DUCT CROSS SECTION - RETURN
	DUCT CROSS SECTION - EXHAUST
	DUCT - FLEXIBLE CONNECTION
	DUCT - FLEXIBLE DUCT
	DUCT TAKE-OFF - ROUND CONICAL
	DUCT TAKE-OFF - RECTANGULAR WITH SHOE TAP
	ELBOW - RECTANGULAR WITH TURNING VANES
	ELBOW - RECTANGULAR/ ROUND SMOOTH RADIUS
	ELBOW DOWN - RECTANGULAR
	ELBOW DOWN - ROUND
	ELBOW UP - RECTANGULAR
	ELBOW UP - ROUND
	FAN - AXIAL
	FAN - CENTRIFUGAL (ELEVATION)
	HEATING COIL
D	INCLINED DROP IN DIRECTION OF AIRFLOW
R	INCLINED RISE IN DIRECTION OF AIRFLOW
	INTAKE OR RELIEF HOOD
	REGISTER - RETURN OR EXHAUST
	REGISTER - RETURN WITH BOOT
	REGISTER - TRANSFER GRILLE
	ROOF EXHAUST FAN
	TRANSITION - CONCENTRIC
	TRANSITION - ECCENTRIC
	UNIT HEATER - HORIZONTAL THROW
	UNIT HEATER - VERTICAL THROW

DOUBLE LINE PIPING SYMBOLS

SYMBOL	DESCRIPTION
	VALVE - 2 WAY CONTROL
	VALVE - 3 WAY CONTROL
	VALVE - BUTTERFLY
H	VALVE - CHECK
	VALVE - DETECTOR CHECK
	VALVE - OS&Y HORIZONTAL STEM
	VALVE - OS&Y VERTICAL STEM

DOUBLE LINE PIPING SYMBOLS

SYMBOL	DESCRIPTION
	FLANGE
	FLEX CONNECTION
	STRAINER - BASKET
	STRAINER - Y TYPE

DOUBLE LINE DUCTWORK SYMBOLS

SYMBOL	DESCRIPTION
	ELBOW - RECTANGULAR SHORT RADIUS WITH SPLITTER VANES
	ELBOW - ROUND
	ELBOW - RECTANGULAR SMOOTH RADIUS

DOUBLE LINE DUCTWORK SYMBOLS

SYMBOL	DESCRIPTION
	DUCT TAKE-OFF - RECTANGULAR WITH SHOE TAP
	DUCT TAKE-OFF - ROUND CONICAL
	ELBOW - RECTANGULAR WITH TURNING VANES
	ELBOW DOWN - RECTANGULAR
	ELBOW DOWN - ROUND
	ELBOW UP - RECTANGULAR
	ELBOW UP - ROUND
	HEATING COIL
D	INCLINED DROP IN DIRECTION OF AIRFLOW
R	INCLINED RISE IN DIRECTION OF AIRFLOW
	TRANSITION - CONCENTRIC
	TRANSITION -ECCENTRIC

MECHANICAL DRAWING INDEX

STANDARD METHODS OF NOTATION

S-1 10ø 350-4	SUPPLY DIFFUSER WITH SCHEDULE TAG "1", 10" DIAMETER NECK SIZE 350 CFM TYPICAL FOR 4
R-1 22x22 640-2	RETURN REGISTER WITH SCHEDULE TAG "1", 22"x 22" NECK SIZE 640 CFM TYPICAL FOR 2 EXHAUST REGISTER E DESIGNATION SIMILAR.
TU-101	AIR TERMINAL UNIT WITH HEATING COIL NO. 101 WITH SERVICE CLEARANCE SHOWN
VTU-101	VENTURI AIR TERMINAL WITH HEATING COIL NO. 101 WITH SERVICE CLEARANCE SHOWN
(2)WC-1	PLUMBING FIXTURE UNIT IDENTIFICATION TAG WATER CLOSET TYPE "1" TYPICAL FOR 2
8	PIPE DIAMETER NOTATION ALL SIZES IN INCHES
8ø 22x10 18x14ø	DUCT SIZE NOTATION ALL SIZES IN INCHES
	OVAL DUCT RECTANGULAR DUCT
1	CONSTRUCTION KEY NOTE (NUMBER) OR DEMOLITION KEY NOTE (LETTER)
EF 1	EQUIPMENT DESIGNATION, (i.e. EXHAUST FAN NUMBER 1)
HW-1	PIPING RISER DESIGNATION, (i.e. HOT WATER RISER NUMBER 1)
	NEW SYSTEM COMPONENT EXISTING SYSTEM COMPONENT TO REMAIN POINT OF NEW CONNECTION SYMBOL
1 M5.1	SECTION OR PLAN NUMBER SHEET WHERE SECTION IS DRAWN
1 M5.1	AREA OF ENLARGEMENT PLAN NUMBER SHEET WHERE ENLARGED PLAN IS DRAWN
1 M5.1	SECTION OR PLAN NUMBER SECTION OR ENLARGED PLAN SCALE: 1/8" = 1' - 0" SHEET WHERE SECTION IS CUT OR ENLARGED PLAN IS REFERENCED
SHEET M1.0 SHEET M1.1	MATCHLINE
	HEAVY LINE WEIGHT INDICATES NEW WORK
	LIGHT LINE WEIGHT INDICATES EXISTING EQUIPMENT OR REFERENCED INFORMATION
	GRAY LINE INDICATES BACKGROUND INFORMATION
	DASHED LINES INDICATE PIPING ROUTED BELOW SLAB OR GRADE
	HATCH MARKS INDICATE EQUIPMENT OR MATERIALS TO BE DISCONNECTED AND REMOVED.

NOTE: SOME SYMBOLS AND ABBREVIATIONS SHOWN MAY NOT APPLY TO THIS PROJECT.

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PBA
Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021.0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
PROFESSIONAL ENGINEER

Project Number	21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: ACF Checked: ACF

City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

MECHANICAL STANDARDS AND DRAWING INDEX

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COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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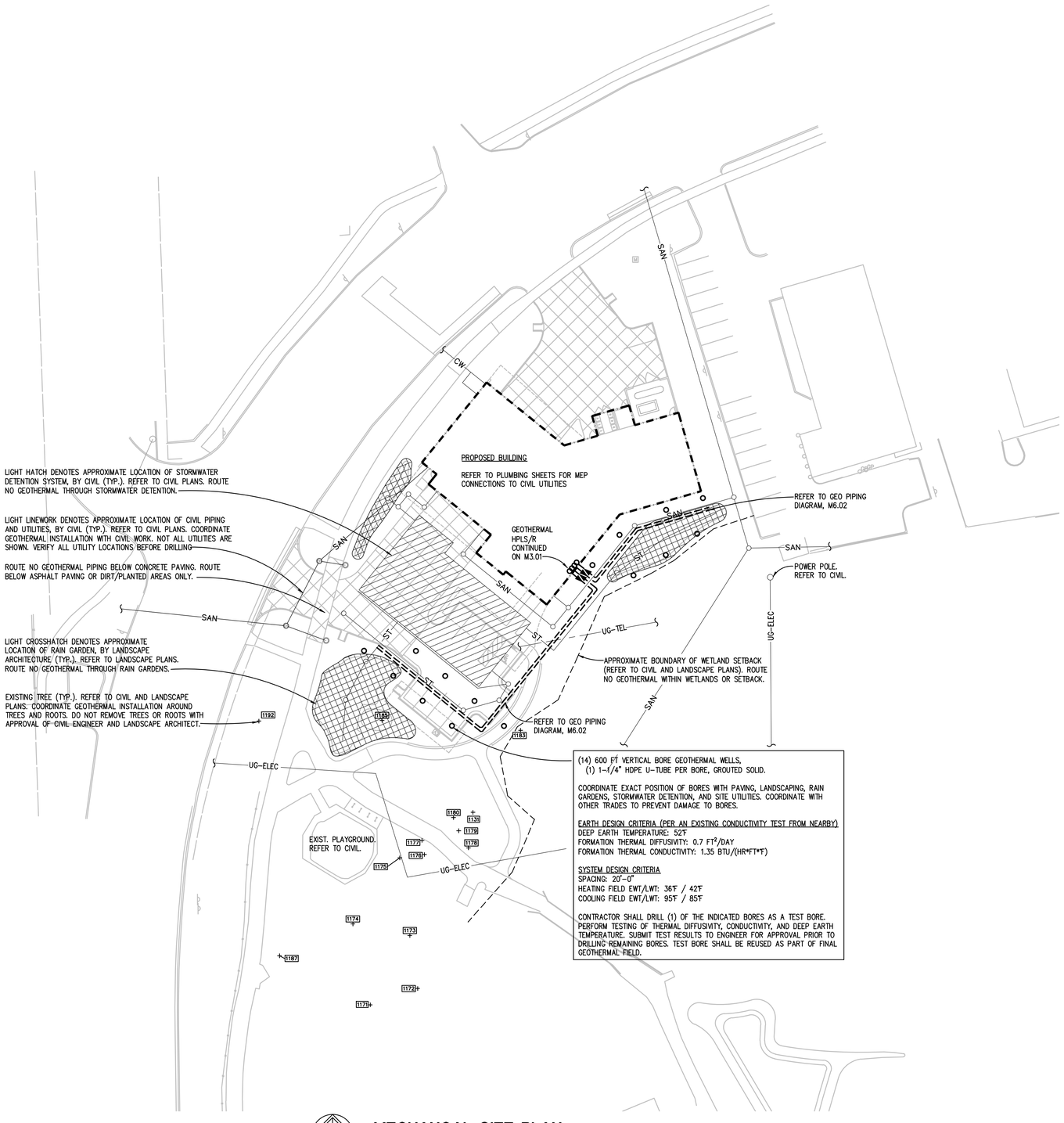

(14) 600 FT VERTICAL BORE GEOTHERMAL WELLS,
(1) 1-1/4" HDPE U-TUBE PER BORE, GROUTED SOLID.

COORDINATE EXACT POSITION OF BORES WITH PAVING, LANDSCAPING, RAIN GARDENS, STORMWATER DETENTION, AND SITE UTILITIES. COORDINATE WITH OTHER TRADES TO PREVENT DAMAGE TO BORES.

EARTH DESIGN CRITERIA (PER AN EXISTING CONDUCTIVITY TEST FROM NEARBY)
DEEP EARTH TEMPERATURE: 52°F
FORMATION THERMAL DIFFUSIVITY: 0.7 FT²/DAY
FORMATION THERMAL CONDUCTIVITY: 1.35 BTU/(HR*FT*°F)

SYSTEM DESIGN CRITERIA
SPACING: 20'-0"
HEATING FIELD EWT/LWT: 36°F / 42°F
COOLING FIELD EWT/LWT: 95°F / 85°F

CONTRACTOR SHALL DRILL (1) OF THE INDICATED BORES AS A TEST BORE. PERFORM TESTING OF THERMAL DIFFUSIVITY, CONDUCTIVITY, AND DEEP EARTH TEMPERATURE. SUBMIT TEST RESULTS TO ENGINEER FOR APPROVAL PRIOR TO DRILLING REMAINING BORES. TEST BORE SHALL BE REUSED AS PART OF FINAL GEOTHERMAL FIELD.

MECHANCAL SITE PLAN
SCALE: 1" = 30'

Know what's **below.**
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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021-0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 620106818
REGISTERED PROFESSIONAL ENGINEER

Project Number 21018

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BIDS/PERMITS	10/11/24

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City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

MECHANCAL SITE PLAN

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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PROJECT TRUE

FIRST LEVEL HVAC PIPING PLAN

SCALE: 1/8" = 1'-0"

HVAC PIPING GENERAL NOTES:

1 THESE DRAWINGS ARE DIAGRAMMATIC, AND REPRESENT THE GENERAL INTENT AND ARRANGEMENT OF SYSTEMS. THEY ARE NOT TO BE CONSIDERED FABRICATION/COORDINATION/SHOP DRAWINGS. COORDINATION WITH OTHER TRADES IS REQUIRED. PROVIDE THE ADDITIONAL FITTINGS AND OFFSETS THAT WILL BE REQUIRED TO COMPLETE EACH SYSTEM AND TO AVOID INTERFERENCES WITH ALL OTHER SYSTEMS INCLUDING THE STRUCTURE, SHEET METAL, OTHER PIPING SYSTEMS, ELECTRICAL CONDUITS, BUS DUCTS, CABLE TRAY, LIGHT FIXTURES, ETC. AND/OR OTHER SPACE CONSTRAINTS.

2 INSTALL SYSTEMS SUCH THAT REQUIRED CLEARANCE AND SERVICE ACCESS SPACE IS PROVIDED AROUND ALL MECHANICAL AND ELECTRICAL EQUIPMENT, AND AROUND ANY COMPONENTS WHICH REQUIRE SERVICE ACCESS.

3 PIPING AND DUCTWORK SHALL NOT BE INSTALLED ABOVE ELECTRICAL TRANSFORMERS, SWITCHBOARDS, PANELBOARDS OR MOTOR CONTROL CENTERS.

4 COORDINATE AND PROVIDE ACCESS DOORS WITHIN INACCESSIBLE CEILING, SHAFT, AND CHASE AREAS FOR ALL COMPONENTS WHICH REQUIRE SERVICE ACCESS. REFER TO ARCHITECTURAL DRAWINGS FOR CEILING TYPES.

5 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

6 SUBMIT PROPOSED METHODS OF ANCHORING AND GUIDING PIPING SYSTEMS TO STRUCTURAL ENGINEER FOR APPROVAL.

7 COORDINATE LOCATION OF DUCT-MOUNTED HYDRONIC DEVICES WITH SHEET METAL TRADES.

8 BRANCH PIPING SERVING TERMINAL UNIT HEATING COILS OR RADIANT CEILING PANELS SHALL BE 3/4" UNLESS OTHERWISE NOTED. BRANCH PIPING SERVING MORE THAN ONE TERMINAL UNIT HEATING COIL SHALL BE 1" UNLESS OTHERWISE NOTED. BRANCH PIPING SERVING HOT WATER UNIT HEATERS AND CABINET UNIT HEATERS SHALL BE 1" UNLESS OTHERWISE NOTED.

9 REFER TO TEMPERATURE CONTROLS STANDARD MOUNTING HEIGHTS DETAIL FOR ELEVATIONS OF WALL MOUNTED TEMPERATURE CONTROL DEVICES.

CONSTRUCTION KEY NOTES:

1 TSTAT TO LOCAL VAV DIFFUSER.

2 ISOLATION VALVES BEHIND ARCHTECTURAL ACCESS PANEL. REFER TO RISER ON SHEET M6.01.

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PBA
Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021.0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
PROFESSIONAL ENGINEER

Project Number 21018

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City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

FIRST LEVEL HVAC PIPING PLAN

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
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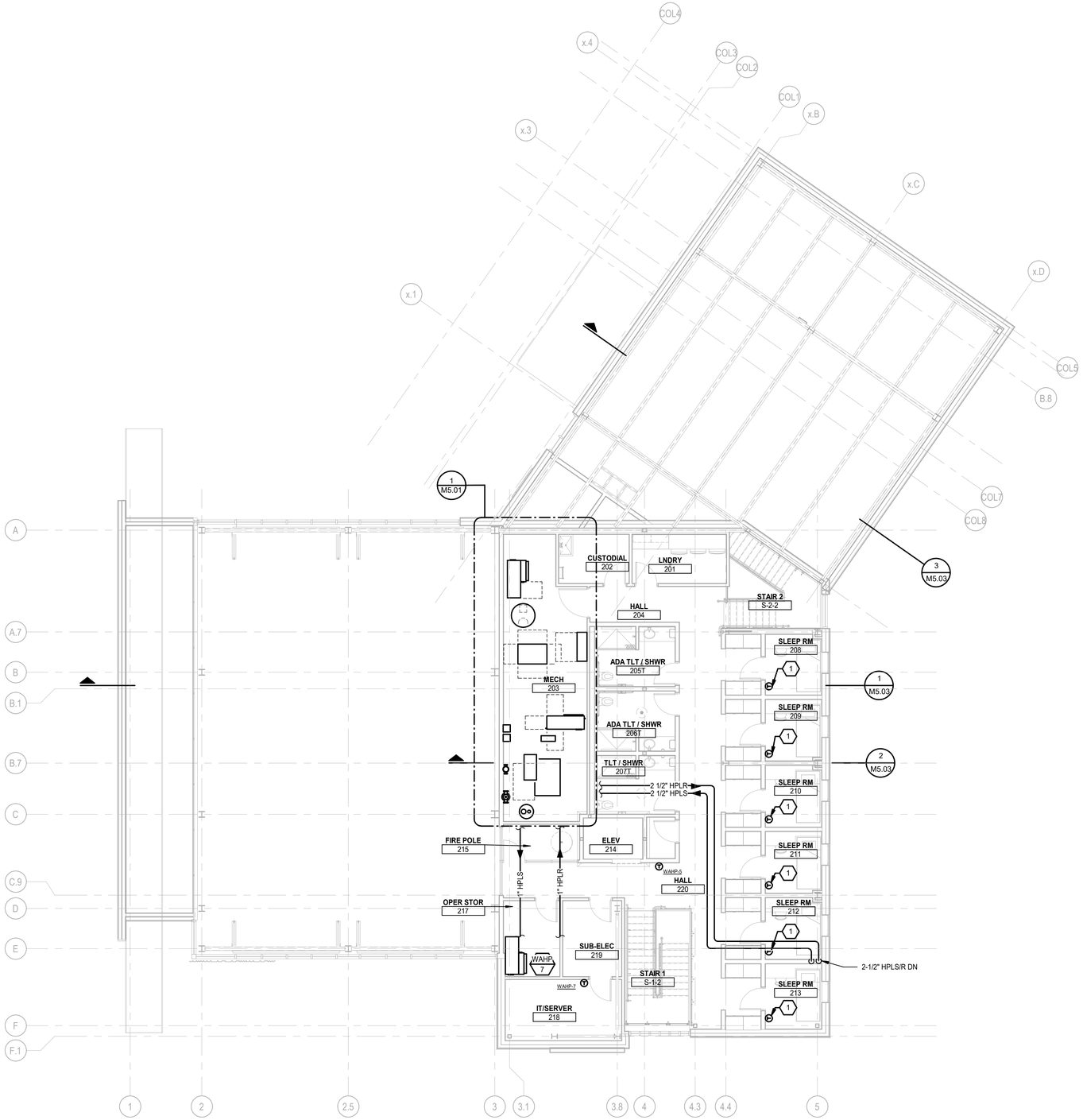

PROJECT TRUE

SECOND LEVEL HVAC PIPING PLAN

SCALE: 1/8" = 1'-0"

HVAC PIPING GENERAL NOTES:

1 THESE DRAWINGS ARE DIAGRAMMATIC, AND REPRESENT THE GENERAL INTENT AND ARRANGEMENT OF SYSTEMS. THEY ARE NOT TO BE CONSIDERED FABRICATION/COORDINATION/SHOP DRAWINGS. COORDINATION WITH OTHER TRADES IS REQUIRED. PROVIDE THE ADDITIONAL FITTINGS AND OFFSETS THAT WILL BE REQUIRED TO COMPLETE EACH SYSTEM AND TO AVOID INTERFERENCES WITH ALL OTHER SYSTEMS INCLUDING THE STRUCTURE, SHEET METAL, OTHER PIPING SYSTEMS, ELECTRICAL CONDUITS, BUS DUCTS, CABLE TRAY, LIGHT FIXTURES, ETC. AND/OR OTHER SPACE CONSTRAINTS.

2 INSTALL SYSTEMS SUCH THAT REQUIRED CLEARANCE AND SERVICE ACCESS SPACE IS PROVIDED AROUND ALL MECHANICAL AND ELECTRICAL EQUIPMENT, AND AROUND ANY COMPONENTS WHICH REQUIRE SERVICE ACCESS.

3 PIPING AND DUCTWORK SHALL NOT BE INSTALLED ABOVE ELECTRICAL TRANSFORMERS, SWITCHBOARDS, PANELBOARDS OR MOTOR CONTROL CENTERS.

4 COORDINATE AND PROVIDE ACCESS DOORS WITHIN INACCESSIBLE CEILING, SHAFT, AND CHASE AREAS FOR ALL COMPONENTS WHICH REQUIRE SERVICE ACCESS. REFER TO ARCHITECTURAL DRAWINGS FOR CEILING TYPES.

5 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

6 SUBMIT PROPOSED METHODS OF ANCHORING AND GUIDING PIPING SYSTEMS TO STRUCTURAL ENGINEER FOR APPROVAL.

7 COORDINATE LOCATION OF DUCT-MOUNTED HYDRONIC DEVICES WITH SHEET METAL TRADES.

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9 REFER TO TEMPERATURE CONTROLS STANDARD MOUNTING HEIGHTS DETAIL FOR ELEVATIONS OF WALL MOUNTED TEMPERATURE CONTROL DEVICES.

CONSTRUCTION KEY NOTES:

1 TSTAT TO LOCAL VAV DIFFUSER.

2 ISOLATION VALVES BEHIND ARCHTECTURAL ACCESS PANEL. REFER TO RISER ON SHEET M6.01.

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
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AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
PROFESSIONAL ENGINEER

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SECOND LEVEL HVAC PIPING PLAN

A3C COLLABORATIVE ARCHITECTURE
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ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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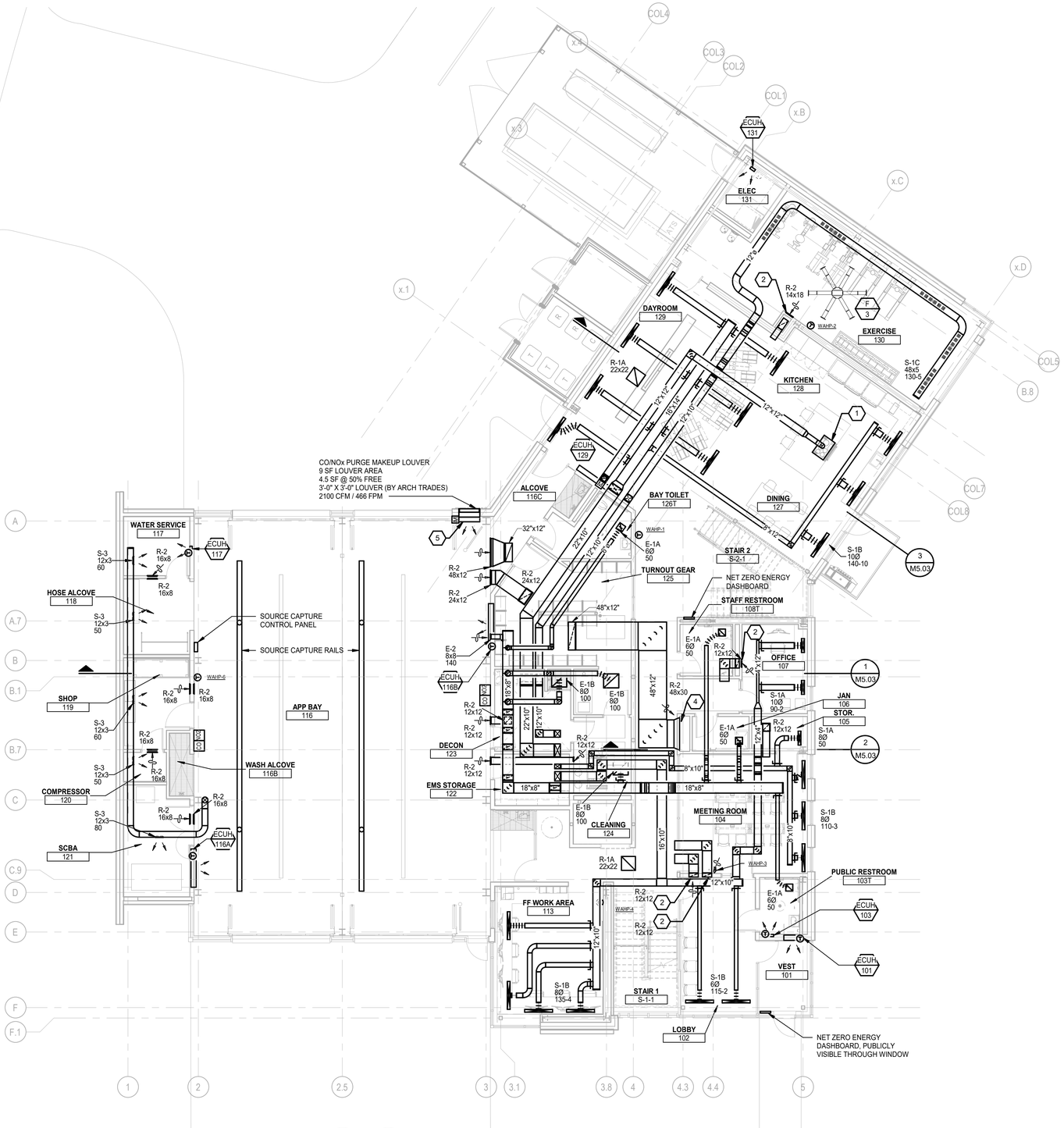

FIRST LEVEL SHEET METAL PLAN

SCALE: 1/8" = 1'-0"

PROJECT TRUE

SHEET METAL GENERAL NOTES:

1 THESE DRAWINGS ARE DIAGRAMMATIC, AND REPRESENT THE GENERAL INTENT AND ARRANGEMENT OF SYSTEMS. THEY ARE NOT TO BE CONSIDERED FABRICATION/COORDINATION/SHOP DRAWINGS. COORDINATION WITH OTHER TRADES IS REQUIRED. PROVIDE THE ADDITIONAL FITTINGS AND OFFSETS THAT WILL BE REQUIRED TO COMPLETE EACH SYSTEM AND TO AVOID INTERFERENCES WITH ALL OTHER SYSTEMS INCLUDING THE STRUCTURE, PIPING SYSTEMS, ELECTRICAL CONDUITS, BUS DUCTS, CABLE TRAY, LIGHT FIXTURES, ETC. AND/OR OTHER SPACE CONSTRAINTS.

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3 PIPING AND DUCTWORK SHALL NOT BE INSTALLED ABOVE ELECTRICAL TRANSFORMERS, SWITCHBOARDS, PANELBOARDS OR MOTOR CONTROL CENTERS.

4 COORDINATE AND PROVIDE ACCESS DOORS WITHIN INACCESSIBLE CEILING, SHAFT, AND CHASE AREAS FOR ALL COMPONENTS WHICH REQUIRE SERVICE ACCESS. REFER TO ARCHITECTURAL DRAWINGS FOR CEILING TYPES.

5 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

6 REFER TO ARCHITECTURAL REFLECTED CEILING PLANS FOR DIMENSIONED LOCATION OF GRILLES, REGISTERS, AND DIFFUSERS.

7 REFER TO TEMPERATURE CONTROLS STANDARD MOUNTING HEIGHTS DETAIL FOR ELEVATIONS OF WALL MOUNTED TEMPERATURE CONTROL DEVICES.

CONSTRUCTION KEY NOTES:

1 PROVIDE 500 CFM RESIDENTIAL STYLE KITCHEN HOOD WITH INTEGRAL WET CHEMICAL FIRE SUPRESSION SYSTEM, GREASE FILTERS, AND CONTROLLER FOR ASSOCIATED EXHAUST FAN. BASIS OF DESIGN; GREENHECK GRRS.

2 BOTTOM OF RETURN GRILLE 1'-0" AFF UON. TOPOF ARCHITECTURAL RETURN PLENUM OPEN TO CEILING PLENUM UON.

3 AIM NOZZLE DIFFUSER AT BASE OF OPPOSITE WALL. REFER TO SECTION.

4 BOTTOM OF RETURN GRILLE 1'-0" AFF UON. CONNECT RETURN AIR DUCT TO ARCHITECTURAL RETURN AIR TRANSFER PLENUM (REFER TO ARCHITECTURAL).

5 COVER OPENING WITH 1/2" WIRE MESH.

6 AIR RETURNS TO ABOVE THROUGH OPEN SLAT ARCHITECTURAL CEILING

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021.0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068185
PROFESSIONAL ENGINEER

Project Number 21018

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City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

FIRST LEVEL SHEET METAL PLAN

A 3 C
COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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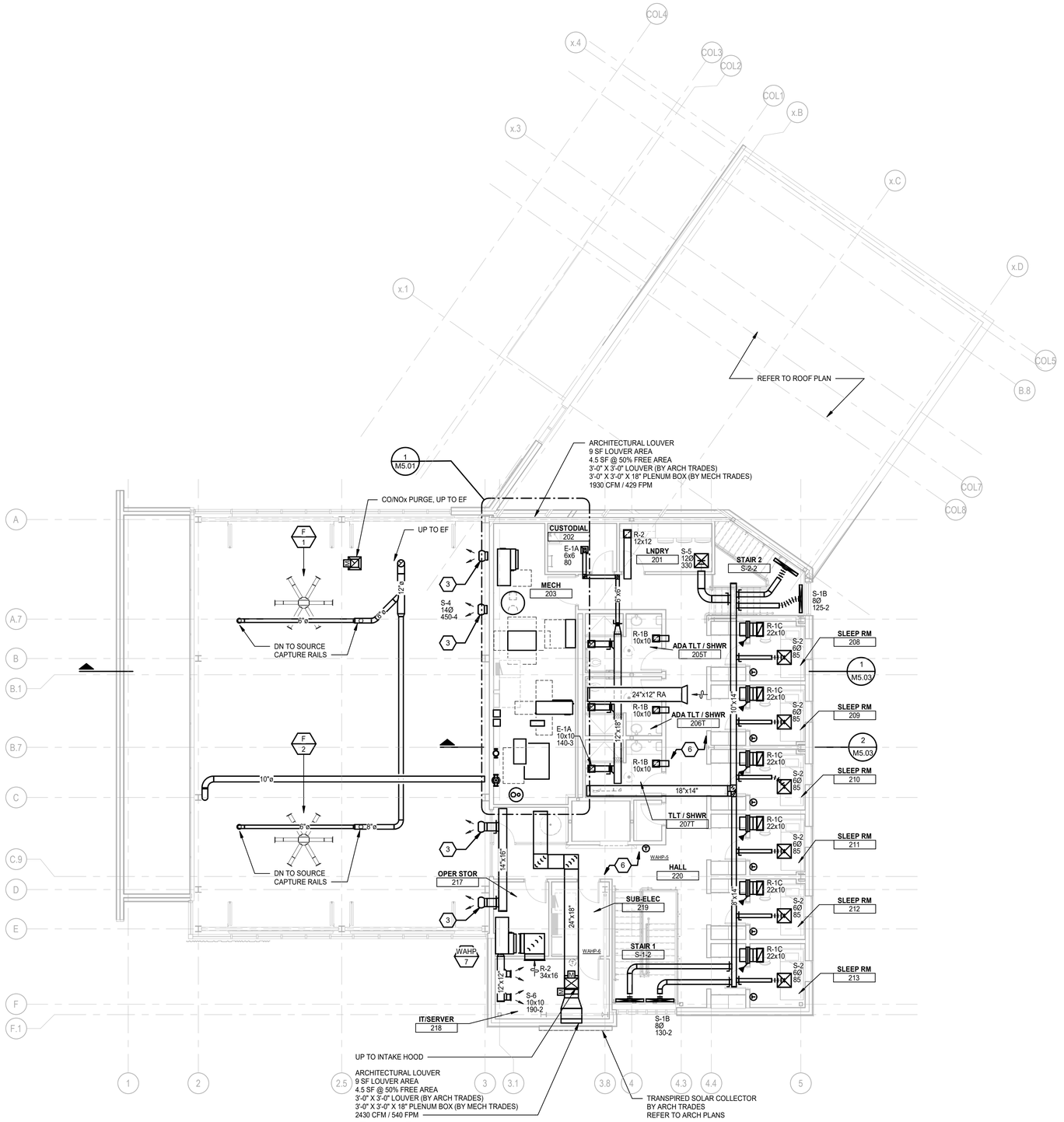

PROJECT TRUE

SECOND LEVEL SHEET METAL PLAN

SCALE: 1/8" = 1'-0"

SHEET METAL GENERAL NOTES:

1 THESE DRAWINGS ARE DIAGRAMMATIC, AND REPRESENT THE GENERAL INTENT AND ARRANGEMENT OF SYSTEMS. THEY ARE NOT TO BE CONSIDERED FABRICATION/COORDINATION/SHOP DRAWINGS. COORDINATION WITH OTHER TRADES IS REQUIRED. PROVIDE THE ADDITIONAL FITTINGS AND OFFSETS THAT WILL BE REQUIRED TO COMPLETE EACH SYSTEM AND TO AVOID INTERFERENCES WITH ALL OTHER SYSTEMS INCLUDING THE STRUCTURE, PIPING SYSTEMS, ELECTRICAL CONDUITS, BUS DUCTS, CABLE TRAY, LIGHT FIXTURES, ETC. AND/OR OTHER SPACE CONSTRAINTS.

2 INSTALL SYSTEMS SUCH THAT REQUIRED CLEARANCE AND SERVICE ACCESS SPACE IS PROVIDED AROUND ALL MECHANICAL AND ELECTRICAL EQUIPMENT, AND AROUND ANY COMPONENTS WHICH REQUIRE SERVICE ACCESS.

3 PIPING AND DUCTWORK SHALL NOT BE INSTALLED ABOVE ELECTRICAL TRANSFORMERS, SWITCHBOARDS, PANELBOARDS OR MOTOR CONTROL CENTERS.

4 COORDINATE AND PROVIDE ACCESS DOORS WITHIN INACCESSIBLE CEILING, SHAFT, AND CHASE AREAS FOR ALL COMPONENTS WHICH REQUIRE SERVICE ACCESS. REFER TO ARCHITECTURAL DRAWINGS FOR CEILING TYPES.

5 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

6 REFER TO ARCHITECTURAL REFLECTED CEILING PLANS FOR DIMENSIONED LOCATION OF GRILLES, REGISTERS, AND DIFFUSERS.

7 REFER TO TEMPERATURE CONTROLS STANDARD MOUNTING HEIGHTS DETAIL FOR ELEVATIONS OF WALL MOUNTED TEMPERATURE CONTROL DEVICES.

CONSTRUCTION KEY NOTES:

1 PROVIDE 500 CFM RESIDENTIAL STYLE KITCHEN HOOD WITH INTEGRAL WET CHEMICAL FIRE SUPRESSION SYSTEM, GREASE FILTERS, AND CONTROLLER FOR ASSOCIATED EXHAUST FAN. BASIS OF DESIGN; GREENHECK GRRS.

2 BOTTOM OF RETURN GRILLE 1'-0" AFF UON. TOPOF ARCHITECTURAL RETURN PLENUM OPEN TO CEILING PLENUM UON.

3 AIM NOZZLE DIFFUSER AT BASE OF OPPOSITE WALL. REFER TO SECTION.

4 BOTTOM OF RETURN GRILLE 1'-0" AFF UON. CONNECT RETURN AIR DUCT TO ARCHITECTURAL RETURN AIR TRANSFER PLENUM (REFER TO ARCHITECTURAL).

5 COVER OPENING WITH 1/2" WIRE MESH.

6 AIR RETURNS TO ABOVE THROUGH OPEN SLAT ARCHITECTURAL CEILING

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CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021.0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
LICENSED PROFESSIONAL ENGINEER

Project Number	21018

Issue	Date
SCHEMATIC DESIGN	03/04/22
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: ACF Checked: ACF

City Of Ann Arbor
NEW FIRE STATION 4
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ANN ARBOR, MI 48104

SECOND LEVEL SHEET METAL PLAN

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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Sheet
M4.02

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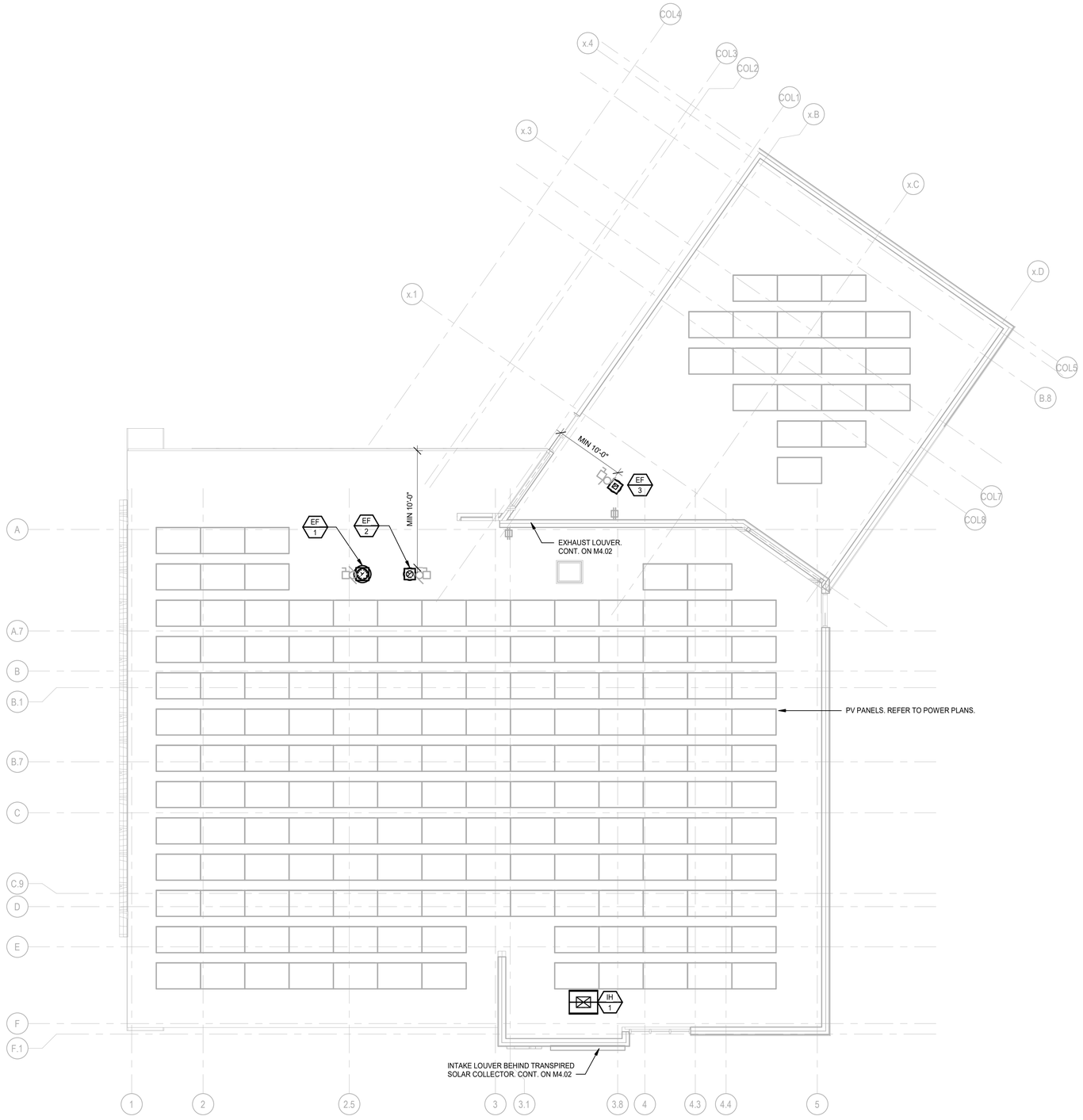
THE FOLLOWING DIMENSION EQUALS ONE INCH WHEN PRINTED TO SCALE. 1"



ROOF SHEET METAL PLAN
SCALE: 1/8" = 1'-0"

PROJECT TRUE

SHEET METAL GENERAL NOTES:

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7 REFER TO TEMPERATURE CONTROLS STANDARD MOUNTING HEIGHTS DETAIL FOR ELEVATIONS OF WALL MOUNTED TEMPERATURE CONTROL DEVICES.

CONSTRUCTION KEY NOTES:

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2415 S HURON PKWY
ANN ARBOR, MI 48104

ROOF SHEET METAL PLAN

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
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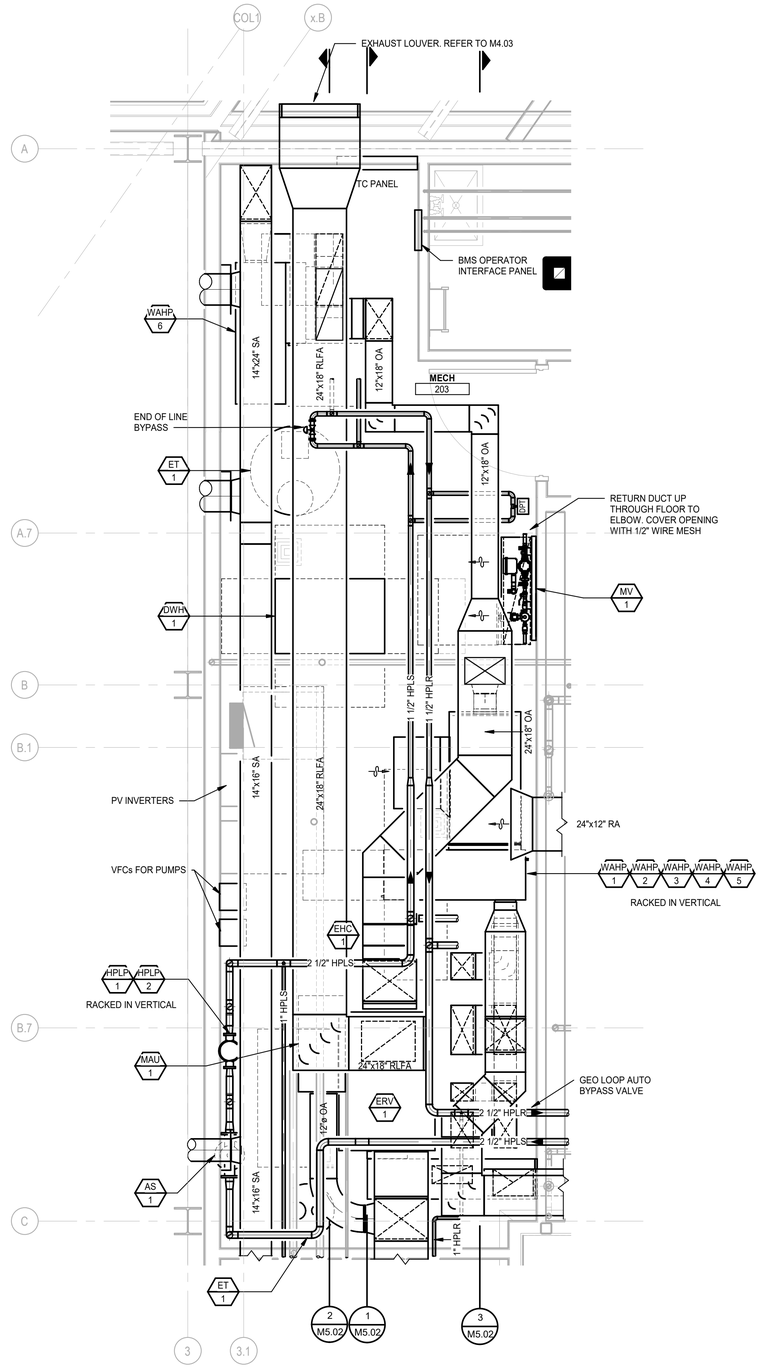

1 M3.02 **ENLARGED MECHANICAL PLAN**
SCALE: 3/8" = 1'-0"

SHEET METAL GENERAL NOTES:

1 THESE DRAWINGS ARE DIAGRAMMATIC, AND REPRESENT THE GENERAL INTENT AND ARRANGEMENT OF SYSTEMS. THEY ARE NOT TO BE CONSIDERED FABRICATION/COORDINATION/SHOP DRAWINGS. COORDINATION WITH OTHER TRADES IS REQUIRED. PROVIDE THE ADDITIONAL FITTINGS AND OFFSETS THAT WILL BE REQUIRED TO COMPLETE EACH SYSTEM AND TO AVOID INTERFERENCES WITH ALL OTHER SYSTEMS INCLUDING THE STRUCTURE, PIPING SYSTEMS, ELECTRICAL CONDUITS, BUS DUCTS, CABLE TRAY, LIGHT FIXTURES, ETC. AND/OR OTHER SPACE CONSTRAINTS.

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5 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

6 REFER TO ARCHITECTURAL REFLECTED CEILING PLANS FOR DIMENSIONED LOCATION OF GRILLES, REGISTERS, AND DIFFUSERS.

7 REFER TO TEMPERATURE CONTROLS STANDARD MOUNTING HEIGHTS DETAIL FOR ELEVATIONS OF WALL MOUNTED TEMPERATURE CONTROL DEVICES.

HVAC PIPING GENERAL NOTES:

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5 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

6 SUBMIT PROPOSED METHODS OF ANCHORING AND GUIDING PIPING SYSTEMS TO STRUCTURAL ENGINEER FOR APPROVAL.

7 COORDINATE LOCATION OF DUCT-MOUNTED HYDRONIC DEVICES WITH SHEET METAL TRADES.

8 BRANCH PIPING SERVING TERMINAL UNIT HEATING COILS OR RADIANT CEILING PANELS SHALL BE 3/4" UNLESS OTHERWISE NOTED. BRANCH PIPING SERVING MORE THAN ONE TERMINAL UNIT HEATING COIL SHALL BE 1" UNLESS OTHERWISE NOTED. BRANCH PIPING SERVING HOT WATER UNIT HEATERS AND CABINET UNIT HEATERS SHALL BE 1" UNLESS OTHERWISE NOTED.

9 REFER TO TEMPERATURE CONTROLS STANDARD MOUNTING HEIGHTS DETAIL FOR ELEVATIONS OF WALL MOUNTED TEMPERATURE CONTROL DEVICES.

CONSTRUCTION KEY NOTES:

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021.0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068185
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
SCHEMATIC DESIGN	03/04/22
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City Of Ann Arbor
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ANN ARBOR, MI 48104

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Sheet M5.01

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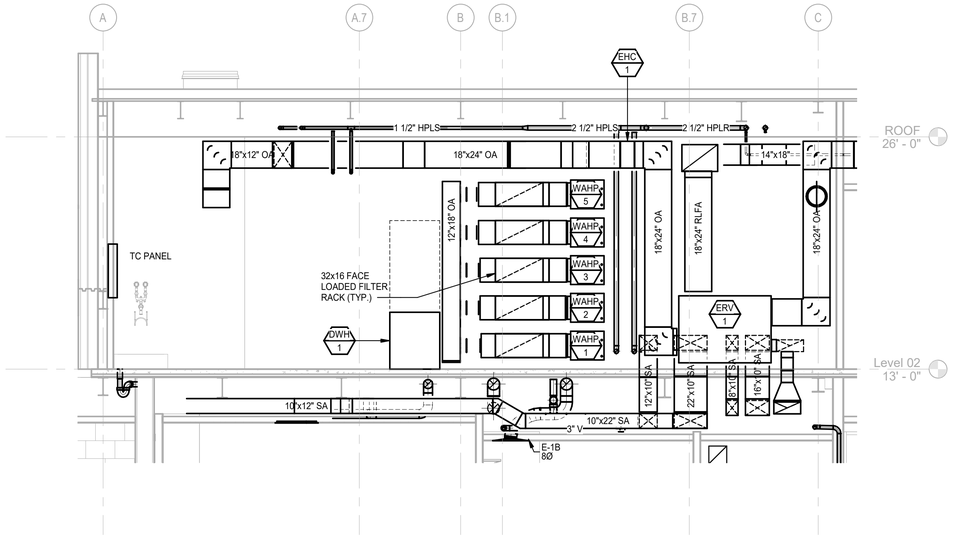
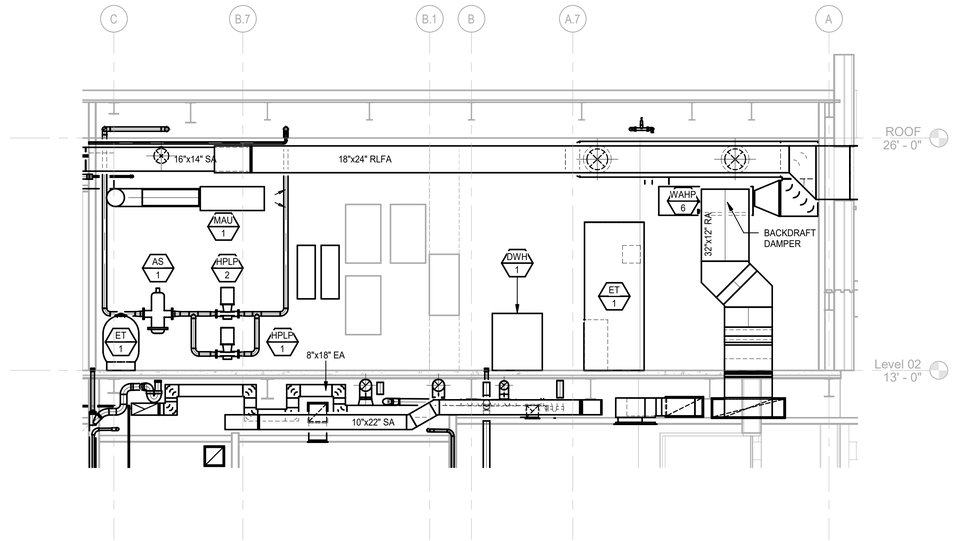
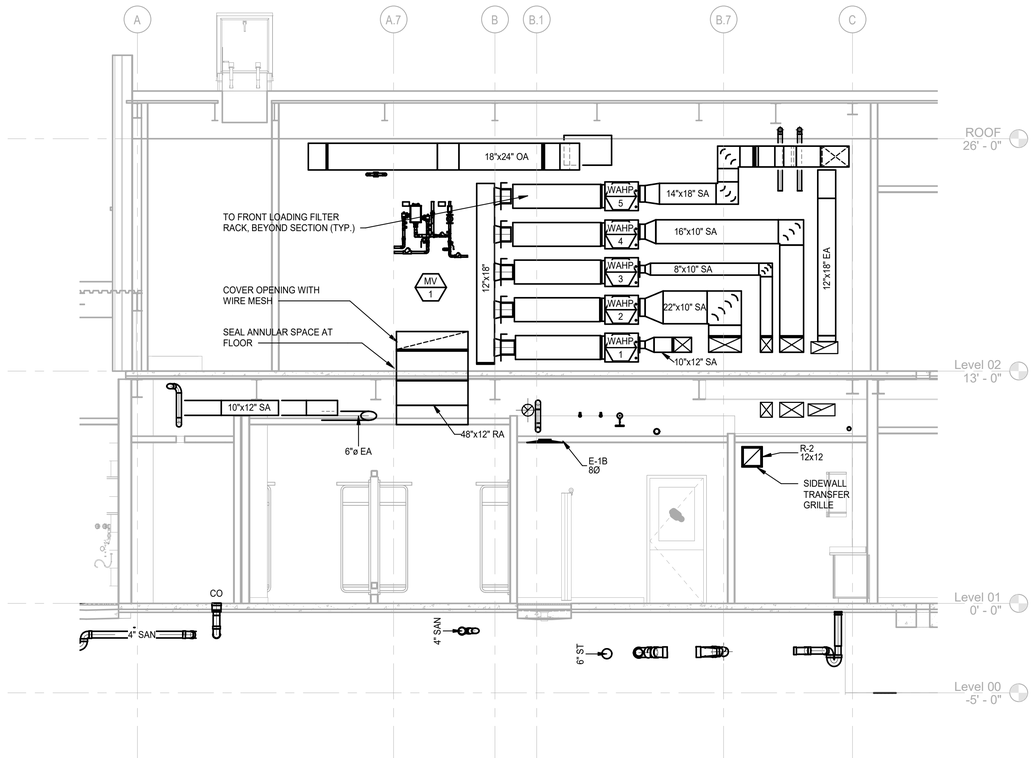
THE FOLLOWING DIMENSION EQUALS ONE INCH WHEN PRINTED TO SCALE. 1"



1 M5.01 **MECHANICAL ROOM SECTION - WEST**
SCALE: 1/4" = 1'-0"



2 M5.01 **MECHANICAL ROOM SECTION - EAST**
SCALE: 1/4" = 1'-0"



3 M5.01 **MECHANICAL ROOM SECTION - EAST 2**
SCALE: 1/4" = 1'-0"

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City Of Ann Arbor
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MECHANICAL SECTIONS

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M5.02

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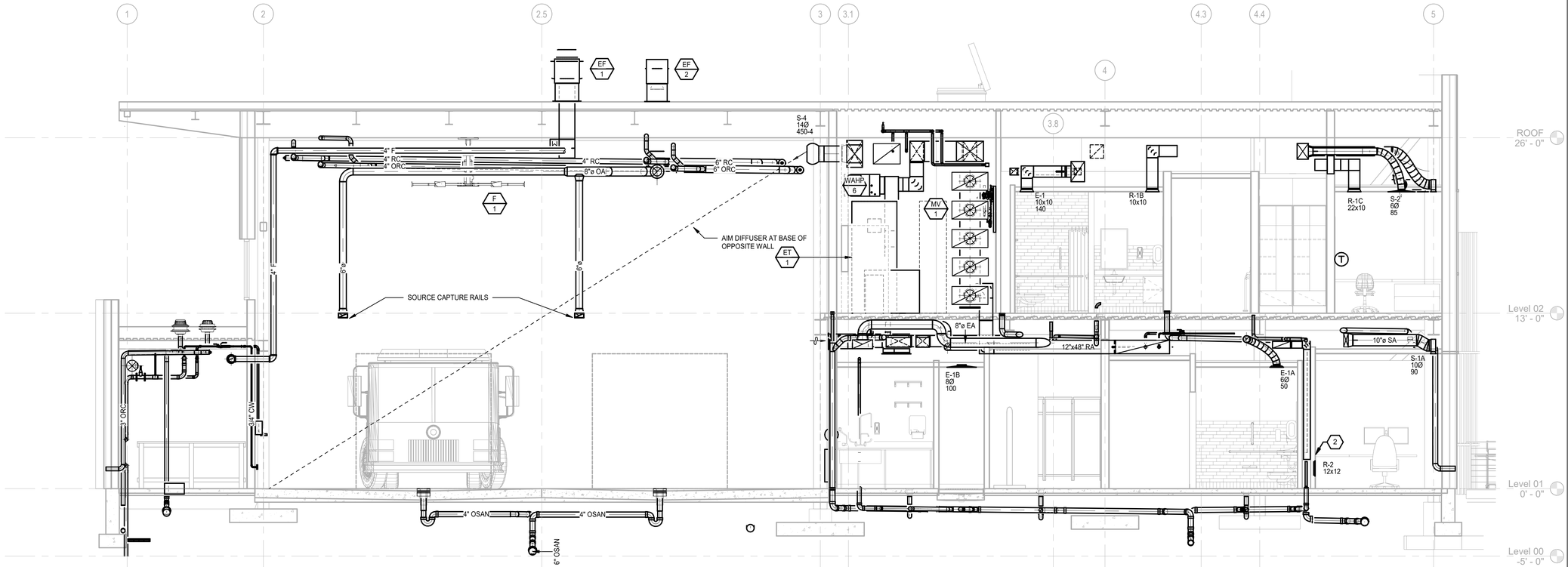
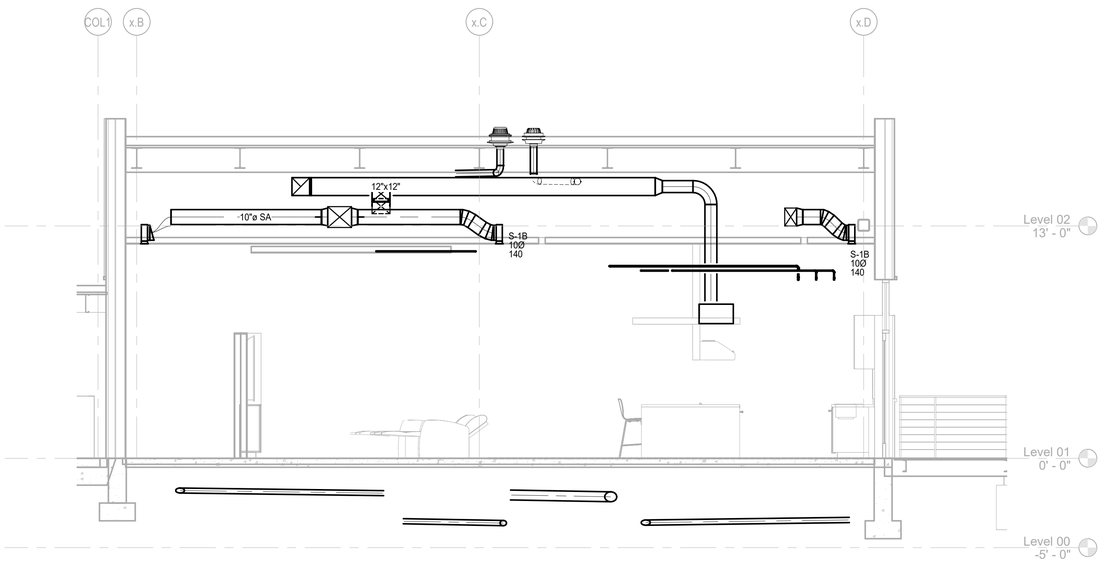
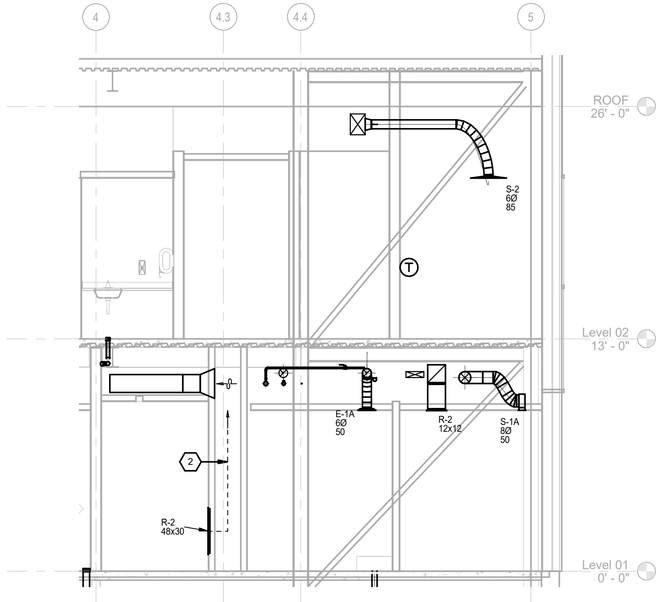


1 M3.01 **APP BAY MECHANICAL SECTION - NORTH**
SCALE: 1/4" = 1'-0"



3 M3.02 **DAYROOM MECHANICAL SECTION - EAST**
SCALE: 1/4" = 1'-0"



2 M3.01 **CORRIDOR MECHANICAL SECTION - NORTH**
SCALE: 1/4" = 1'-0"

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CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
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STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 620106818
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
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City Of Ann Arbor
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Sheet M5.03

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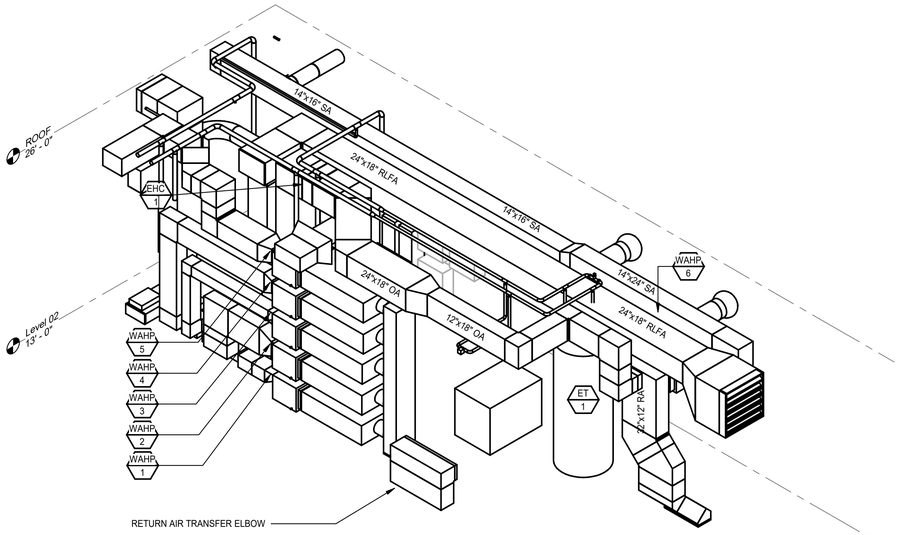
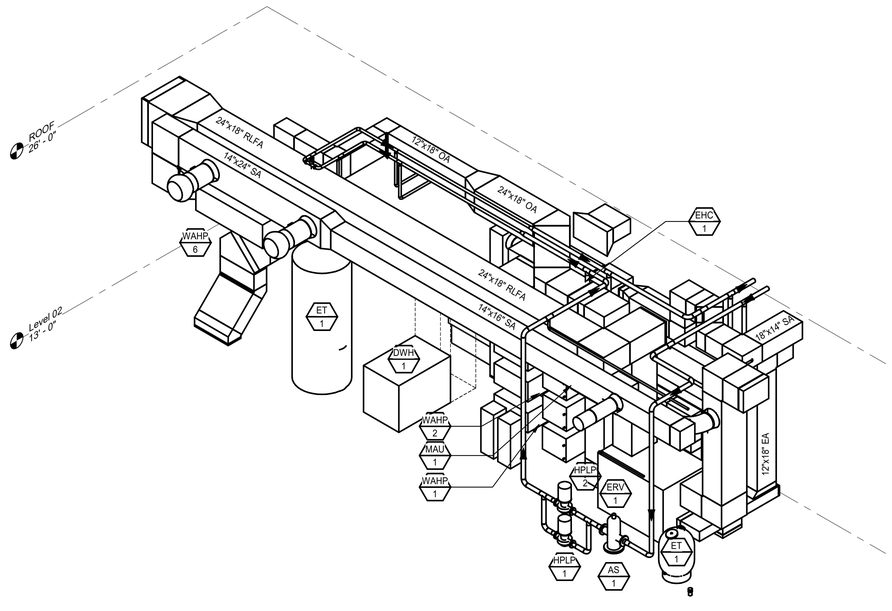


MECH ROOM ISO 1



MECH ROOM ISO 2

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5145 Livernois, Suite 100
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City Of Ann Arbor
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MECHANICAL ISOMETRIC VIEWS

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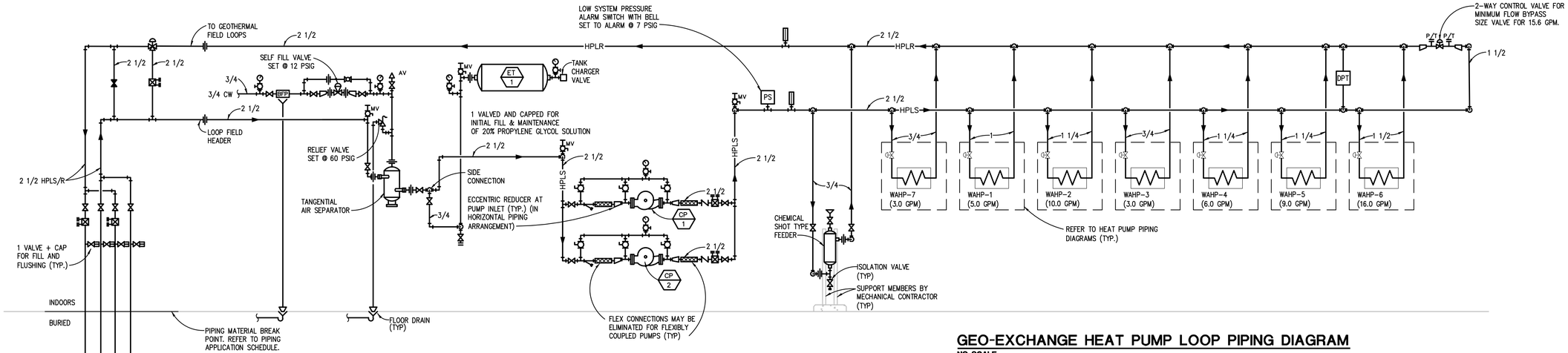
Sheet
M5.51

NOTES

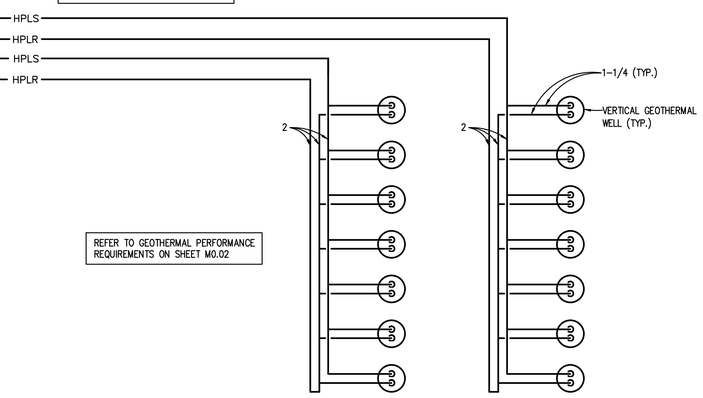
ALL BRANCH PIPING CONNECTIONS TO MAINS SHALL BE FROM SIDE OR BOTTOM OF PIPE



GEO-EXCHANGE HEAT PUMP LOOP PIPING DIAGRAM

NO SCALE

ALL UNDERGROUND JOINTS SHALL BE FUSION. REFER TO SPECIFICATIONS.



REFER TO GEOTHERMAL PERFORMANCE REQUIREMENTS ON SHEET M0.02

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
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MECHANICAL DETAILS

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115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
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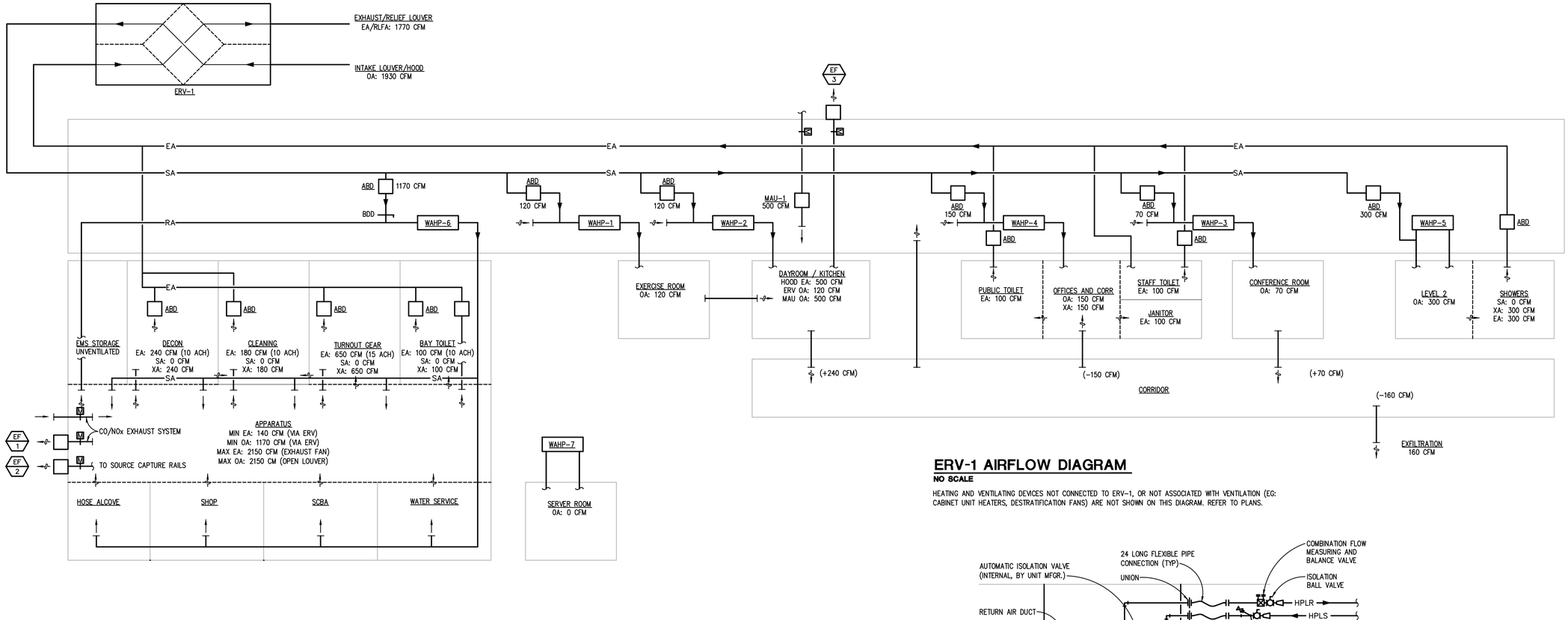
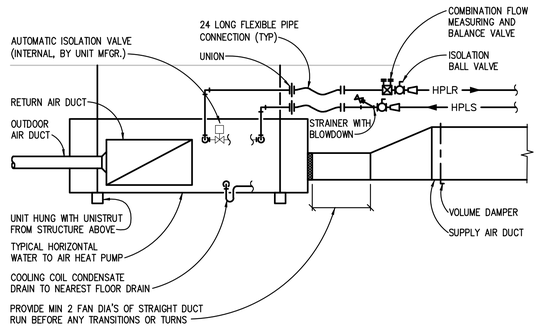


ERV-1 AIRFLOW DIAGRAM

NO SCALE

HEATING AND VENTILATING DEVICES NOT CONNECTED TO ERV-1, OR NOT ASSOCIATED WITH VENTILATION (EG: CABINET UNIT HEATERS, DESTRATIFICATION FANS) ARE NOT SHOWN ON THIS DIAGRAM. REFER TO PLANS.



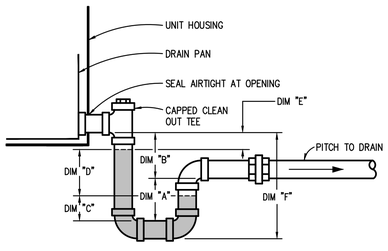
HORIZONTAL HEAT PUMP PIPING DIAGRAM AND INSTALLATION DETAIL

NO SCALE

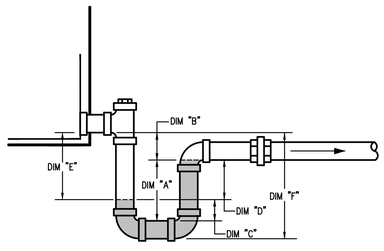
TRAP DIMENSION TABLE

TYPE OF SYSTEM	S.P. AT DRAIN PAN (IN.) (NOTE A)	DIMENSION "A" (INCHES) MIN.	DIMENSION "B" (INCHES)	DIMENSION "C" (INCHES) (TRAP SEAL)	DIMENSION "D" (INCHES)	DIMENSION "E" (INCHES)	DIMENSION "F" (INCHES) (+/-) DRAIN PIPE SIZE (INCHES)			
							1 TO 1-1/2	2	2 1/2, 3	4
DRAW THROUGH	-2.1 TO -3	3.5	3.5	2	3	2	8.0-8.5	9.0	9.5-10.0	11.0
	UP TO -2	3.0	3.0	2	2	2	7.0-7.5	8.0	8.5-9.0	10.0
BLOW THROUGH	UP TO +2	4.0	2.0	2	2	4	7.0-7.5	8.0	8.5-9.0	10.0
	+2.1 TO +3	5.0	2.0	2	3	5	8.0-8.5	9.0	9.5-10.0	11.0

NOTES:
A. REFER TO EQUIPMENT SCHEDULES FOR (-) OR (+) STATIC PRESSURE AT DRAIN PAN.
A. BASE TRAP DIMENSIONS ON -____" S.P. FOR DRAW THROUGH UNITS AND +____" S.P. FOR BLOW THROUGH UNITS.
B. DRAIN PIPE SIZE SHALL BE SIZE OF DRAIN PAN OUTLET, MINIMUM 1".
C. DIMENSION "G" IS MIN: 3" FOR UP TO 1 1/2" DRAIN PIPE
4" FOR 2" DRAIN PIPE
5" FOR 2 1/2" OR 3" DRAIN PIPE
6" FOR 4" DRAIN PIPE



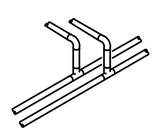
DRAW THROUGH



BLOW THROUGH

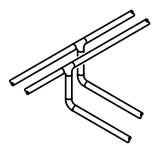
CONDENSATE DRAIN PAN TRAP DETAIL (UNITARY UNITS NOT ABOVE CEILING)

NO SCALE



BRANCH CONNECTION OFF TOP

APPLIES TO THE FOLLOWING SYSTEMS:
(NO SYSTEMS IN MECHANICAL DIVISION)



BRANCH CONNECTION OFF BOTTOM

APPLIES TO THE FOLLOWING SYSTEMS:
HEAT PUMP LOOP

NOTE: BOTTOM AS INDICATED OR SIDE CONNECTION IS ACCEPTABLE. CONNECTION ABOVE CENTERLINE OF MAINS IS NOT ACCEPTABLE.

TYPICAL BRANCH TAKE-OFF CONNECTION PIPING DETAIL

NO SCALE

TCA ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021-0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
REGISTERED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: ACF Checked: ACF

City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

MECHANICAL DETAILS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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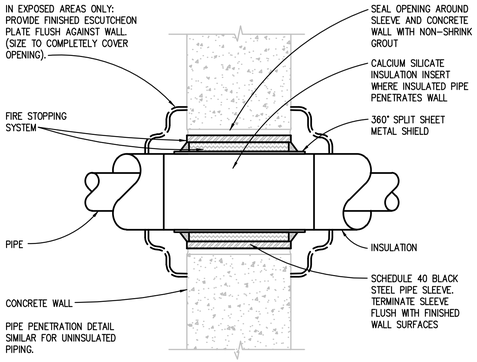
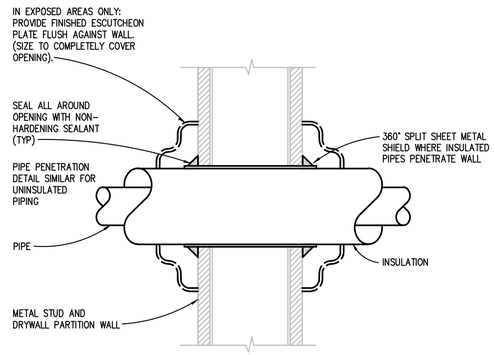


DETAIL INDICATES THE INSTALLATION REQUIREMENTS FOR A FIRE RATED ASSEMBLY. FOR A NON-FIRE RATED ASSEMBLY PACK SLEEVED OPENING WITH INSULATION MATERIAL AND CAULK WITH NON-HARDENING SEALANT.

FIRE RATED AND NON-FIRE RATED POURED CONCRETE OR BLOCK WALL PIPE PENETRATION DETAIL

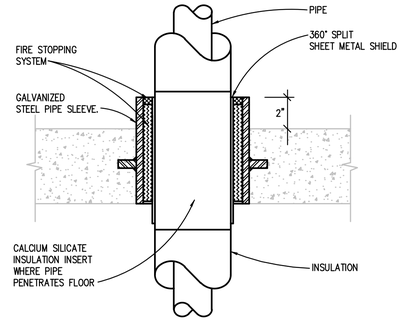
NO SCALE



THIS DETAIL DOES NOT APPLY TO HEATING PIPING 2" AND LARGER. FOR HEATING PIPING 2" AND LARGER REFER TO "FIRE RATED AND NON-FIRE RATED METAL STUD AND DRYWALL PARTITION WALL PIPE PENETRATION DETAIL"

NON-FIRE RATED METAL STUD AND DRYWALL PARTITION WALL PIPE PENETRATION DETAIL

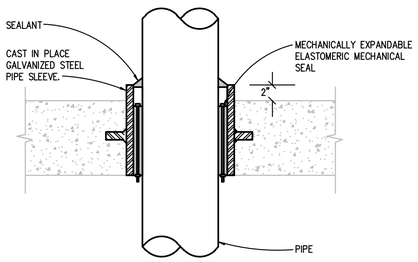
NO SCALE



NEW FLOOR PIPE PENETRATION DETAIL

NO SCALE

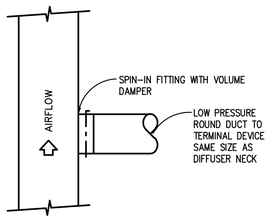
NOTE: PIPES ENCASED IN WALLS EXEMPT FROM THIS DETAIL.



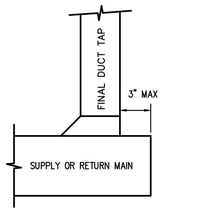
NEW SLAB ON GRADE FLOOR PIPE PENETRATION DETAIL

NO SCALE

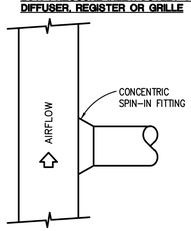
NOTE: PIPES ENCASED IN WALLS EXEMPT FROM THIS DETAIL.



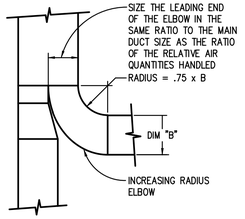
LOW PRESSURE INLET/OUTLET TO/FROM DIFFUSER, REGISTER OR GRILLE



LOW PRESSURE END OF RUN

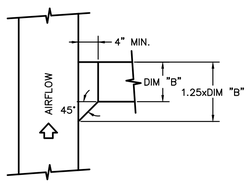


RECTANGULAR TO ROUND DUCT

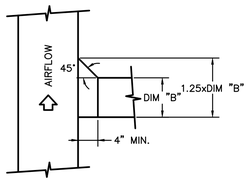


SUPPLY, RETURN OR EXHAUST DUCT

FOR USE WHEN A BRANCH TAKE-OFF IS TO HANDLE MORE THAN 25% OF THE AIR HANDLED BY THE MAIN DUCT



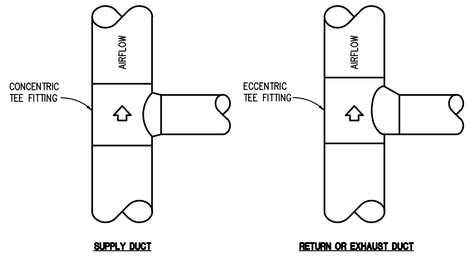
SUPPLY DUCT



RETURN OR EXHAUST DUCT

RECTANGULAR DUCT BRANCH TAKE-OFF DETAILS

NO SCALE



SUPPLY DUCT

RETURN OR EXHAUST DUCT

SPIRAL DUCT BRANCH TAKE-OFF DETAILS

NO SCALE **(ROUND AND FLAT OVAL SIMILAR)**

T C A
ARCHITECTURE + PLANNING + DESIGN

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T: (734) 663 - 1910
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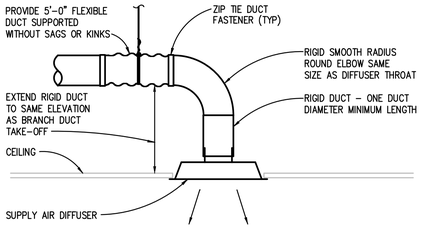
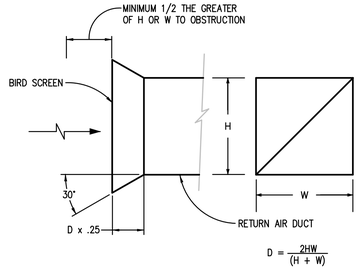


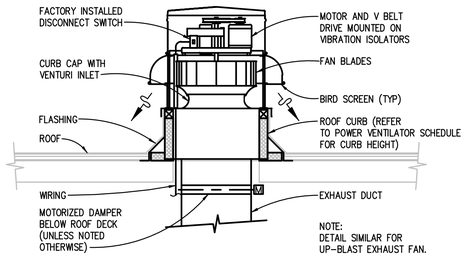
ROUND NECK SUPPLY AIR DIFFUSER DETAIL

NO SCALE



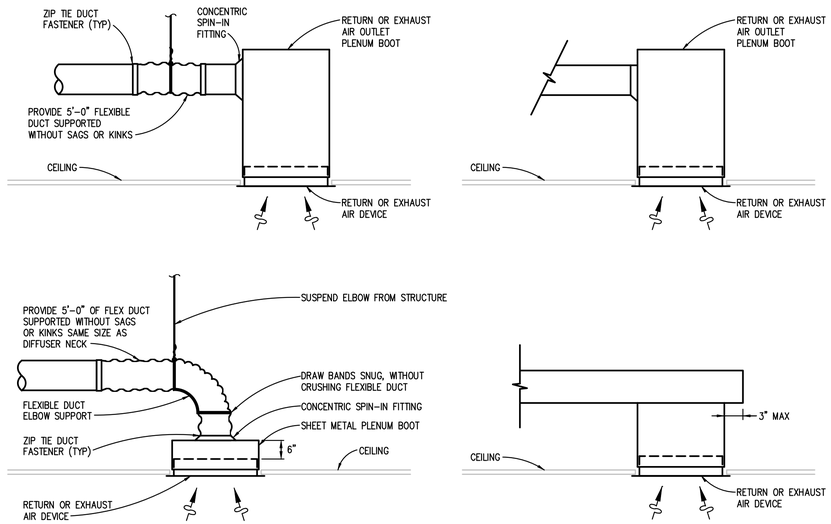
BELLMOUTH DETAIL

NO SCALE



ROOF MOUNTED POWER VENTILATOR EXHAUST FAN DETAIL

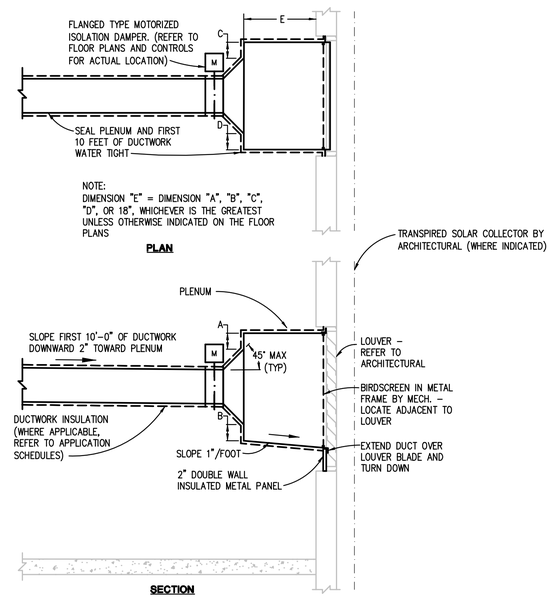
NO SCALE



RETURN OR EXHAUST AIR DEVICE INSTALLATION DETAIL

NO SCALE

NOTE: PAINT INTERIOR SURFACE OF PLENUM BOX FLAT BLACK.



OUTDOOR AIR INTAKE OR EXHAUST/RELIEF PLENUM DETAIL

NO SCALE

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ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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ABOVEGROUND HVAC PIPING & VALVE APPLICATION SCHEDULE

PIPE SIZE (INCHES)	MATERIAL: SOFT COPPER TYPE K	HARD COPPER TYPE L	HARD COPPER TYPE M	CARBON STEEL (SCHED. 40)	CARBON STEEL (SCHED. 80)	CARBON STEEL (STD.)	COPPER TYPE DWV	POLYPROPYLENE RCT	CONNECTION: SOLDERED	BRAZED	WELDED	THREADED	FLANGED	GROOVED	PRESSURE SEAL	MECHANICALLY FORMED TEE	SOCKET FUSION	ISOLATION VALVES: BALL	GENERAL SERVICE BUTTERFLY	HI-PERF BUTTERFLY	GATE	KEYED NOTES
HEAT PUMP LOOP - MIN. WORKING PRESS. & TEMP.: 125 PSIG AT 200 DEG F																						
UP TO 2		X							X	X					X	X		X				
UP TO 2								X									X	X				
2-1/2 TO 4		X								X				X	X	X			X			A
2-1/2 TO 4								X									X		X			

GENERAL NOTES

1. 'X' INDICATES ACCEPTABLE SELECTION. IF MORE THAN ONE SELECTION IS INDICATED FOR A PIPING SYSTEM, CONTRACTOR MAY SELECT FROM THOSE INDICATED SELECTIONS.
2. DISSIMILAR-METAL PIPING JOINTS: CONSTRUCT JOINTS USING DIELECTRIC FITTINGS COMPATIBLE WITH BOTH PIPING MATERIALS. IF A BRONZE VALVE CONNECTS THE DISSIMILAR METALS NO FURTHER DIELECTRIC ISOLATION IS REQUIRED.

   a. NPS 2 AND SMALLER: USE BRASS COUPLING, NIPPLE, OR UNION.
   b. NPS 2-1/2 AND LARGER: USE DIELECTRIC FLANGE KITS.

3. USE UNIONS OR FLANGES AT VALVE AND EQUIPMENT CONNECTIONS.
4. HVAC EQUIPMENT DRAINS, VENTS, SAFETY VALVE PIPING, BLOWDOWN PIPING AND THE LIKE SHALL BE SAME PIPING MATERIAL AS ASSOCIATED PIPING SYSTEM.
5. GROOVED END VALVES MAY BE USED WITH GROOVED PIPING.

KEYED NOTES

A. GROOVED AND FLANGED FITTINGS, JOINTS, AND COUPLINGS, IF INDICATED AS AN ACCEPTABLE SELECTION, MAY BE USED IN ACCESSIBLE LOCATIONS FOR THIS PIPING SYSTEM ONLY. ACCESSIBLE LOCATIONS ARE DEFINED AS EXPOSED CONSTRUCTION OR ABOVE LAY-IN CEILINGS.

ABOVEGROUND HVAC PIPE & ACCESSORY INSULATION APPLICATION SCHEDULE

	INSULATION MATERIAL & THICKNESS (INCHES): FLEXIBLE ELASTOMERIC	FIBERGLASS	MINERAL WOOL	POLYISOCYANURATE	PHENOLIC	CELLULAR GLASS	CALCIUM SILICATE	FIELD-APPLIED JACKET MATERIAL: ALUMINUM	STAINLESS STEEL	PVC	SELF-ADHESIVE (FOR OUTDOOR APPLICATIONS)	PVDC (INDOOR)	PVDC (OUTDOOR)	KEYED NOTES
INDOOR PIPE SYSTEM AND SIZE (INCHES)														
HEAT PUMP LOOP SUPPLY & RETURN														
NPS 1-1/4 AND SMALLER	1	1						X		X				A
NPS 1-1/2 AND LARGER	1.5	1.5						X		X				A

UNLESS OTHERWISE INDICATED OR SCHEDULED, THE FOLLOWING DO NOT REQUIRE INSULATION:
DIRECT BURIED COOLING SYSTEM PIPING

GENERAL NOTES

1. 'X' OR THICKNESS IN INCHES INDICATES ACCEPTABLE SELECTION. IF MORE THAN ONE SELECTION IS INDICATED, CONTRACTOR MAY SELECT FROM THOSE INDICATED SELECTIONS.
2. INSULATE PIPING WITHIN AIR HANDLING EQUIPMENT THE SAME AS INDOOR PIPING. PROVIDE ALUMINUM OR STAINLESS STEEL JACKET.
3. FOR PIPING NPS 1-1/4 AND SMALLER WITHIN PARTITIONS IN CONDITIONED SPACES INSULATION MAY BE REDUCED BY ONE-INCH THICKNESS, BUT NOT TO LESS THAN ONE-INCH THICKNESS.
4. FOR PIPING NPS 1 AND SMALLER, INSULATION IS NOT REQUIRED FOR STRAINERS, CONTROL VALVES, AND BALANCING VALVES.

KEYED NOTES

A. PROVIDE FIELD APPLIED JACKET FOR PIPING EXPOSED IN EQUIPMENT ROOMS, STORAGE ROOMS, JANITORS CLOSETS, RECEIVING ROOMS, TEST AREAS, CIRCULATION AREAS AND SUCH AREAS SUBJECT TO DAMAGE WITHIN 10 FEET (3 METERS) OF FINISHED FLOOR.

DUCT SYSTEM APPLICATION SCHEDULE

AIR SYSTEMS	DUCT MATERIAL: G90 GALV. SHEET METAL	DOUBLE-WALL LINED G90 GALV. SHEET METAL (SOLID INNER WALL)	DOUBLE-WALL LINED G90 GALV. SHEET METAL (PERF. INNER WALL)	G90 GALV. SHEET METAL WITH 1-INCH LINING	GALVANNEALED SHEET METAL	ALUMINUM	TYPE 304 STAINLESS STEEL	TYPE 316 STAINLESS STEEL	PVC COATED GALV. SHEET METAL (4X1)	PVC COATED GALV. SHEET METAL (1X4)	PVC COATED GALV. SHEET METAL (4X4)	16 GA. CARBON STEEL	ZERO-CLEARANCE PREFABRICATED RANGE HOOD EXHAUST DUCT	FABRIC	DESIGN PRESSURE CLASS (INCHES WG)	SEAL CLASS	MAX. ALLOWABLE LEAKAGE RATE (PERCENT)	KEYED NOTES
SUPPLY AIR WITHOUT TERMINAL UNITS	X														+2	A	5	
RETURN AIR WITHOUT TERMINAL UNITS	X														−2	A	5	
EXHAUST AIR WITHOUT TERMINAL UNITS	X														−2	A	5	
KITCHEN EXHAUST (NON-COMMERCIAL)							X								−2	N/A	N/A	C
LOCKER ROOM AND WET AREA EXHAUST						X	X								−2	A	5	
AIR TRANSFER DUCT				X											+2	A	5	
RELIEF AIR DOWNSTREAM OF FANS	X														+6	A	5	
OUTSIDE AIR AND MIXED AIR DUCT	X														−6	A	5	

GENERAL NOTES

1. 'X' INDICATES ACCEPTABLE SELECTION. IF MORE THAN ONE SELECTION IS INDICATED FOR A DUCT SYSTEM, CONTRACTOR MAY SELECT FROM THOSE INDICATED SELECTIONS.
2. 4 X 1 PVC-COATED GALVANIZED STEEL: FACTORY-APPLIED PVC COATINGS SHALL BE 4 MILS (0.10 MM) THICK ON EXTERIOR SHEET METAL SURFACES OF DUCTS AND FITTINGS EXPOSED TO CORROSIVE CONDITIONS AND MINIMUM 1 MIL (0.025 MM) THICK ON INTERIOR SURFACES.
3. 1 X 4 (4 X 1 REVERSE COATED) PVC-COATED GALVANIZED STEEL: FACTORY-APPLIED PVC COATINGS SHALL BE 4 MILS (0.10 MM) THICK ON INTERIOR SHEET METAL SURFACES OF DUCTS AND FITTINGS EXPOSED TO CORROSIVE CONDITIONS AND MINIMUM 1 MIL (0.025 MM) THICK ON EXTERIOR SURFACES.
4. 4 X 4 PVC-COATED GALVANIZED STEEL: FACTORY-APPLIED PVC COATINGS SHALL BE 4 MILS (0.10 MM) THICK ON SHEET METAL SURFACES OF DUCTS AND FITTINGS EXPOSED TO CORROSIVE CONDITIONS AND 4 MILS (0.10 MM) THICK ON OPPOSITE SURFACES.

KEYED NOTES

A. SCREWS, DAMPERS, OR PROJECTIONS OF ANY TYPE ON INTERIOR OF DUCT SURFACE ARE PROHIBITED.
B. DUCT SHALL BE LINED WITHIN 25 FEET UPSTREAM OF FANS.
C. ALL WELDED CONSTRUCTION.

DUCT SYSTEM INSULATION APPLICATION SCHEDULE

	INSULATION MATERIAL & THICKNESS (INCHES): FIBERGLASS BLANKET 0.75 LB/CU FT	FIBERGLASS BLANKET 1.0 LB/CU FT	FIBERGLASS BOARD 2.25 LB/CU FT	FIBERGLASS BOARD 6.0 LB/CU FT	FLEXIBLE ELASTOMERIC	ASTM E2336 2-HOUR FIRE RATED BLANKET	2-HOUR FIRE RATED BLANKET	FIELD APPLIED JACKET MATERIAL: ALUMINUM	SELF-ADHESIVE (FOR OUTDOOR APPLICATIONS)	KEYED NOTES
DUCT SYSTEMS LOCATED INDOORS										
SUPPLY AIR, EXCEPT AS NOTED BELOW		1.5								A, E
RECTANGULAR SUPPLY AIR IN MECHANICAL ROOMS			1.5							
ROUND & FLAT OVAL SUPPLY AIR IN MECHANICAL ROOMS		1.5								
RECTANGULAR RETURN AIR IN MECHANICAL EQUIPMENT ROOMS			1.5							
OUTSIDE AIR AND MIXED AIR, EXCEPT AS NOTED BELOW		1.5								
RECTANGULAR OUTSIDE AIR AND MIXED AIR IN MECHANICAL ROOMS			1.5							
KITCHEN EXHAUST AIR (TYPE II HOODS)		1.5								

PLENUMS, DUCTS, AND DUCT ACCESSORIES NOT REQUIRING INSULATION:
- FIBROUS-GLASS DUCTS
- DOUBLE-WALL METAL DUCTS WITH INSULATION OF SUFFICIENT THICKNESS TO COMPLY WITH ENERGY CODE AND ASHRAE/IESNA 90.1 – 2013
- METAL DUCTS WITH DUCT LINER OF SUFFICIENT THICKNESS TO COMPLY WITH ENERGY CODE AND ASHRAE/IESNA 90.1 – 2013
- FABRIC SUPPLY DUCTS
- FACTORY-INSULATED FLEXIBLE DUCTS
- FACTORY-INSULATED PLENUMS AND CASINGS
- FLEXIBLE CONNECTORS
- VIBRATION-CONTROL DEVICES
- FACTORY-INSULATED ACCESS PANELS AND DOORS

GENERAL NOTES

1. 'X' OR THICKNESS IN INCHES INDICATE ACCEPTABLE SELECTION. IF MORE THAN ONE SELECTION IS INDICATED FOR A DUCT SYSTEM, CONTRACTOR MAY SELECT FROM THOSE INDICATED SELECTIONS.
2. REFER TO METAL DUCT SECTION OF SPECIFICATIONS FOR DUCT LINING AND DOUBLE-WALL INSULATED DUCT.
3. REFER TO HVAC CASINGS SECTION OF SPECIFICATIONS FOR DOUBLE-WALL INSULATED PLENUMS.

KEYED NOTES
A. INCLUDE INSULATION AROUND DUCT MOUNTED COILS AND AIR TERMINAL UNIT COILS.
E. EXPOSED SUPPLY DUCTWORK LOCATED IN A CONDITIONED SPACE SERVED BY THE SAME AIR HANDLING SYSTEM IS NOT REQUIRED TO BE INSULATED.

SCHEDULES GENERAL NOTES:

TYPICAL FOR ALL SCHEDULE SHEETS:

1. REFER TO ELECTRICAL STANDARD SCHEDULES, ONE LINE DIAGRAM AND PANEL SCHEDULES FOR ADDITIONAL ELECTRICAL INFORMATION
2. PROVIDE THE FOLLOWING FACTORY-WIRED ELECTRICAL OPTIONS/ACCESSORIES WHERE INDICATED IN SCHEDULE:
   - A – NON-FUSED DISCONNECT SWITCH
   - B – UNIT SHALL BE SINGLE POINT ELECTRICAL CONNECTION WITH FACTORY INSTALLED DISCONNECTING MEANS AND ALL REQUIRED STARTERS AND CONTROLS
   - C – SERVICE RECEPTACLE
   - D – FUSED DISCONNECT SWITCH
   - E – COMBINATION STARTER
   - F – UNIT SHALL HAVE (2) SINGLE POINT CONNECTIONS WITH FACTORY INSTALLED DISCONNECTING MEANS AND ALL REQUIRED STARTERS AND CONTROLS. (1) CONNECTION SHALL BE FOR CONDENSING SECTION AND (1) CONNECTION SHALL BE FOR THE REMAINDER OF THE UNIT.
3. FOR MODULATION/CONTROL TYPE COLUMN, "VFC" INDICATES VARIABLE FREQUENCY CONTROLLERS, "AUTO" INDICATES AUTOMATIC OPERATION (CONTROLLED BY TEMPERATURE CONTROLS OR SELF CONTAINED CONTROLS), "MANUAL" INDICATES HAND OPERATION.
4. IF VARIABLE FREQUENCY CONTROLLERS ARE INDICATED TO BE PROVIDED AND ARE NOT INSTALLED INTEGRAL TO THE UNIT, VARIABLE FREQUENCY CONTROLLERS SHALL BE SUPPLIED BY THE MECHANICAL CONTRACTOR (UNLESS OTHERWISE NOTED) AND INSTALLED BY THE ELECTRICAL CONTRACTOR INCLUDING THE LINE SIDE AND LOAD SIDE WIRING TO THE MOTOR AND INCLUDING MISCELLANEOUS STEEL REQUIRED FOR THE SUPPORT AND MOUNTING OF THE VFC. REFER TO FLOOR PLANS FOR LOCATION.
5. WHERE EQUIPMENT IS INDICATED TO HAVE A SINGLE POINT ELECTRICAL CONNECTION, THAT EQUIPMENT SHALL COME COMPLETE WITH FACTORY INSTALLED STARTERS, MOTOR OVERLOAD PROTECTION, CONTACTORS, FUSING AND ALL NECESSARY INTERNAL WIRING AND CONTROLS. PROVIDE A FACTORY MOUNTED UNIT DISCONNECTING MEANS WHERE THE ELECTRICAL CONTRACTOR SHALL MAKE SINGLE POINT CONNECTION. INSTALL PACKAGED EQUIPMENT SUCH THAT THE ELECTRICAL CONNECTION AND CONTROLS ARE ACCESSIBLE AND HAVE CLEARANCES MEETING THE NATIONAL ELECTRICAL CODE.
6. WHERE PACKAGED EQUIPMENT IS PROVIDED, NAMEPLATE MUST INDICATE MAXIMUM OVERCURRENT PROTECTION BY HACR RATED CIRCUIT BREAKERS OR FUSES. IF FUSE PROTECTION ONLY IS INDICATED, PROVIDE A FUSIBLE DISCONNECT AND FUSES WITH THE UNIT.
7. WHERE EQUIPMENT IS DESIGNATED BY MANUFACTURER AND MODEL NUMBER, THIS IS THE BASIS OF DESIGN. IF THE CONTRACTOR ELECTS TO PROVIDE EQUIPMENT BY OTHER SPECIFIED MANUFACTURERS OR PROPOSED ALTERNATE EQUIPMENT BY THE BASIS OF DESIGN MANUFACTURER, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY REVISIONS TO ELECTRICAL REQUIREMENTS, STRUCTURAL LOADING, OR ARCHITECTURAL APPURTENANCES AND SHALL INCLUDE THE COST OF SUCH REVISIONS IN HIS BID.
8. WHERE EQUIPMENT IS SCHEDULED TO INCLUDE A SERVICE RECEPTACLE, PROVIDE A FACTORY MOUNTED SERVICE RECEPTACLE WITH APPROPRIATE FUSES AND TRANSFORMERS CONNECTED ON THE LINE SIDE OF THE UNIT DISCONNECT. PROVIDE A NAMEPLATE ON THE DISCONNECT SWITCH INDICATING THE PRESENCE OF LIVE POWER TO THE SERVICE RECEPTACLE WHEN THE UNIT DISCONNECT IS IN THE OFF POSITION.
9. SIZE ALL EQUIPMENT FEEDERS BASED ON THE LISTED MOP (MAXIMUM OVERCURRENT PROTECTION). REFER TO THE FEEDER AND BRANCH CIRCUIT SIZING SCHEDULE ON THE ELECTRICAL STANDARD SCHEDULES SHEET.

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ENGINEER
No. 620106818
REGISTERED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: ACF Checked: ACF

City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

MECHANICAL SCHEDULES

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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Sheet M7.01

GRILLE, REGISTER, AND DIFFUSER SCHEDULE

UNIT IDENTIFICATION	TYPE	FACE SIZE	NECK SIZE	FRAME TYPE	ACCESSORY	CONSTRUCTION	FINISH	MODEL NUMBER	KEYED NOTES
S-1A	DIFFUSER	24x2 SLOTS	SEE PLAN	LAY IN	INSULATED PLENUM WITH REMOTE BALANCING DAMPER	ALUMINUM	WHITE	ML39	1
S-1B	DIFFUSER	48x2 SLOTS	SEE PLAN	LAY IN	INSULATED PLENUM WITH REMOTE BALANCING DAMPER	ALUMINUM	WHITE	ML39	1
S-1C	DIFFUSER	48x2 SLOTS	SEE PLAN	DUCT MOUNTED TYPE 16 BORDER	---	ALUMINUM	WHITE	ML39	2
S-2	VAV DIFFUSER	24x24	SEE PLAN	LAY IN	DISIO DISPLAY	STEEL	WHITE	PRICE VARITHERM VPD-C	
S-3	REGISTER	D+1-3/4	SEE PLAN	DUCT MOUNTED	OPPOSED BLADE DAMPER	ALUMINUM	WHITE	S300FL	
S-4	NOZZLE DIFFUSER	---	SEE PLAN	DUCT MOUNTED	---	ALUMINUM	WHITE	TND-AA	
S-5	DIFFUSER	24x24	SEE PLAN	LAY IN	---	STEEL	WHITE	PAS	
S-6	GRILLE	D+1-3/4	SEE PLAN	DUCT MOUNTED	---	STEEL	WHITE	300RL	
R-1A	GRILLE	24x24	22x22	LAY IN	---	STEEL	WHITE	PAR	
R-1B	GRILLE	12x12	10x10	LAY IN	---	STEEL	WHITE	PAR	
R-1C	GRILLE	24x12	22x10	LAY IN	---	STEEL	WHITE	PAR	
R-2	GRILLE	D+1-3/4	SEE PLAN	DUCT MOUNTED	---	STEEL	WHITE	350RL	
E-1A	GRILLE	12x12	SEE PLAN	LAY IN	---	STEEL	WHITE	PAR	
E-1B	GRILLE	24x24	SEE PLAN	LAY IN	---	STEEL	WHITE	PAR	
E-2	GRILLE	D+1-3/4	SEE PLAN	DUCT MOUNTED	---	STEEL	WHITE	350RL	

GENERAL NOTES:
1. MODEL NUMBERS ARE TITUS UNLESS OTHERWISE NOTED.

KEYED NOTES:
1. PROVIDE PLASTER FRAME WHERE INSTALLED IN HARD LID CEILING.
2. PROVIDE ROUND DUCT MOUNT FRAME.

VIBRATION ISOLATOR APPLICATION SCHEDULE

EQUIPMENT TYPE	EQUIPMENT CATEGORY	HORSEPOWER AND OTHER	RPM	EQUIPMENT LOCATION						KEYED NOTES
				SLAB ON GRADE			UP TO 40 FT (12 M) FLOOR SPAN			
				BASE TYPE	ISOLATOR TYPE	MIN. DEFL., IN. (MM)	BASE TYPE	ISOLATOR TYPE	MIN. DEFL., IN. (MM)	
PUMPS	CLOSE COUPLED	≤7.5 ≥10	ALL ALL	B C	2 3	0.25 (6) 0.75 (19)	C C	3 3	0.75 (19) 1.50 (38)	NOTE 3
	INLINE	5 TO 25 ≥30	ALL ALL	A A	3 3	0.75 (19) 1.50 (38)	A A	3, 8a OR 8b 3, 8a OR 8b	1.50 (38) 2.50 (64)	
	END SUCTION AND DOUBLE SUCTION/SPLIT CASE	≤40 50 TO 125 ≥150	ALL ALL ALL	C C C	3 3 3	0.75 (19) 0.75 (19) 0.75 (19)	C C C	3 3 3	1.50 (38) 2.50 (64) 3.50 (89)	
	PACKAGED PUMP SYSTEMS	ALL	ALL	A	3	0.75 (19)	C	3	2.50 (64)	
BASE MOUNTED HEAT PUMPS, FAN COILS, COMPUTER ROOM UNITS	ALL	ALL	ALL	A	3	0.75 (19)	A	3	1.50 (38)	NOTES 1, 3, 4
SUSPENDED HEAT PUMPS, FAN COILS, CONDENSING UNITS, COMPUTER ROOM UNITS, LOCATED INDOORS.	ALL	ALL	ALL				A OR B	8a OR 8b	1.50 (38)	NOTES 1, 3, 4

GENERAL NOTES:

KEYED NOTES:
1. THRUST RESTRAINTS: PROVIDE THRUST RESTRAINTS BETWEEN FAN DISCHARGE AND DUCT (IN PAIRS, LOCATED ON THE CENTERLINE OF THE DISCHARGE OUTLET OF THE FAN, BRIDGING THE FLEXIBLE DUCT CONNECTOR) FOR ALL FAN HEADS, FOR AXIAL AND CENTRIFUGAL FANS UNITS OPERATING AT 2 INCHES OR GREATER TOTAL STATIC PRESSURE AND AS SHOWN ON DRAWINGS. SPRING DEFLECTION SHALL BE SAME AS THE SUPPORT ISOLATORS.
2. PIPING RISER ISOLATION: PROVIDE PIPE RISER RESILIENT ANCHORS, SPRING MOUNTS AND RESILIENT PIPE GUIDES CAPABLE OF DISTRIBUTING THE LOADS WITHIN THE BUILDING DESIGN LIMITS AT THE SUPPORT POINTS.
3. HORIZONTAL PIPING VIBRATION ISOLATION: PROVIDE TYPE 8a OR 8b SPRING HANGERS FOR PIPING CONNECTED TO VIBRATION ISOLATED EQUIPMENT FOR ALL PIPING IN MECHANICAL ROOMS OR THE FOLLOWING MINIMUM HORIZONTAL DISTANCES FROM THE ISOLATED EQUIPMENT: UP TO 6" – 50 FEET (1 1/2" MINIMUM DEFLECTION), 8" AND LARGER – 100 FEET (2 1/2" MINIMUM DEFLECTION), WHICHEVER IS GREATER, AND AS SHOWN ON DRAWINGS. THE FIRST 4 HANGERS FROM THE ISOLATED EQUIPMENT SHALL BE TYPE 8b.
4. DUCTWORK VIBRATION ISOLATION: PROVIDE TYPE 8a OR 8b SPRING HANGERS FOR DUCTWORK WITH A CROSS SECTION OF 2 SQUARE FEET OR GREATER CONNECTED TO AIR HANDLING UNITS, RETURN OR RELIEF FANS, AND VIBRATION ISOLATED EQUIPMENT FOR ALL SUCH DUCTWORK IN MECHANICAL ROOMS OR FOR A MINIMUM HORIZONTAL DISTANCE OF 100 FEET FROM THE ISOLATED EQUIPMENT, WHICHEVER IS GREATER, AND AS SHOWN ON DRAWINGS (3/4" MINIMUM DEFLECTION).
5. IF SPAN DOES NOT EXCEED 20 FT, SPRING DEFLECTION MAY BE 1.0 IN AND TYPE D BASE MAY BE USED. FOR SPANS GREATER THAN 20 FT, USE SPRING DEFLECTION INDICATED AND TYPE E BASE.

BASE TYPES:

BASE TYPE A – NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT.
BASE TYPE B – STRUCTURAL, STEEL RAILS OR BASE.
BASE TYPE C – CONCRETE INERTIA BASE.
BASE TYPE D – CURB – MOUNTED ALUMINUM BASE WITH 1" DEFL. SPRING ISOLATORS
BASE TYPE E – CURB – MOUNTED STEEL BASE WITH ADJUSTABLE 1", 2" OR 3" DEFL. SPRING ISOLATORS

ISOLATOR TYPES:

ISOLATOR TYPE 1a – ELASTOMERIC ISOLATION PAD.
ISOLATOR TYPE 1b – ELASTOMERIC ISOLATION PAD WITH STEEL LOAD BEARING PLATE.
ISOLATOR TYPE 2 – ELASTOMERIC FLOOR ISOLATOR.
ISOLATOR TYPE 3 – FREE STANDING SPRING FLOOR ISOLATOR.
ISOLATOR TYPE 4 – RESTRAINED SPRING ISOLATOR.
ISOLATOR TYPE 5 – THRUST RESTRAINT.
ISOLATOR TYPE 6 – AIR SPRING.
ISOLATOR TYPE 7 – ELASTOMERIC HANGERS.
ISOLATOR TYPE 8a – SPRING HANGERS.
ISOLATOR TYPE 8b – SPRING HANGERS WITH VERTICAL-LIMIT STOP.

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021-0121

STATE OF MICHIGAN
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Sheet M7.02

PUMP SCHEDULE

UNIT IDENTIFICATION		SYSTEM SERVED	LOCATION	TYPE	COUPLING TYPE	WATERFLOW GPM	FLUID TYPE	COLDEST SYSTEM OPERATING TEMP. °F. FOR PUMP SELECTION	PUMP HEAD FT.	MINIMUM EFFICIENCY %	MOTOR			MODULATION / CONTROL TYPE	ELECTRICAL				MODEL NUMBER	KEYED NOTES
DES.	NO.										BHP	HP	RPM		VOLTS	PHASE	SCCR KA (NOTE 4)	OPTIONS / ACCESSORIES		
HPLP	1	GEOTHERMAL	MECH 203	VERTICAL INLINE	CLOSED	52	WATER	40	74	51	1.9	3	1739	VFC	208	3	5	---	E-80 1.5X1.5X9.5B	
HPLP	2	GEOTHERMAL	MECH 203	VERTICAL INLINE	CLOSED	52	WATER	40	74	51	1.9	3	1739	VFC	208	3	5	---	E-80 1.5X1.5X9.5B	

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBER ARE BELL & GOSSETT UNLESS OTHERWISE NOTED.
3. FLUID TYPE: W = WATER, PGXX = PROPYLENE GLYCOL SOLUTION XX PERCENTAGE OF GLYCOL, EGXX = ETHYLENE GLYCOL SOLUTION XX PERCENTAGE OF GLYCOL.
4. CONTROLLER (E.G. VARIABLE FREQUENCY CONTROLLER, MOTOR STARTER) FOR SPECIFIED EQUIPMENT SHALL BE MANUFACTURED AND MARKED PER NEC WITH A MINIMUM SHORT CIRCUIT CURRENT RATING AS INDICATED.

HVAC SYSTEM EXPANSION TANK SCHEDULE

UNIT IDENTIFICATION		SYSTEM SERVED	ESTIMATED TOTAL SYSTEM VOLUME GALLON	TYPE	FLUID TYPE	SYSTEM FILL VALVE OR GLYCOL PUMP PRESSURE SETTING PSIG	OPERATING PRESSURES AT EXPANSION TANK		SYSTEM OPERATING TEMPERATURES		EXPANSION VOLUME GALLONS	ACCPETANCE FACTOR	MINIMUM TANK VOLUME GALLONS	DIMENSIONS		MODEL NUMBER	KEYED NOTES
DES.	NO.						PRE-CHARGE PSIG	MAX (OPERATING) PSIG	MINIMUM °F	MAXIMUM °F				DIAMETER INCHES	HEIGHT INCHES		
ET	1	GEOTHERMAL	1400	DIAPHRAGM	W	12	18	51	35	95	12	0.5	25	20	30	B-100	

GENERAL NOTES:
1. MODEL NUMBERS ARE BELL & GOSSETT UNLESS OTHERWISE NOTED.
2. THE CONTRACTOR SHALL PRE-CHARGE THE TANK TO THE VALUE INDICATED IN THE SCHEDULE. FOR TANKS THAT ARE SUPPLIED PRE-CHARGED BY THE MANUFACTURER, THE CONTRACTOR SHALL CONFIRM THE PRESSURE AND MAKE ADJUSTMENTS AS REQUIRED.
3. FLUID TYPE: W = WATER, PGXX = PROPYLENE GLYCOL SOLUTION XX PERCENTAGE OF GLYCOL, EGXX = ETHYLENE GLYCOL SOLUTION XX PERCENTAGE OF GLYCOL.

AIR & DIRT SEPARATOR SCHEDULE

UNIT IDENTIFICATION		INLET PIPE SIZE	OUTLET PIPE SIZE	MAX SYSTEM FLOW (GPM)	MAX PRESSURE DROP CLEAN (FT HD.)	BUNDLE REMOVAL CLEARANCE NOTE 3 (INCHES)	OPERATING WEIGHT (LBS)	MODEL NO.	KEYED NOTES
DES.	NO.								
AS	1	2	2	52	0.60	16	107	VDN	

GENERAL NOTES:
1. MODEL NUMBERS ARE SPIROTHERM UNLESS OTHERWISE NOTED.
2. SEPARATOR FLANGE CONNECTION MUST BE A MINIMUM OF THE PIPE DIAMETER SIZE OF WHICH THE SEPARATOR IS INSTALLED.
3. MINIMUM BUNDLE REMOVAL CLEARANCE IS MEASURED FROM CENTERLINE OF INLET/OUTLET PIPING. PROVIDE CLEARANCE BELOW UNIT TO DIMENSION LISTED TO ALLOW REMOVAL OF HEAD AND ELEMENT BUNDLE.
4. REFER TO PUMP SCHEDULE FOR SYSTEM FLOW.

WATER SOURCE HEAT PUMP SCHEDULE

			FAN			LOOP WATER			COOLING MODE (85 °F ENT. WATER TEMP.)					HEATING MODE (40 °F ENT. WATER TEMP.)					COMPRESSORS				FILTER				ELECTRICAL							
									AIR		TOTAL			AIR		TOTAL																		
DES.	NO.	NOMINAL SIZE (TONS)	AIRFLOW CFM	ESP IN. W.G.	HP	FLOW GPM	FLUID TYPE	MAX W.P.D. FT. HEAD	E.A.T. °F	L.A.T. °F	CAPACITY MBH	THR MBH	MINIMUM E.E.R.	E.A.T. °F	L.A.T. °F	CAPACITY MBH	THA MBH	MINIMUM C.O.P.	NO. OF COMP.	R.L.A. EA.	L.R.A. EA.	ARRANGEMENT	FILTER TYPE	MERV	CLEAN FILTER P.D.	DIRTY FILTER P.D.	VOLTS	PHASE	FLA	MOP	SCCR KA	OPTIONS / ACCESSORIES	MODEL NUMBER	KEYED NOTES
WAHP	1	1.5	650	0.8	0.25	5	W	13.8	78	55	19.5	23.4	17	65	80	14	10.1	3.6	1	7.4	33	HORIZONTAL	THROWAWAY	13	0.30	1.00	208	1	9.2	15	5	B	50PC	
WAHP	2	3.5	1380	0.6	0.50	10	W	31.4	78	55	42.1	50.8	16.6	65	80	29	20.5	3.4	1	11.2	84	HORIZONTAL	THROWAWAY	13	0.30	1.00	208	3	15.6	25	5	B	50PC	
WAHP	3	1	375	0.5	0.10	3	W	15	78	55	11.8	14.7	14.1	65	80	8.7	6	3.2	1	4.6	27.9	HORIZONTAL	THROWAWAY	13	0.30	1.00	208	1	5.6	15	5	B	50PC	
WAHP	4	2	850	0.5	0.25	6	W	24.2	78	55	25.8	30.8	17.7	65	80	17.7	12.8	3.6	1	7.1	55.4	HORIZONTAL	THROWAWAY	13	0.30	1.00	208	3	8.9	15	5	B	50PC	
WAHP	5	3	1200	0.2	0.50	9	W	22.5	78	55	38.8	46.5	17.1	65	80	26.7	19.3	3.6	1	10.4	73	HORIZONTAL	THROWAWAY	13	0.30	1.00	208	3	14.8	25	5	B	50PC	
WAHP	6	6	2100	0.5	0.75	16	W	29.2	78	55	67.6	81.5	16.6	65	80	50	35.7	3.5	1	19.2	136	HORIZONTAL	THROWAWAY	13	0.30	1.00	208	3	24.7	45	5	B	50PC	
WAHP	7	1	375	0.1	0.10	3	W	15	78	55	11.8	14.7	14.1	65	80	8.7	6	3.2	1	4.6	27.9	HORIZONTAL	THROWAWAY	13	0.30	1.00	208	1	5.6	15	5	B	50PC	

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBERS ARE CARRIER UNLESS OTHERWISE NOTED.
3. FLUID TYPE: W = WATER, PGXX = PROPYLENE GLYCOL SOLUTION XX PERCENTAGE OF GLYCOL, EGXX = ETHYLENE GLYCOL SOLUTION XX PERCENTAGE OF GLYCOL.
4. INTERNAL STATIC PRESSURE VALUE SHALL INCLUDE WET COIL PRESSURE DROP, EXTERNAL PRESSURE INCLUDES DIRTY FILTER PRESSURE DROP AS SCHEDULED.

KEYED NOTES:
1. PROVIDE HEAT PUMP LOOP MOTORIZED ISOLATION VALVE.

ENERGY RECOVERY UNIT SCHEDULE (A)

UNIT IDENTIFICATION		SUPPLY FAN						EXHAUST FAN					HEAT EXCHANGER (SUMMER)						HEAT EXCHANGER (WINTER)					
						MOTOR					MOTOR		SUPPLY SIDE			EXHAUST SIDE			SUPPLY SIDE			EXHAUST SIDE		
DES.	NO.	CFM	MIN. OA CFM	ESP"	CONROL TYPE	BHP	HP	CFM	ESP"	CONTROL TYPE	BHP	HP	E.A.T. °F	L.A.T. °F	A.P.D. IN. WG.	E.A.T. °F	L.A.T. °F	EFFIC. (%)	E.A.T. °F	L.A.T. °F	A.P.D. IN. WG.	E.A.T. °F	L.A.T. °F	EFFIC. (%)
ERV	1	1930	1930	0.50	AUTO	0.9	1	1770	0.75	AUTO	1.1	1.5	90	84	1.50	80	86	50	-2	34	1.50	60	22	50

ENERGY RECOVERY UNIT SCHEDULE (B)

UNIT IDENTIFICATION		OUTSIDE AIR FILTERS		RETURN FILTERS		SA/RA CONFIG.	EA/OA CONFIG.	ELECTRICAL						MODEL NUMBER	KEYED NOTES
DES.	NO.	MERV	SP" TOTAL	MERV	SP" TOTAL			VOLTS	PHASE	FLA	MOP	SCCR KA	OPTIONS/ ACCESSORIES		
ERV	1	13	0.65	8	0.65	END/END	TOP/END	208	1	16	20	5	B	ECV-20-P	

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBERS ARE GREENHECK UNLESS OTHERWISE NOTED.
3. COORDINATE UNIT CONFIGURATION WITH PLANS IN ORDER TO ALLOW FOR PROPER SERVICE ACCESS.
4. DESIGN MINIMUM OUTSIDE AIRFLOW CFM (VENTILATION) LISTED IS BASED ON THE ESTIMATED MAXIMUM OCCUPANT LOAD.
5. REFER TO TEMPERATURE CONTROL DRAWINGS FOR OUTSIDE AIR CONTROL SEQUENCE.

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021.0121

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Sheet M7.11

ELECTRIC CENTRIFUGAL FAN CABINET UNIT HEATER SCHEDULE

UNIT IDENTIFICATION			AIR			HEATING ELEMENT		DIMENSIONS			RECESS DEPTH INCHES	MODULATION / CONTROL TYPE	ELECTRICAL							
DES.	NO.	CAPACITY MBH	AIRFLOW CFM	E.D.B. °F	L.D.B. °F	1ST STAGE KW	TOTAL KW	LENGTH INCHES	HEIGHT INCHES	DEPTH INCHES			VOLTS	PHASE	FLA	MOP	SCCR KA	OPTIONS / ACCESSORIES	MODEL NUMBER	KEYED NOTES
ECUH	101	15.2	250	40	96	5	5	33	29	9	9	AUTO	208	3	17.6	25	5	B	6333D052033	
ECUH	103	0.5	100	40	45	1	1	9	12	4	0	AUTO	120	1	12.5	20	5	B	E3055T2DWB	
ECUH	116A	61	750	40	115	18	18	66	29	9	9	AUTO	208	3	52.6	70	10	B	6366D182033	
ECUH	116B	77	1000	40	111	24	24	79	29	9	9	AUTO	208	3	70.1	90	10	B	6379D242033	
ECUH	117	1.8	100	40	57	1	1	9	12	4	0	AUTO	120	1	12.5	20	5	B	E3055T2DWB	
ECUH	129	39	750	40	88	12	12	66	29	9	9	AUTO	208	3	40.1	60	10	B	6366D122033	
ECUH	131	0.5	100	40	45	1	1	9	12	4	0	AUTO	120	1	12.5	20	5	B	E3055T2DWB	

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBERS ARE TRANE UNLESS OTHERWISE NOTED.

POWER VENTILATOR SCHEDULE - PART A

UNIT IDENTIFICATION								MOTOR				CURB HEIGHT INCHES	MODULATION / CONTROL TYPE	ELECTRICAL					
DES.	NO.	SYSTEM SERVED	TYPE	AIRFLOW CFM	T.S.P. IN. W.G.	TIP SPEED FPM	FAN RPM	BHP	HP	RPM	DRIVE TYPE			VOLTS	PHASE	SCCR KA (NOTE 3)	OPTIONS / ACCESSORIES	MODEL NUMBER	KEYED NOTES
EF	1	APPARATUS BAY EXHAUST	CENTRIFUGAL UPBLAST	2100	0.50	3486	1224	0.21	0.50	1725	DIRECT	18	ECM	120	1	5	B	CUE-141-VG	
EF	2	TAILPIPE SOURCE CAPTURE	UTILITY SET						5.00	3480	DIRECT	18	AUTO	208	3	5	B	TEV-559-60	1
EF	3	KITCHEN HOOD	CENTRIFUGAL UPBLAST	500	0.50	4139	1300	0.04	0.10	1725	DIRECT	18	ECM	120	1	5	B	CUE-90-VG	2

POWER VENTILATOR SCHEDULE - PART B

UNIT IDENTIFICATION			UNIT INLET Lw BY OCTAVE BAND									
DES.	NO.	SYSTEM SERVED	63 Hz (DB)	125 Hz (DB)	250 Hz (DB)	500 Hz (DB)	1000 Hz (DB)	2000 Hz (DB)	4000 Hz (DB)	8000 Hz (DB)	MODEL NUMBER	KEYED NOTES
EF	1	APPARATUS BAY EXHAUST	70	78	76	70	63	64	56	50	CUE-141-VG	
EF	2	TAILPIPE SOURCE CAPTURE									TEV-559-60	1
EF	3	KITCHEN HOOD	66	66	62	55	52	51	47	40	CUE-90-VG	2

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBERS ARE GREENHECK UNLESS OTHERWISE NOTED.
3. CONTROLLER (E.G. VARIABLE FREQUENCY CONTROLLER, MOTOR STARTER) FOR SPECIFIED EQUIPMENT SHALL BE MANUFACTURED AND MARKED PER NEC WITH A MINIMUM SHORT CIRCUIT CURRENT RATING AS INDICATED.

KEYED NOTES
1. FAN TO BE PROVIDED BY SOURCE CAPTURE SYSTEM MANUFACTURER AS PART OF PACKAGED SYSTEM.
2. FAN OPERATION TO BE CONTROLLED BY HOOD AND INTERLOCKED TO MAU OPERATION. REFER TO CONTROLS DRAWINGS.

ELECTRIC MAKE-UP AIR UNIT SCHEDULE

UNIT IDENTIFICATION			SUPPLY FAN		ELECTRIC HEATING COIL				FILTER SECTION	MAXIMUM UNIT DIMENSIONS			TOTAL UNIT ELECTRICAL							
DES.	NO.	AREA SERVED	AIRFLOW CFM	E.S.P. IN. W.G.	AIR TEMP. E.A.T. °F	AIR TEMP. L.A.T. °F	CAPACITY MBH	COIL SIZE kW	TYPE	LENGTH INCHES	HEIGHT INCHES	WIDTH INCHES	VOLTS	PHASE	FLA	MCA / MOP	SCCR KA	OPTIONS / ACCESSORIES	MODEL NUMBER	KEYED NOTES
MAU	1	KITCHEN HOOD	500	0.20	0	60	32.4	10	PLEATED	44	16	21	208	3	29	0	5	B	FER	

GENERAL NOTES:
1. REFER TO SCHEDULE GENEARL NOTES.
2. MODEL NUMBERS ARE THERMOELEC UNLESS OTHERWISE NOTED
3. DESIGN MINIMUM OUTSIDE AIRFLOW CFM (VENTILATION) LISTED IS BASED ON THE ESTIMATED MAXIMUM OCCUPANT LOAD. REFER TO TEMPERATURE CONTROL DRAWINGS FOR OUTSIDE AIR CONTROL SEQUENCE.

INTAKE HOOD SCHEDULE

UNIT IDENTIFICATION							HOOD SIZE						
DES.	NO.	SYSTEM SERVED	CFM	THROAT SIZE INCHES	THROAT VELOCITY FPM	STATIC PRESSURE DROP IN. W.G.	WIDTH INCHES	LENGTH INCHES	HEIGHT INCHES	CURB HEIGHT INCHES	HOOD CONSTRUCTION	MODEL NUMBER	KEYED NOTES
IH	1	TRANSPIRED COLLECTOR BYPASS	2430	24x24	608	0.10	48	36	19	18	GALVANIZED	FGI-24X24	

GENERAL NOTES:
1. MODEL NUMBERS ARE GREENHECK UNLESS OTHERWISE NOTED.
2. PROVIDE WITH BIRD SCREEN.

ELECTRIC COIL SCHEDULE

UNIT IDENTIFICATION				DUCT SIZE (IN.)					ELECTRICAL					
DES.	NO.	CAPACITY MBH	AIRFLOW CFM	WIDTH	HEIGHT	COIL LOAD kW	FINAL AIR TEMPERATURE °F	MODULATION / CONTROL TYPE	VOLTS	PHASE	SCCR KA	OPTIONS / ACCESSORIES	MODEL NUMBER	KEYED NOTES
EHC	1	63	1900	24	18	18.5	60	SCR	208	3	10	B	IDHE	

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBERS ARE GREENHECK UNLESS OTHERWISE NOTED.

DESTRATIFICATION FAN SCHEDULE

UNIT IDENTIFICATION		FAN DIAMETER INCHES	MOTOR HP	MODULATION / CONTROL TYPE	ELECTRICAL				MODEL NUMBER	KEYED NOTES
DES.	NO.				VOLTS	PHASE	SCCR KA	OPTIONS / ACCESSORIES		
F	1	56	0.1	SOLID STATE	120	1	5	---	56201CLSK	1
F	2	56	0.1	SOLID STATE	120	1	5	---	56201CLSK	1
F	3	56	0.1	SOLID STATE	120	1	5	---	56201CLSK	1

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBERS ARE MARLEY ENGINEERED PRODUCTS UNLESS OTHERWISE NOTED.

KEYED NOTES:
1. PROVIDE SOLID STATE WALL CONTROLLER.

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ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021.0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068185
PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: ACF Checked: ACF

City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

MECHANICAL SCHEDULES

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet M7.12

TEMPERATURE CONTROL - SYMBOLS LIST

SCHEMATIC SYMBOLS

SYMBOL	DESCRIPTION
AFC	AIR FLOW CONTROLLER
AQ	AQUASTAT, STRAP ON BULB
CO2	CARBON DIOXIDE SENSOR – WALL MOUNTED
CO2	CARBON DIOXIDE SENSOR – DUCT MOUNTED
CO	CARBON MONOXIDE SENSOR – WALL MOUNTED
CO	CARBON MONOXIDE SENSOR – DUCT MOUNTED
CS	CURRENT SWITCH
CT	CURRENT TRANSMITTER
	DAMPER – INLET VANES
	DAMPER – OPPOSED BLADE
	DAMPER – PARALLEL BLADE
M	DAMPER MOTOR
M	DAMPER MOTOR W/ POSITIVE POSITIONER
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
DPS	DIFFERENTIAL PRESSURE SWITCH
EP	ELECTRIC–PNEUMATIC RELAY
EPT	ELECTRIC TO PNEUMETIC TRANSDUCER
CM	FIRE ALARM SYSTEM, ADDRESSABLE CONTROL MODULE
IM	FIRE ALARM SYSTEM, ADDRESSABLE INTERFACE MODULE
FMS	FLOW MEASURING STATION
FM	FLOW METER
FS	FLOW SWITCH
FZ	FREEZESTAT
F	GAUGE – FLOW
P	GAUGE – PRESSURE
T	GAUGE – TEMPERATURE
	GUARD FOR STAT OR SENSOR
	HUMIDIFIER
H	HUMIDISTAT OR HUMIDITY SENSOR (AS DEFINED ON TC DRAWINGS)
H	HUMIDITY SENSOR, DUCT MOUNTED
LVL	LEVEL SWITCH OR TRANSMITTER
LS	LIMIT SWITCH
	LINE – ELECTRIC
	LINE – PNEUMATIC
M	MAIN CONTROL AIR SUPPLY
M/S	MOTOR STARTER
OS	OCCUPANCY SENSOR
R	PILOT LIGHT OR BEACON R – RED LENS A – AMBER LENS B – BLUE LENS G – GREEN LENS
PE	PNEUMATIC–ELECTRIC SWITCH
PS	PRESSURE SWITCH
PT	PRESSURE TRANSMITTER
R	RELAY, ELECTRIC
N	SELECTOR SWITCH, (N=NUMBER OF POSITIONS)
AI	SIGNAL – DDC/BAS, ANALOG INPUT
AO	SIGNAL – DDC/BAS, ANALOG OUTPUT
DI	SIGNAL – DDC/BAS, DIGITAL INPUT
DO	SIGNAL – DDC/BAS, DIGITAL OUTPUT
AI	SIGNAL – PACKAGED EQUIPMENT, ANALOG INPUT
AO	SIGNAL – PACKAGED EQUIPMENT, ANALOG OUTPUT
DI	SIGNAL – PACKAGED EQUIPMENT, DIGITAL INPUT
DO	SIGNAL – PACKAGED EQUIPMENT, DIGITAL OUTPUT

SCHEMATIC SYMBOLS (CONT.)

SYMBOL	DESCRIPTION
DD	SMOKE DETECTOR – DUCT MOUNTED
SD	SMOKE DETECTOR – SPACE MOUNTED
S/S	START/STOP RELAY
SPT	STATIC PRESSURE TRANSMITTER
SP	STATIC PRESSURE SENSOR OR PROBE
SW	SWITCH
T	TEMPERATURE SENSOR – RIGID ELEMENT IN WELL
T	TEMPERATURE SENSOR – STRAP ON BULB
T	TEMPERATURE SENSOR – DUCT MOUNTED AVG ELEMENT
T	TEMPERATURE SENSOR – DUCT MOUNTED RIGID ELEMENT
T	THERMOSTAT OR TEMPERATURE SENSOR (AS DEFINED ON TC DRAWINGS)
T N	THERMOSTAT FOR NIGHT SETBACK
TMR	TIMER SWITCH
XF	TRANSFORMER
	VALVE – 2 WAY CONTROL VALVE
	VALVE – 3 WAY CONTROL VALVE
M	VALVE – 2 WAY CONTROL W/ POSITIONER
M	VALVE – 3 WAY CONTROL W/ POSITIONER
VFC	VARIABLE FREQUENCY CONTROLLER
VS	VELOCITY SENSOR
VIB	VIBRATION SWITCH
V	VOLTAGE SENSOR

WIRING SYMBOLS

SYMBOL	DESCRIPTION
	AUDIBLE DEVICE (AS DEFINED ON TC DRAWINGS)
M/S	COIL – MOTOR STARTER CONTACTOR
R	COIL – RELAY
TDR	COIL – TIME DELAY RELAY
VFC	COIL – VARIABLE SPEED DRIVE CONTACTOR
	COIL – EP OR SOLENOID VALVE
	CONTACT – INSTANT OPERATING, NO
	CONTACT – INSTANT OPERATING, NC
	CONTACT – TIMED AFTER COIL IS ENERGIZED, NOTC
	CONTACT – TIMED AFTER COIL IS ENERGIZED, NCTO
	CONTACT – TIMED AFTER COIL IS DE–ENERGIZED, NOTO
	CONTACT – TIMED AFTER COIL IS DE–ENERGIZED, NCTC
	GROUND
	MOTOR, SINGLE PHASE
R	PILOT LIGHT OR BEACON R – RED LENSE A – AMBER LENS B – BLUE LENSE G – GREEN LENS
R	PILOT LIGHT, WITH PUSH–TO–TEST
	PUSH BUTTON – MOMENTARY CONTACT, NO
	PUSH BUTTON – MOMENTARY CONTACT, NC
	PUSH BUTTON – MOMENTARY CONTACT, NO & NC
	PUSH BUTTON – MOMENTARY, NO (MUSHROOM HEAD)
	PUSH BUTTON – MOMENTARY, NC (MUSHROOM HEAD)

WIRING SYMBOLS (CONT.)

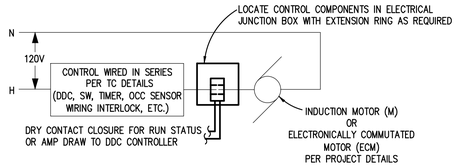
SYMBOL	DESCRIPTION
1 2	SWITCH – 2 POSITION SELECTOR
H O A	SWITCH – 3 POSITION SELECTOR HAND/OFF/AUTO
	SWITCH – FLOW (AIR, WATER, ETC.), NO
	SWITCH – FLOW (AIR, WATER, ETC.), NC
	SWITCH – LIMIT, NO
	SWITCH – LIMIT, NO, HELD CLOSED
	SWITCH – LIMIT, NC
	SWITCH – LIMIT, NC, HELD OPEN
	SWITCH – LIQUID LEVEL, NO
	SWITCH – LIQUID LEVEL, NC
	SWITCH – MANUAL SPST, NO
	SWITCH – MANUAL DPST, NO
	SWITCH – MANUAL SPST, NC
	SWITCH – MANUAL DPST, NC
	SWITCH – MANUAL SPDT
	SWITCH – MANUAL DPDT
	SWITCH – PRESSURE & VACUUM, NO
	SWITCH – PRESSURE & VACUUM, NC
	SWITCH – TEMPERATURE ACTUATED, NO
	SWITCH – TEMPERATURE ACTUATED, NC
	THERMAL OVERLOAD, SINGLE PHASE
OLs	THERMAL OVERLOAD CONTACTS – 3 PHASE
	TRANSFORMER
	WIRE TERMINATION AT DEVICE
	WIRE TO WIRE TERMINATION
	WIRING NOT CONNECTED

ABBREVIATIONS

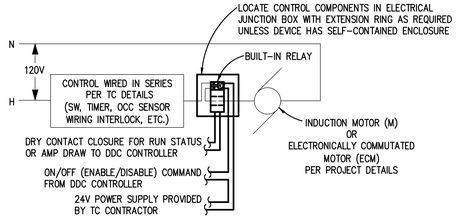
ABBREVIATION	DESCRIPTION
BAS	BUILDING AUTOMATION SYSTEM
DDC	DIRECT DIGITAL CONTROL
TC	TEMPERATURE CONTROLS
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
NOTO	NORMALLY OPEN TIMED OPEN
NOTC	NORMALLY OPEN TIMED CLOSED
NCTO	NORMALLY CLOSED TIMED OPEN
NCTC	NORMALLY CLOSED TIMED CLOSED
SPST	SINGLE POLE SINGLE THROW
SPDT	SINGLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DPDT	DOUBLE POLE DOUBLE THROW

NOTES:

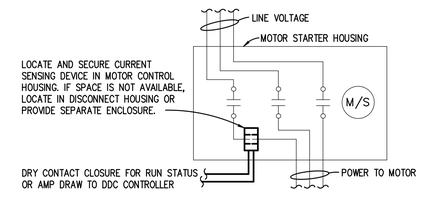
1. SOME SYMBOLS & ABBREVIATIONS SHOWN MAY NOT APPLY TO THIS PROJECT.
2. REFER TO MECHANICAL STANDARDS ON DRAWING M0.1 FOR ADDITIONAL SYMBOLS & ABBREVIATIONS THAT MAY BE USED ON TEMPERATURE CONTROL DRAWINGS.



1-PHASE POWER APPLICATION - DDC MONITORING



1-PHASE POWER APPLICATION - COMBO DDC MONITORING & CONTROL



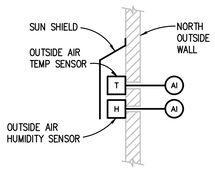
3-PHASE POWER APPLICATION - DDC MONITORING

CURRENT SWITCH INSTALLATION DETAILS

TYPICAL

NOTES:

1. CURRENT SWITCH (CS) OR CURRENT TRANSDUCER (CT) AMP MONITORING AS APPLICABLE PER CONTROL DETAILS SHALL BE INSTALLED FOR DDC SYSTEM STATUS INDICATION OF FAN OR PUMP OPERATION. APPROPRIATE TIME DELAY FOR STATUS FEEDBACK UPON DDC START AND STOP COMMANDS SHALL BE INCLUDED WITH THE DDC LOGIC TO AVOID NUISANCE OPERATIONAL ALARMS.
2. REVIEW EQUIPMENT SHOP DRAWINGS TO DETERMINE POTENTIAL AMPERAGE RANGE OF FAN OR PUMP OPERATION FOR AMPERAGE TRIP SETTING REQUIREMENTS PRIOR TO SELECTING APPROPRIATE CURRENT SWITCH (MINIMUM SPEED AMPERAGE FOR FPTU WITH ECM CAN BE VERY LOW).
3. FOR ECM CURRENT SWITCH APPLICATIONS: PROVIDE CURRENT SWITCH RATED FOR ECM OPERATION WITH AMPERAGE TRIP SETTING HIGHER THAN TRICKLE/IDLE/STANDBY AMPERAGE ASSOCIATED WITH ECM WHEN OFF AND AMPERAGE TRIP SETTING LOWER THAN THE MINIMUM SPEED OPERATION OF FAN OR PUMP AS SET BY THE TAB CONTRACTOR.
4. FOR INDUCTION MOTOR CURRENT SWITCH APPLICATIONS (AS APPLICABLE): AMPERAGE TRIP SETTING SHALL BE ADJUSTABLE TO ACCOMMODATE VFC MINIMUM SPEED SETTING, TO DETECT FAN BELT LOSS, OR TO DETECT PUMP COUPLING DETACHMENT.
5. WHEN FAN OR PUMP IS ON AND NOT IN ALARM, DDC SYSTEM SHALL TOTALIZE RUN TIME HOURS FOR OPERATOR INFORMATION FROM BUILDING AUTOMATION SYSTEM OPERATOR INTERFACE.

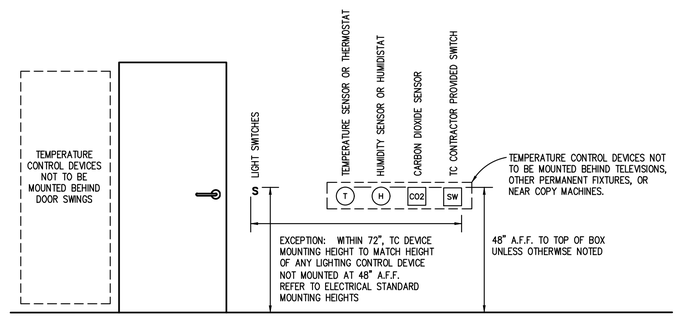


OA SENSOR INSTALLATION DETAIL

NO SCALE

NOTES:

1. TC CONTRACTOR HAS THE OPTION OF USING EXISTING OA TEMP AND HUMIDITY SENSORS AS AVAILABLE FOR BUILDING.
2. CALCULATE OA ENTHALPY OR DEW POINT TEMPERATURE AS REQUIRED PER SEQUENCE OF OPERATION REQUIREMENTS.
3. BROADCAST OUTSIDE AIR TEMPERATURE, HUMIDITY, AND CALCULATED OA ENTHALPY OR DEWPOINT TEMPERATURE, AS REQUIRED, THROUGH BAS COMMUNICATION NETWORK TO CONTROLLERS REQUIRING INFORMATION FOR DDC PROGRAMMING LOGIC.



TC DEVICE STANDARD MOUNTING HEIGHTS DETAIL

NO SCALE

TC GENERAL NOTES

1. THESE GENERAL NOTES SHALL BE APPLICABLE FOR ALL TEMPERATURE CONTROL (TC) DRAWINGS.
2. "PROVIDE" IS DEFINED AS "FURNISH AND INSTALL".
3. TEMPERATURE CONTROLS CONTRACTOR (TC CONTRACTOR) SHALL BE RESPONSIBLE TO COMPLY WITH ALL APPLICABLE CODES AND STANDARDS.
4. FOR TEMPERATURE CONTROL DRAWINGS ONLY: ALL DETAILED INFORMATION IDENTIFIED WITH HEAVY LINE WEIGHT SHALL BE PROVIDED BY TC CONTRACTOR. ALL OTHER INFORMATION IDENTIFIED WITH LIGHT LINE WEIGHT SHALL BE PROVIDED BY OTHER TRADES.
5. ALL CONTROL SCHEMATICS AND WIRING DIAGRAMS ARE FOR THE CLARIFICATION OF EQUIPMENT INTERLOCKING FUNCTIONS AND THE INTERFACE OF VARIOUS CONTRACTORS' WORK AND SHALL NOT BE MISTAKEN AS SHOP DRAWINGS FOR ACTUAL INSTALLATION.
6. TC CONTRACTOR SHALL PROVIDE DDC CONTROLLERS AS REQUIRED TO MEET INTENT OF DESIGN DOCUMENTS. REFER TO THE PLANS FOR THE DDC FUNCTIONS THAT APPLY TO EACH MECHANICAL SYSTEM.
7. ALL TC PROVIDED COMPONENTS AND ALL TC CONTRACTOR INSTALLED WIRING SHALL BE LABELED PER SPECIFICATIONS.
8. ALL WIRING AND SYSTEM CONTROL VOLTAGES SHALL BE IN ACCORDANCE WITH THE EQUIPMENT MANUFACTURER'S RECOMMENDATION AND THE ELECTRICAL SPECIFICATIONS.
9. VARIABLE FREQUENCY CONTROLLER, FAN AND PUMP MOTOR STARTERS, STARTER WIRING, CONTROL VOLTAGE TRANSFORMERS AND ASSOCIATED POWER WIRING SHALL BE PROVIDED BY OTHER TRADES.
10. DUCT SMOKE DETECTORS SHALL BE FURNISHED, INSTALLED AND WIRED TO THE FIRE ALARM SYSTEM BY THE ELECTRICAL CONTRACTOR. ELECTRICAL SHALL PROVIDE FIRE ALARM SYSTEM CONTROL MODULES FOR REQUIRED SAFETIES TO MOTOR STARTERS OR VFC'S AS INDICATED. CONTROL MODULES SHALL BE LOCATED NEAR RESPECTIVE MOTOR STARTERS OR VFCs. TC CONTRACTOR SHALL PROVIDE INTERLOCK WIRING FROM CONTROL MODULES TO MOTOR STARTERS OR VFCs.
11. ALL DDC AND CONTROL INTERLOCK WIRING SHALL BE BY TC CONTRACTOR UNLESS OTHERWISE NOTED. TC CONTRACTOR SHALL COORDINATE WITH VFC AND MOTOR STARTER SUPPLIERS TO DETERMINE EXACT WIRING REQUIREMENTS AND TERMINATION POINTS.
12. ALL DDC AND CONTROL INTERLOCK WIRING BETWEEN COMPONENTS SHALL BE INSTALLED WITHOUT INTERMEDIATE STOPS. WIRE SPLICING AT INTERMEDIATE TERMINAL STRIPS IS NOT ACCEPTABLE.
13. ALL ELECTRICAL WIRING AND RACEWAY SYSTEMS SHALL COMPLY WITH ELECTRICAL SPECIFICATION REQUIREMENTS. WHERE RACEWAY IS REQUIRED, TWO SEPARATE ELECTRICAL RACEWAY SYSTEMS SHALL BE PROVIDED: ONE FOR 120V WIRING AND THE OTHER FOR 24V WIRING.
14. TC CONTRACTOR SHALL BE RESPONSIBLE FOR ALL POWER SUPPLIES REQUIRED FOR TC SYSTEM UNLESS OTHERWISE NOTED. REFER TO ELECTRICAL PANEL SCHEDULES FOR SPARE CIRCUITS OR CIRCUITS DEDICATED TO TEMPERATURE CONTROLS. COORDINATE CIRCUIT USE WITH ELECTRICAL CONTRACTOR.
15. TC CONTRACTOR SHALL VERIFY EXACT LOCATION OF ALL FIELD MOUNTED COMPONENTS.
16. REFER TO TEMPERATURE CONTROLS STANDARD MOUNTING HEIGHTS DETAIL FOR ELEVATIONS OF WALL MOUNTED TEMPERATURE CONTROL DEVICES. PROVIDE WALL MOUNTED DEVICE GUARDS WHERE INDICATED ON TC DETAILS OR AT SPECIFIC LOCATIONS INDICATED ON MECHANICAL FLOOR PLANS.
17. TC CONTRACTOR SHALL PROVIDE AUXILIARY PANELS FOR REQUIRED PANEL MOUNTED EQUIPMENT SUCH AS RELAYS, TRANSDUCERS, CONTROL TRANSFORMERS, ETC. AUXILIARY PANELS SHALL BE LOCATED NEXT TO ASSOCIATED DDC PANEL. DEPENDING ON WIRE QUANTITY OR COMPLEXITY, PROVIDE CONDUITS BETWEEN PANELS OR WIRING THROUGH WITH CONDUIT STUBS ABOVE ALL ASSOCIATED PANELS.
18. REMOTELY MOUNTED FIELD DEVICES SUCH AS RELAYS, CONTROL TRANSFORMERS, ETC., SHALL BE HOUSED IN AN ENCLOSURE PROVIDED BY THE TC CONTRACTOR.
19. CONTROL TRANSFORMERS WHEN REQUIRED SHALL BE SIZED FOR 150% OF ACTUAL LOAD.
20. FREEZESTATS SHALL BE MOUNTED ON UPSTREAM FACE OF COOLING COILS. FREEZESTAT QUANTITY SHALL BE ONE PER 20 SQ. FT OF CROSS SECTIONAL AREA.
21. CURRENT SWITCHES USED FOR OPERATIONAL STATUS SHALL HAVE CURRENT THRESHOLD SETPOINT ADJUSTED TO INDICATE BELT OR DRIVE FAILURE.
22. ALL CONTROL VALVES, CONTROL DAMPERS AND ASSOCIATED CONTROL ACTUATORS IDENTIFIED ON TC DRAWINGS SHALL BE FURNISHED BY TC CONTRACTOR UNLESS OTHERWISE NOTED. DAMPER SIZE AND LOCATIONS ARE INDICATED ON MECHANICAL FLOOR PLAN DRAWINGS.
23. ALL CONTROL VALVES AND DAMPERS FURNISHED BY THE TC CONTRACTOR SHALL BE INSTALLED BY THE MECHANICAL CONTRACTOR. ALL PIPE PENETRATIONS AND BASIC FITTINGS REQUIRED FOR SENSOR INSTALLATIONS SHALL BE PROVIDED BY MECHANICAL CONTRACTOR.
24. DAMPER ACTUATORS SHALL BE INSTALLED BY TC CONTRACTOR WHEN FURNISHED BY TC CONTRACTOR.
25. ALL INSTRUMENTATION TUBING REQUIRED FOR DPS AND DPT COMPONENT INSTALLATIONS SHALL BE PROVIDED BY TC CONTRACTOR.
26. TC CONTRACTOR SHALL FIELD MOUNT ALL REQUIRED "SHIPPED LOOSE" PACKAGED CONTROL COMPONENTS FURNISHED BY EQUIPMENT SUPPLIERS WHERE INDICATED. ALL REQUIRED 24V AND 120V FIELD WIRING SHALL BE PROVIDED BY TC CONTRACTOR UNLESS NOTED OTHERWISE. TC CONTRACTOR SHALL COORDINATE SPECIFIC SYSTEM WIRING REQUIREMENTS WITH PACKAGED EQUIPMENT SUPPLIERS.

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NEW FIRE STATION 4
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TEMPERATURE CONTROL STANDARDS AND GENERAL NOTES

A3C
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115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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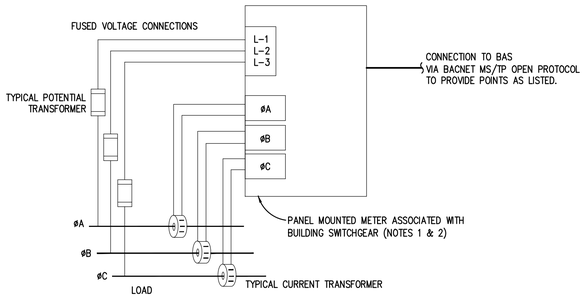
Sheet M8.01



BUILDING ELECTRICAL METERING

NO SCALE

NOTES:

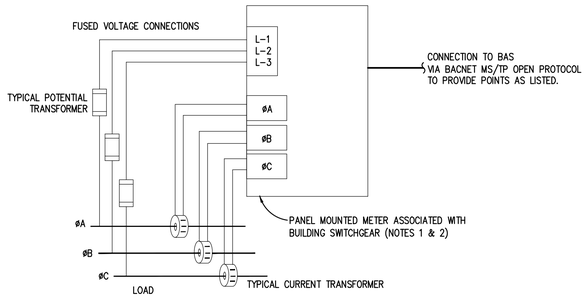
1. APPLICABLE FOR NEW BUILDING ELECTRICAL SUBSTATION INSTALLATIONS. REFER TO ELECTRICAL DETAILS FOR ELECTRICAL SERVICE CAPACITY.
2. METER WITH BACnet INTERFACE CAPABILITY SHALL BE PROVIDED BY ELECTRICAL CONTRACTOR.

SEQUENCE OF OPERATION:

1. METERS SHALL PROVIDE DATA AS REQUIRED FOR THE TWO GRAPHICAL ENERGY DASHBOARDS AS SHOWN ON THIS SHEET.

POINTS LIST:

1. KWH CONSUMPTION
2. KW DEMAND
3. KVAR REACTIVE POWER
4. KVA APPARENT POWER
5. POWER FACTOR
6. VOLTAGE: A TO B, B TO C, A TO C
7. AMPERAGE, EACH PHASE



SOLAR GENERATION METERING

NO SCALE

NOTES:

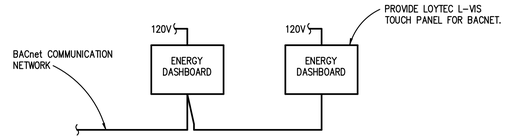
1. APPLICABLE FOR NEW BUILDING ELECTRICAL SUBSTATION INSTALLATIONS. REFER TO ELECTRICAL DETAILS FOR ELECTRICAL SERVICE CAPACITY.
2. METER WITH BACnet INTERFACE CAPABILITY SHALL BE PROVIDED BY ELECTRICAL CONTRACTOR.

SEQUENCE OF OPERATION:

1. METERS SHALL PROVIDE DATA AS REQUIRED FOR THE TWO GRAPHICAL ENERGY DASHBOARDS AS SHOWN ON THIS SHEET.

POINTS LIST:

1. KWH PRODUCTION
2. KVAR REACTIVE POWER
3. KVA APPARENT POWER
4. POWER FACTOR
5. VOLTAGE: A TO B, B TO C, A TO C
6. AMPERAGE, EACH PHASE



GRAPHICAL ENERGY DASHBOARD

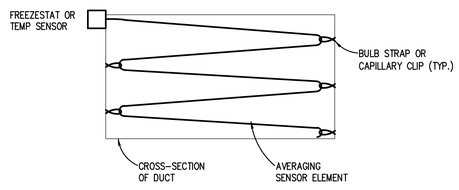
TYPICAL

NOTES:

1. REFER TO MECHANICLA DRAWINGS FOR LOCATION.

SEQUENCE OF OPERATION:

1. DDC SHALL PROVIDE ENERGY DASHBOARD TO INDICATE BUILDING POWER GENERATION AND DEMAND (CURRENT AND TOTALED).
   1.1. TOTALS SHALL BE DAILY, MONTHLY, ANNUALLY, AND LIFETIME.

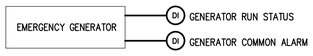


AVERAGING ELEMENT INSTALLATION DETAIL

TYPICAL

NOTES:

1. FREEZESTAT QUANTITY SHALL BE ONE PER 20 SQ. FT. OF CROSS-SECTIONAL AREA.
2. AVERAGING DDC SENSOR QUANTITY SHALL BE SUFFICIENT TO COVER AND SENSE THE CROSS-SECTIONAL AREA.
3. PROVIDE REQUIRED CAPILLARY STRAP OR CLIPS TO SUPPORT SENSOR TO PREVENT VIBRATION FROM AIR MOVEMENT.
4. PROVIDE PROTECTION AT EACH CAPILLARY STRAP OR CLIP TO PREVENT ABRASION TO CAPILLARY.



EMERGENCY GENERATOR MONITORING

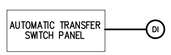
TYPICAL

NOTES:

1. DRY CONTACTS FOR REMOTE SYSTEM MONITORING SHALL BE PROVIDED WITH GENERATOR SYSTEM. COORDINATE WIRING REQUIREMENTS WITH SYSTEM SUPPLIER.
2. REFER TO DRAWINGS FOR GENERATOR SYSTEM SYSTEM PANEL LOCATION.

SEQUENCE OF OPERATION:

1. DDC SHALL MONITOR EACH GENERATOR SYSTEM FOR FOR BAS DISPLAY OF COMMON ALARM AND RUNNING STATUS.



AUTOMATIC TRANSFER SWITCH MONITORING

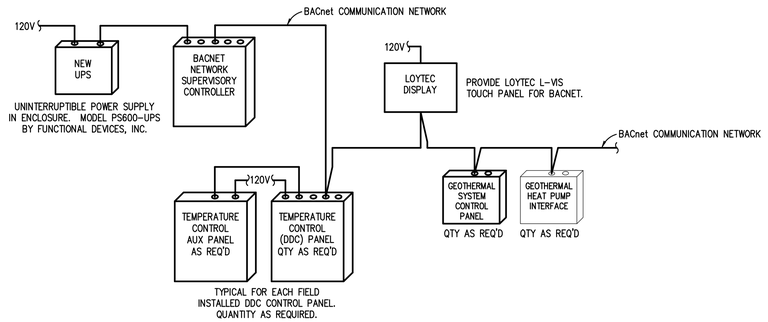
TYPICAL

NOTES:

1. DRY CONTACTS FOR REMOTE TRANSFER SWITCH MONITORING SHALL BE PROVIDED WITH SYSTEM. COORDINATE WIRING REQUIREMENTS WITH SYSTEM SUPPLIER.
2. REFER TO ELECTRICAL DRAWINGS FOR AUTOMATIC TRANSFER SWITCH (ATS) LOCATIONS.

SEQUENCE OF OPERATION:

1. DDC SHALL MONITOR EACH ATS CONTACT FOR BAS DISPLAY INDICATING "ON COMMERCIAL POWER" AND "ON GENERATOR POWER."



DDC SYSTEM ARCHITECTURE

NO SCALE

NOTES:

1. REFER TO TEMPERATURE CONTROL SCHEMATICS FOR THE REQUIRED DDC POINTS ASSOCIATED FOR EACH SYSTEM.
2. THE TC CONTRACTOR SHALL PROVIDE THE BUILDING AUTOMATION SYSTEM (BAS) FOR HVAC SYSTEMS AND ASSOCIATED AND/OR RELATED CONTROLS AND BACNET INTEGRATION OF HVAC AND RELATED SYSTEMS AND EQUIPMENT. THE TEMPERATURE CONTROLS (TC) CONTRACTOR SHALL PROVIDE THE ASSOCIATED COMPONENTS AS INDICATED.
3. TC CONTRACTOR SHALL DETERMINE DDC PANEL QUANTITY BASED ON POINT DENSITIES AND AVAILABLE MOUNTING SPACE, PANEL COMPONENTS, CONFIGURATION AND SIZE REQUIREMENTS WITH THE OWNER'S REPRESENTATIVE (OR ARCHITECT).
4. THE TC CONTRACTOR SHALL COORDINATE TERMINATION REQUIREMENTS FOR POWER SUPPLY TO HVAC SYSTEM CONTROLS AND COMMUNICATION WIRING FOR BAS INTEGRATION TO HVAC AND RELATED SYSTEMS AND EQUIPMENT. TC CONTRACTOR SHALL PROVIDE REQUIRED PROGRAMMING FOR HVAC SYSTEM CONTROLS. TC CONTRACTOR SHALL LOCATE DDC PANELS AND COORDINATE WITH OTHER TRADES.
5. TC CONTRACTOR SHALL PROVIDE REQUIRED 120V POWER SUPPLIES FROM SPARE CIRCUITS IDENTIFIED ON ELECTRICAL PANEL SCHEDULES. COORDINATE WITH ELECTRICAL CONTRACTOR. REFER TO ELECTRICAL DRAWINGS FOR PANEL SCHEDULES AND PANEL LOCATIONS.
6. TC CONTRACTOR SHALL PROVIDE 24V TRANSFORMERS AS REQUIRED FOR DDC CONTROLLERS LOCATED IN MECHANICAL OR ELECTRICAL ROOMS – COORDINATE LOCATIONS. MAXIMUM TRANSFORMER SIZE SHALL BE 100VA. PROVIDE ENCLOSURE(S) FOR TRANSFORMERS.
7. TC CONTRACTOR SHALL BE RESPONSIBLE TO INTEGRATE PROJECT RELATED HVAC CONTROLLERS PROVIDED BY EQUIPMENT MANUFACTURERS AS SHOWN ON M8 DRAWINGS FOR CONTROL BY BUILDING OPERATORS.
8. TC CONTRACTOR SHALL PROVIDE TIME OF DAY SCHEDULING FUNCTIONS, TRENDING, ALARM MONITORING, AND TREND DATA FOR CONTROLLERS THAT REQUIRE THEM.
9. BUILDING DDC NETWORK SHALL BE CONNECTED TO THE LOYTEC DISPLAY FOR OWNER'S USE TO MONITOR SYSTEMS/SUBSYSTEMS, TIME OF DAY SCHEDULES, ALARM REPORTS, CHANGE SETPOINTS, ETC. TC CONTRACTOR SHALL PROVIDE NETWORK COMMUNICATION CONTROLLER PANEL COMPATIBLE FOR THIS CONNECTION.
10. TC CONTRACTOR SHALL PROVIDE INTEGRATION OF 3RD PARTY HVAC EQUIPMENT CONTROLLERS PROVIDED BY HVAC EQUIPMENT MANUFACTURERS.
11. TC CONTRACTOR SHALL PROVIDE AUXILIARY PANEL FOR GAUGES, TRANSMITTERS, RELAYS, POWER TRANSFORMERS, ETC.
12. TC CONTRACTOR SHALL PROVIDE GRAPHICS ASSOCIATED WITH FIELD INSTALLED AND 3RD PARTY BACNET DDC CONTROLLERS FOR THE HVAC SYSTEM AND ASSOCIATED AND/OR RELATED CONTROLS.
13. BACNET NETWORK SUPERVISORY CONTROLLER, GENERATOR ATS MONITOR, AND ECUH CONTROLLER SHALL BE POWERED FROM UPS.

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ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021-0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
PROFESSIONAL ENGINEER

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City Of Ann Arbor
NEW FIRE STATION 4
2415 S. HURON PKWY
ANN ARBOR, MI 48104

TEMPERATURE CONTROLS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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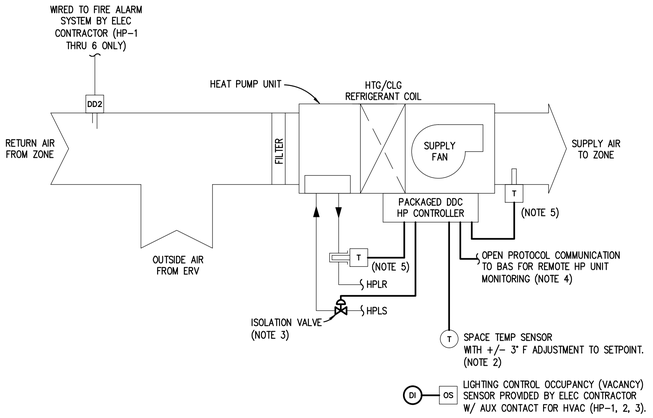


GEOTHERMAL HEAT PUMP UNIT CONTROL

TYPICAL

NOTES:

1. REFER TO SHEET METAL PLANS FOR QUANTITY OF UNITS AND LOCATIONS OF ASSOCIATED ZONE SPACE TEMP SENSORS.
2. SPACE TEMP SENSOR FURNISHED BY HEAT PUMP UNIT SUPPLIER AND FIELD INSTALLED BY TC CONTRACTOR. REFER TO FLOOR PLANS FOR LOCATION.
3. TC CONTRACTOR SHALL PROVIDE CONTROL VALVE FOR WATER SOURCE LOOP ISOLATION VALVE AND WIRE TO PACKAGED CONTROLS. SELECT VALVE TO ACHIEVE THE SCHEDULED FLOW RATE. COORDINATE CONTROL SIGNAL REQUIREMENTS AND TERMINATIONS WITH HEAT PUMP UNIT SUPPLIER.
4. OPEN PROTOCOL COMMUNICATION PREFERENCE IS BACNET.
5. TC CONTRACTOR SHALL FIELD INSTALL DISCHARGE AIR TEMP AND LEAVING WATER TEMP SENSORS FURNISHED BY HEAT PUMP UNIT SUPPLIER. COORDINATE WIRING REQUIREMENTS.

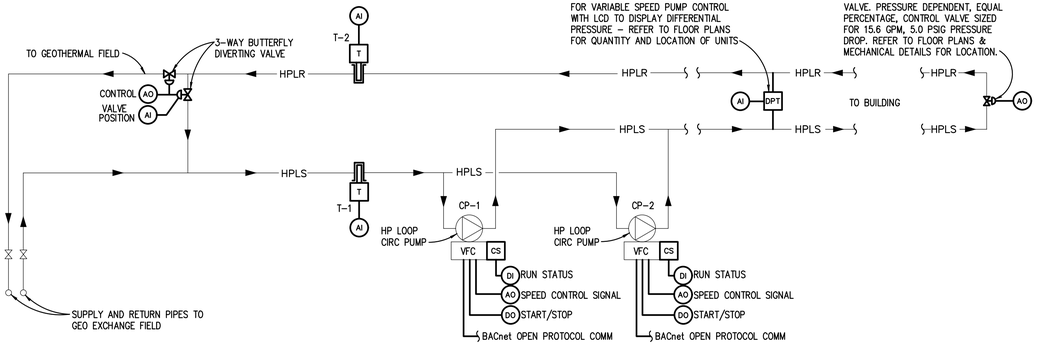
SEQUENCE OF OPERATION – GEOTHERMAL HEAT PUMP UNIT (TYPICAL):

NOTE: HEAT PUMP UNIT SHALL INCLUDE PACKAGED CONTROLS. THE FOLLOWING SEQUENCE DESCRIBES THE BAS INTERFACE AND OTHER INTERLOCKING FUNCTIONS WHERE APPLICABLE.

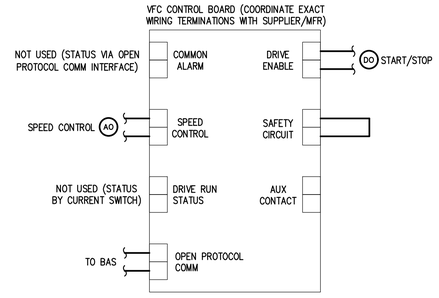
1. HEAT PUMP UNIT FAN SHALL RUN CONTINOUSLY IN OCCUPIED MODE. HEAT PUMP UNIT FAN SHALL CYCLE ON & OFF IN UNOCCUPIED MODE TO MAINTAIN REPSECTIVE ZONE HEATING OR COOLING SETPOINT. BAS SHALL CONTROL OCCUPIED/UNOCCUPIED/STANDBY MODES THRU BAS INTEGRATION BASED ON SCHEDULED OCC/UNOCC SCHEDULING AND OCCUPANCY (VACANCY) SENSOR MONITORING FOR STANDBY MODE. UPON INTEGRATION COMMUNICATION FAILURE, THE HEAT PUMP DEFAULT SHALL BE OCCUPIED MODE.
2. HEAT PUMP UNIT COMPRESSOR SHALL CYCLE ON & OFF TO MAINTAIN RESPECTIVE ZONE HEATING OR COOLING SETPOINT. BAS SHALL CONTROL OCCUPIED/UNOCCUPIED/STANDBY MODES THRU BAS INTEGRATION BASED ON SCHEDULED OCC/UNOCC SCHEDULING AND OCCUPANCY (VACANCY) SENSOR MONITORING FOR STANDBY MODE. UPON INTEGRATION COMMUNICATION FAILURE, THE HEAT PUMP DEFAULT SHALL BE OCCUPIED MODE.
3. WHEN SPACE TEMP RISES ABOVE COOLING SETPOINT, THE HEAT PUMP UNIT CONTROLLER SHALL SWITCH REVERSING VALVE TO COOLING MODE, OPEN WATER SOURCE HEAT PUMP LOOP VALVE AND ACTIVATE COMPRESSOR TO ACHIEVE SETPOINT.
4. WHEN SPACE TEMP FALLS BELOW HEATING SETPOINT; THE HEAT PUMP UNIT CONTROLLER SHALL SWITCH REVERSING VALVE TO HEATING MODE (FAIL SAFE POSITION), OPEN WATER SOURCE HEAT PUMP LOOP VALVE AND ACTIVATE COMPRESSOR TO ACHIEVE SETPOINT.
5. FOR INITIAL SETUP, ZONE SPACE TEMPERATURE (GLOBAL) SETPOINTS SHALL BE AS FOLLOWS:

   HEATING OCCUPIED SETPOINT = 71°F
   HEATING STANDBY SETPOINT = 69°F
   HEATING UNOCCUPIED SETPOINT = 60°F
   COOLING OCCUPIED SETPOINT = 75°F
   COOLING STANDBY SETPOINT = 77°F
   COOLING UNOCCUPIED SETPOINT = 85°F

   OCCUPIED SPACE TEMPERATURE SETPOINTS SHALL BE ADJUSTABLE THRU LOCAL SPACE TEMPERATURE SENSOR. UNOCCUPIED SETPOINTS SHALL BE ADJUSTABLE THRU BAS INTEGRATION
6. HEAT PUMP UNIT CONTROLLER SHALL OVERRIDE COMPRESSOR AS REQUIRED TO PREVENT DISCHARGE AIR TEMPERATURE FROM DROPPING BELOW LOW LIMIT SETPOINT OF 45°F FOR COOLING MODE AND 65°F FOR HEATING MODE.
7. WHEN HEAT PUMP IS DEACTIVATED, THE WATER SOURCE HEAT PUMP LOOP VALVE SHALL REMAIN CLOSED.
8. DUCT SMOKE DETECTOR(S) SHALL DEACTIVATE SF AND EF WHEN PRODUCTS OF COMBUSTION ARE DETECTED.
9. HEAT PUMP UNIT DIAGNOSTICS SHALL BE COMMUNICATED TO BAS THROUGH OPEN PROTOCOL CONNECTION. COORDINATE WITH HEAT PUMP UNIT SUPPLIER THE STATUS AND ALARM INFORMATION THAT IS AVAILABLE TO MONITOR.



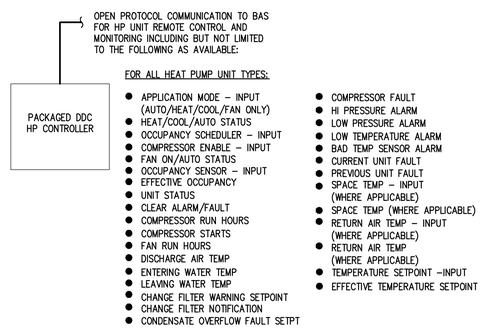
GEO-THERMAL HEAT PUMP LOOP CONTROL



HEAT PUMP LOOP PUMPS CP-1 & 2

TYPICAL

NOTE: WIRING DETAIL IDENTIFIES INTENT AND DOES NOT INDICATE ACTUAL WIRING REQUIREMENTS. CONSULT WITH VFC SUPPLIER FOR THE ACTUAL WIRING REQUIREMENTS.



HEAT PUMP UNIT BAS INTEGRATION

TYPICAL

NOTES:

1. OPEN PROTOCOL COMMUNICATION PREFERENCE IS LONWORKS. BACNET IS ALTERNATIVE CHOICE IF LONWORKS IS NOT AN AVAILABLE OPTION WITH THE HP PACKAGED CONTROLS.
2. COORDINATE WITH HEAT PUMP UNIT SUPPLIER FOR EXACT SETPOINT AND MONITOR POINTS AVAILABLE THROUGH OPEN PROTOCOL INTERFACE FOR EACH SPECIFIC HEAT PUMP UNIT TYPE.

SEQUENCE OF OPERATION

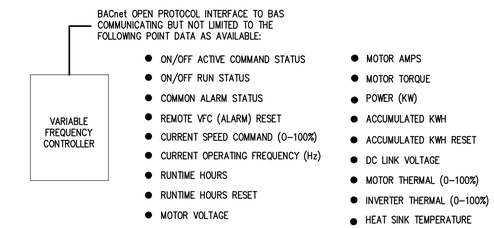
GEOTHERMAL HEAT PUMP LOOP SYSTEM:

NOTE: ALL SETPOINTS AND TIME INTERVALS SETPOINTS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS (CREATE REQUIRED VIRTUAL POINTS).

1. HEAT PUMP LOOP SYSTEM SHALL BE ACTIVATED FOR CONTINUOUS OPERATION DURING BUILDING OCCUPANCY. BUILDING IS OCCUPIED 24/7.
2. HEAT PUMP LOOP CIRC PUMPS CP-1 & 2 SHALL HAVE START/STOP CAPABILITY FROM THE DDC SYSTEM. ONE OF THE TWO PUMPS SHALL BE ACTIVATED BY DDC TO OPERATE CONTINUOUSLY. THE OTHER WILL SERVE AS STANDBY.
3. DDC SHALL ALTERNATE PUMP OPERATION BASED ON RUNTIME HOURS OR AT THE BEGINNING OF EACH MONTH – OPERATOR SELECTABLE.
4. DDC SHALL MONITOR OPERATING STATUS OF EACH PUMP. UPON PUMP FAILURE, DDC SHALL ACTIVATE FAILURE ALARM AND AUTOMATICALLY START THE STANDBY PUMP.
5. VFC COMMON FAILURE ALARM FOR EACH CIRC PUMP SHALL BE MONITORED BY DDC THRU BACNET OPEN PROTOCOL COMMUNCIATION AT RESPECTIVE PUMP VFC.
6. DDC SHALL MODULATE THE VARIABLE SPEED DRIVE OF ACTIVATED HEAT PUMP LOOP CIRC PUMP TO MAINTAIN LOOP DIFFERENTIAL PRESSURE SETPOINT TO BE DETERMINED AT SYSTEM BALANCING.
7. HEAT PUMP LOOP SUPPLY TEMPERATURE MAY VARY BETWEEN 34°F FOR FULL HEATING DEMAND AND 90°F FOR FULL COOLING DEMAND. 3-WAY DIVERTING VALVE CONTROL WITH DEADBAND LOGIC OF 50°F TO 70°F SHALL BE USED TO BYPASS THE GEOTHERMAL FIELD FOR INCREASED ENERGY EFFICIENCY DURING PERIODS WHEN SIMULTANEOUS HEATING AND COOLING IS REQUIRED WITHIN THE BUILDING. DDC SHALL MODULATE 3-WAY DIVERTING VALVE AS FOLLOWS:

   A. WHEN HEAT PUMP LOOP SUPPLY TEMP (T-1) DROPS BELOW 50°F, DDC SYSTEM SHALL MODULATE THE DIVERTING VALVE WITH DIRECT ACTING CONTROL TO MAINTAIN A HEAT PUMP LOOP SUPPLY TEMP (T-1) OF 50°F. WHEN LOOP SUPPLY TEMP DROPS BELOW SETPOINT, BYPASS VALVE SHALL BE MODULATED OPEN TO GEOTHERMAL FIELD. WHEN LOOP SUPPLY TEMP RISES ABOVE SETPOINT, BYPASS VALVE SHALL BE MODULATED CLOSED TO BYPASS GEOTHERMAL FIELD.

   B. WHEN HEAT PUMP LOOP SUPPLY TEMP (T-1) RISES ABOVE 70°F, DDC SYSTEM SHALL MODULATE THE DIVERTING VALVE WITH REVERSE ACTING CONTROL TO MAINTAIN A HEAT PUMP LOOP SUPPLY TEMP (T-1) OF 70°F. WHEN LOOP SUPPLY TEMP RISES ABOVE SETPOINT, BYPASS VALVE SHALL BE MODULATED OPEN TO GEOTHERMAL FIELD. WHEN LOOP SUPPLY TEMP DROPS BELOW SETPOINT, BYPASS VALVE SHALL BE MODULATED CLOSED TO BYPASS GEOTHERMAL FIELD.
8. DDC SHALL MONITOR 3-WAY DIVERTING VALVE POSITION FOR DIAGNOSTIC PURPOSES.



VFC BACnet INTERFACE & MONITORING REQUIREMENTS

TYPICAL FOR NEW FAN & PUMP VFCs

NOTE:

TC CONTRACTOR SHALL COORDINATE BACnet OPEN PROTOCOL WIRE TERMINATION REQUIREMENTS AND POINT INTEGRATION CAPABILITIES WITH VFC SUPPLIER/MANUFACTURER AND PROVIDE APPROPRIATE BAS COMPONENTS FOR COMMUNICATION INTERFACE TO BAS.

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
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NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

TEMPERATURE CONTROLS

A3C
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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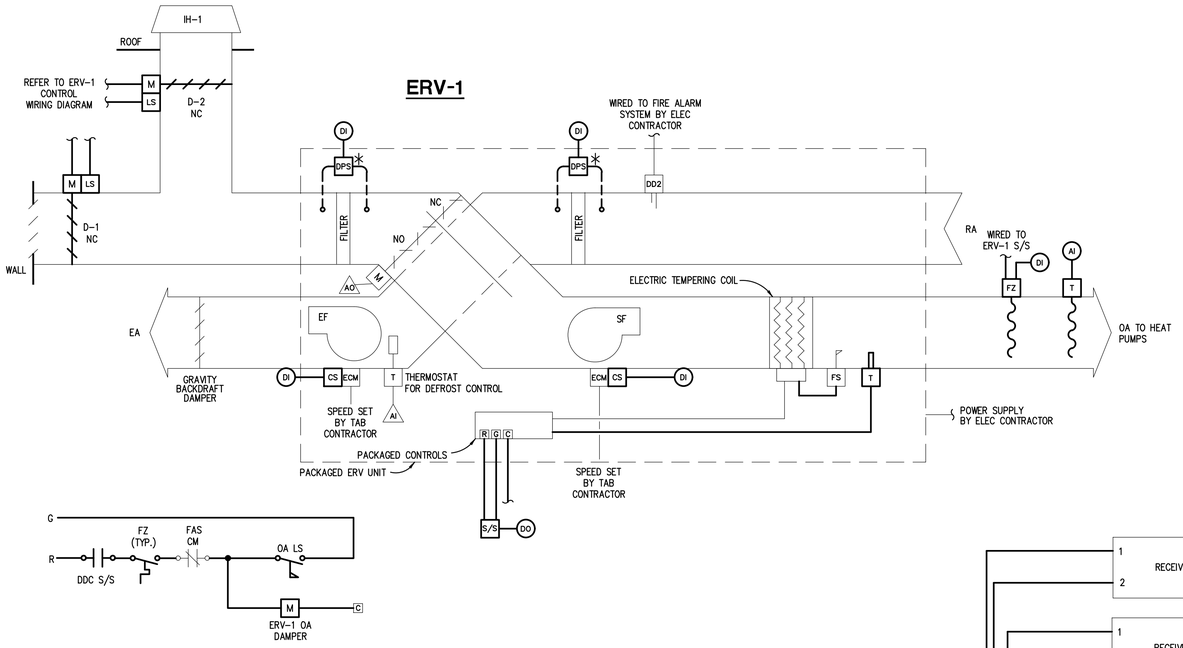


ERV-1 CONTROL WIRING

ERV-1 CONTROLS

NOTES:

1. ✳ INDICATES PANEL MOUNTED COMPONENT.
2. DAMPERS SHALL BE FURNISHED AND FACTORY INSTALLED BY TC CONTRACTOR. TC CONTRACTOR SHALL PROVIDE DAMPER ACTUATORS.
3. ELECTRICAL CONTRACTOR SHALL PROVIDE FIRE ALARM SYSTEM COMPONENTS AND WIRING FROM FIRE ALARM PANEL TO CONTROL MODULE (CM). TC CONTRACTOR SHALL PROVIDE WIRING FROM CONTROL MODULE TO SAFETY CIRCUIT.
4. COORDINATE WIRING, TERMINATION, CONTROL, AND I/O REQUIREMENTS WITH EQUIPMENT MANUFACTURER. SPECIFIC CONTROL REQUIREMENTS MAY DIFFER SLIGHTLY DEPENDING ON EQUIPMENT MANUFACTURER.
5. TC CONTRACTOR SHALL ADJUST DPSs BASED ON THE FILTER MANUFACTURER'S LOADED FILTER DATA.

SEQUENCE OF OPERATION

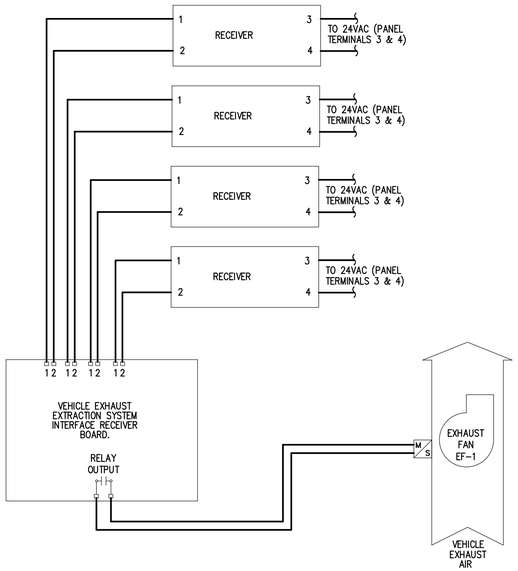
ENERGY RECOVERY UNIT CONTROL:

NOTE: ALL SETPOINTS, RESET SCHEDULE SETPOINTS, DEADBANDS, AND TIME INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS. ALL MOTOR CONTROL SWITCHES SHALL BE IN "AUTO" POSITION. ALL CONTROL LOOPS SHALL BE ENABLED AND DISABLED BASED ON SYSTEM STATUS TO PREVENT LOOP WINDUP.

1. ERV-1 (SF AND EF), SHALL HAVE START/STOP CAPABILITY FROM THE DDC/BAS SYSTEM. BAS TIME OF DAY SHALL SCHEDULE THE FAN TO RUN CONTINUOUSLY.
2. SFs AND EF STATUSES SHALL BE MONITORED BY DDC SYSTEM THRU RESPECTIVE CURRENT SWITCHES. ALL CURRENT SWITCHES SHALL PROVIDE FEEDBACK TO ENABLE TEMPERATURE CONTROLS. ABNORMAL STATUS CONDITION FOR ANY FAN SHALL ACTIVATE AN ALARM AT THE BAS.
3. WHEN RUNNING, ERV-1 OA DAMPER SHALL OPEN, ERV-1 SF & EF SHALL RUN. ERV-1 SHALL PROVIDE DISCHARGE AIR BASED ON OA TEMPERATURE AND RA TEMPERATURE FROM THE SPACE. DDC SHALL MODULATE OA DAMPERS D-1 AND D-2 AS DESCRIBED BELOW:

   3.1. DDC SHALL POLL WATER SOURCE HEAT PUMPS FOR OPERATING MODE. WHEN MAJORITY OF HEAT PUMPS ARE IN HEATING MODE, DDC SHALL OPEN D-1 AND CLOSE D-2. WHEN MAJORITY OF HEAT PUMPS ARE IN COOLING MODE, DDC SHALL CLOSE D-1 AND OPEN D-2.

4. WHEN ERV-1 IS ACTIVATED, PACKAGED CONTROLS SHALL MODULATE ELECTRIC HEATING COIL TO MAINTAIN A DISCHARGE AIR TEMPERATURE OF 55° F.
5. ERV-1 PACKAGED DEFROST CYCLE SHALL BE ACTIVATED WHEN ERV-1 PLATE EXHAUST AIR TEMPERATURE DROPS BELOW FACTORY SETPOINT.
6. DDC SHALL MONITOR ALL SENSORS AND DEVICES FOR BAS DISPLAY.
7. DUCT SMOKE DETECTOR(S) SHALL DEACTIVATE SF AND EF WHEN PRODUCTS OF COMBUSTION ARE DETECTED.
8. ERV-1 OA AND RA FILTER STATUSES SHALL BE MONITORED BY DDC SYSTEM THRU DIFFERENTIAL PRESSURE SWITCHES. FILTER STATUS ALARMS SHALL BE MONITORED BY DDC SYSTEM. TC CONTRACTOR SHALL ADJUST DPS AND DP SETPOINT BASED ON MANUFACTURER'S FILTER LOADED FILTER INFORMATION.
9. IF ERV-1 IS DEACTIVATED, OA DAMPER SHALL CLOSE, AND ALL FANS SHALL TURN OFF.



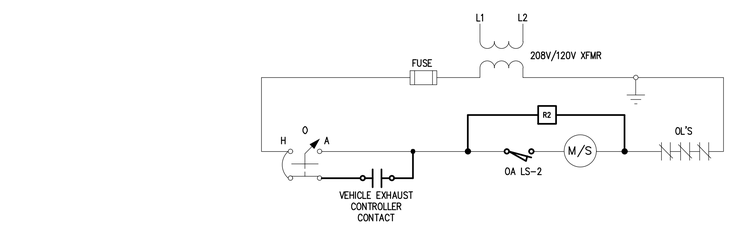
VEHICLE EXHAUST EF-1 SYSTEM WIRING

NOTE:

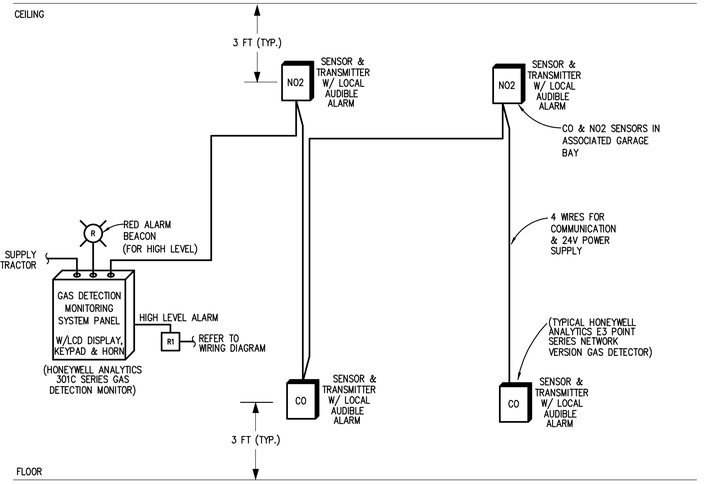
1. CONTRACTOR SHALL PROVIDE INTERLOCK WIRING AS INDICATED. COORDINATE WIRING REQUIREMENTS WITH EQUIPMENT SUPPLIER.

SEQUENCE OF OPERATION:

1. EXHAUST FAN SHALL BE STARTED AND STOPPED BY VEHICLE EXHAUST SYSTEM CONTROLLER WHENEVER AN EXHAUST HOSE IS PLACED INTO USE.
2. WIRING INTERLOCK SHALL OPEN VENTILATION OUTSIDE AIR DAMPER ASSOCIATED WITH EF-1.



EF-1 M/S WIRING



GAS DETECTION MONITORING SYSTEM CONTROLS

ASSOCIATED WITH GARAGE AREA

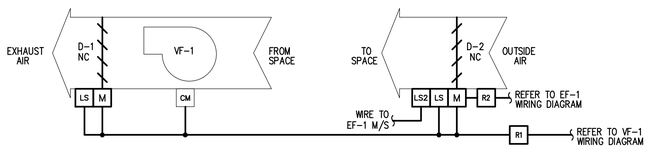
NOTES:

1. REFER TO MECHANICAL FLOOR PLANS FOR SENSORS AND DEVICE QUANTITIES & LOCATIONS.
2. TC CONTRACTOR SHALL PROVIDE GAS DETECTION MONITORING SYSTEM & SENSORS AS SPECIFIED.
3. THE REPRESENTATIVE OF THE GAS DETECTION SYSTEM MANUFACTURER SHALL PROVIDE RESPECTIVE CO AND NO2 ALARM LIMITS FOR THE OPERATION AND PROGRAMMING OF THE CONTROLLER.
4. PER MMC-2015, CO SHALL NOT EXCEED 25PPM AND NO2 SHALL NOT EXCEED 3PPM.
5. GAS DETECTION SYSTEM REPRESENTATIVE SHALL PROVIDE ENGINEERED DRAWINGS WITH SUBMITTAL.

SEQUENCE OF OPERATION

NOTE: ALL SETPOINTS, RESET SCHEDULE SETPOINTS, DEADBANDS, AND TIME INTERVALS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS. ALL MOTOR CONTROL SWITCHES SHALL BE IN "AUTO" POSITION.

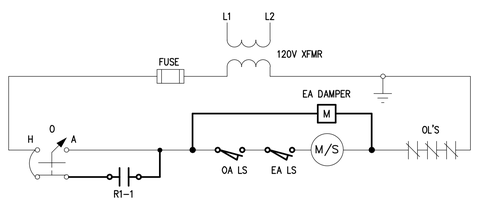
1. WHEN THE GAS DETECTION SYSTEM IS IN "NORMAL" MODE (NO GAS DETECTED), VF-1 SHALL REMAIN OFF.
2. WHEN GAS IS DETECTED, PURGE MODE SHALL BE ACTIVATED BY GAS DETECTION SYSTEM'S DRY CONTACT CLOSURE FOR HIGH LIMIT ALARM. CONTROL RELAY R1 IS ENERGIZED, INTERLOCK WIRING OPENS THE DAMPERS, WHEN LIMIT SWITCHES MAKE, VF-1 SHALL BE ENERGIZED.
3. WHEN GAS DETECTION SYSTEM'S CONTACT CLOSES, RELAY R1'S CONTACTS OPEN, VF-1 IS DE-ENERGIZED AND DAMPERS SHALL CLOSE.
4. IN PURGE MODE, VF-1 SHALL RUN UNTIL THE GAS DETECTION SYSTEM IS RESET BACK TO NORMAL OPERATION.



PURGE VENT FAN VF-1 CONTROL WIRING

SERVES THE APPARATUS BAY

SEQUENCE OF OPERATION: REFER TO GAS DETECTION MONITORING SEQUENCE OF OPERATION.



VF-1 M/S WIRING

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
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A3C
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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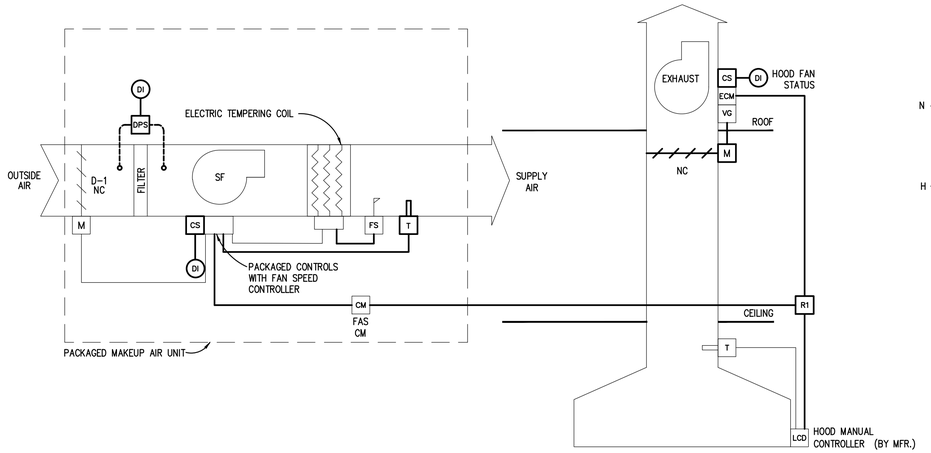
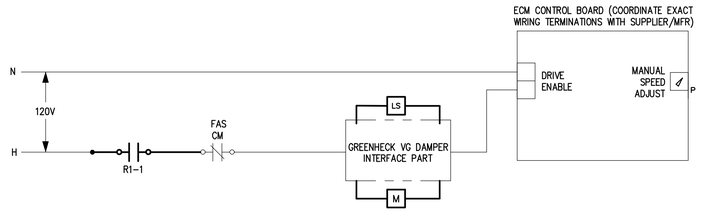
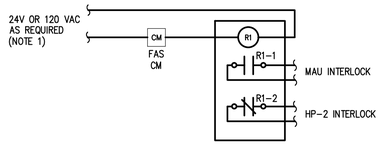




GREENHECK VG ECM WIRING

NOTE:

1. WIRING DETAIL IDENTIFIES INTENT AND DOES NOT INDICATE ACTUAL WIRING REQUIREMENTS. CONSULT WITH ECM SUPPLIER FOR THE ACTUAL WIRING REQUIREMENTS.
2. MOUNT CURRENT SWITCH ON MOTOR LEADS.



KITCHEN EXHAUST HOOD CONTROL

NOTES:

1. INDICATES INDOOR PANEL MOUNTED COMPONENT. COORDINATE PANEL LOCATION WITH ARCHITECT.
2. TC CONTRACTOR SHALL COORDINATE WITH THE AUTHORITY HAVING JURISDICTION WHETHER EXHAUST WILL RUN AFTER FIRE SUPPRESSION SYSTEM ACTIVATION
3. TC CONTRACTOR SHALL COORDINATE WIRING AND TERMINATION REQUIREMENTS WITH SUPPLIERS.
4. TC CONTRACTOR SHALL PROVIDE WIRING FROM FIRE SUPPRESSION SYSTEM FOR INTERLOCK WIRING AND SIGNAL TO THE FSE CONTROLLER. COORDINATE WIRING AND TERMINATION REQUIREMENTS WITH SUPPLIER.

KITCHEN HOOOD SYSTEM INTERLOCK WIRING

NOTE:

1. COORDINATE VOLTAGE REQUIREMENTS, WIRING, ETC. WITH ELECTRICAL TRADES. HOOD FIRE SUPPRESSION SYSTEM WILL BE WIRED TO FIRE ALARM SYSTEM (FAS). NORMALLY OPEN CONTACT SHALL BE PROVIDED BY ELECTRICAL TRADES FOR FAN INTERLOCK REQUIREMENTS TO BE PROVIDED BY TC CONTRACTOR.

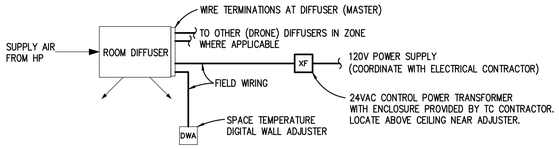
SEQUENCE OF OPERATION

NOTES:

1. ALL SETPOINTS, RESET SETPOINTS, DEADBANDS, AND TIME DELAYS DESCRIBED IN SEQUENCE SHALL BE ADJUSTABLE BY SYSTEM OPERATORS. APPROPRIATE DEADBANDS SHALL BE USED TO PREVENT SHORT CYCLING SITUATIONS. ALL MOTOR CONTROL SWITCHES SHALL BE IN "AUTO" POSITION.

SEQUENCE OF OPERATION:

1. KITCHEN HOOD IS MANUALLY ACTIVATED BY KITCHEN USER THROUGH MFR'S HUMAN MACHINE INTERFACE (HMI) OR HOOD THERMOSTAT(S).
2. WHEN DDC CURRENT SWITCH SENSES THAT THE HOOD FAN IS ENERGIZED, DDC SHALL COMMAND MAU TO ACTIVATE..
3. WHEN DDC CURRENT SWITCH SENSES THAT THE HOOD FAN IS DE-ENERGIZED, DDC SHALL COMMAND MAU TO DEACTIVATE.
4. WHEN MAU-1 SF IS ACTIVATED, PACKAGED CONTROLLER SHALL MODULATE ELECTRIC HEATING COIL TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT OF 65F.
5. IF FIRE SUPPRESSION SYSTEM ACTIVATES, FAS CM INTERLOCK RELAY SHALL SIGNAL MAU AND HP-2 TO DEACTIVATE REGARDLESS OF WHETHER THE KITCHEN EXHAUST FAN IS RUNNING OR NOT. INTEGRAL HOOD ELECTRICAL SHUTDOWN SHALL DEACTIVATE POWER TO RANGE/OVEN.

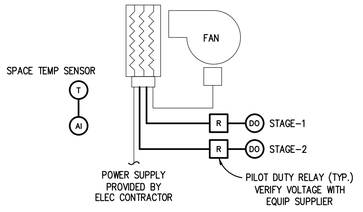


VAV DIFFUSER FIELD WIRING

TYPICAL – REFER TO FLOOR PLANS FOR QUANTITY, LOCATIONS AND ZONES

NOTES:

1. SPACE TEMPERATURE DIGITAL WALL ADJUSTER FURNISHED BY DIFFUSER SUPPLIER.
2. TEMPERATURE CONTROLS CONTRACTOR SHALL FIELD MOUNT SYSTEM CONTROL COMPONENTS AND PROVIDE FIELD WIRING. COORDINATE EXACT FIELD WIRING AND TERMINATION REQUIREMENTS WITH DIFFUSER MANUFACTURER.
3. REFER TO FLOOR PLANS FOR SPACE TEMP DIGITAL WALL ADJUSTER LOCATIONS.



ELECTRIC CUH CONTROL

TYPICAL

NOTES: REFER TO FLOOR PLANS FOR QUANTITY AND LOCATION OF UNITS. COORDINATE WIRING REQUIREMENTS AND TERMINATIONS WITH EQUIPMENT SUPPLIER.

SEQUENCE OF OPERATION:

1. DDC SHALL ENABLE/DISABLE 1ST & 2ND STAGE HEATING FOR CUH AS REQUIRED TO MAINTAIN SPACE TEMP SETPOINT OF 68F DURING BLDG OCCUPANCY AND 55F DURING BUILDING UNOCCUPANCY. SETPOINTS SHALL BE ADJUSTABLE THRU LOYTEC TOUCHSCREEN.

2. ASHRAE 90.1-2013 FOR VESTIBULES ONLY:

2.1. DDC SHALL ENABLE/DISABLE 1ST & 2ND STAGE HEATING FO CUH AS REQUIRED TO MAINTAIN SPACE TEMPERATURE SETPOINT OF 60F. DDC SHALL PROVIDE 2F DEADBAND FOR CONTROL.

2.2. WHEN OUTSIDE AIR TEMPERATURE INCREASES ABOVE 45F, DDC SHALL DISABLE CONTROL OF THE CUH.

3. FOR ECUH-116A, 116B, AND 129 ONLY:

3.1. WHEN AUTOMATIC TRANSFER SWITCH MONITORING INDICATED BUILDING IS ON GENERATOR POWER, DDC SHALL DISABLE ECUH-116A, 116B, AND 129.

ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021-0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn:JTH Checked: ACF

City Of Ann Arbor
NEW FIRE STATION 4
2415 S. HURON PKWY
ANN ARBOR, MI 48104

TEMPERATURE CONTROLS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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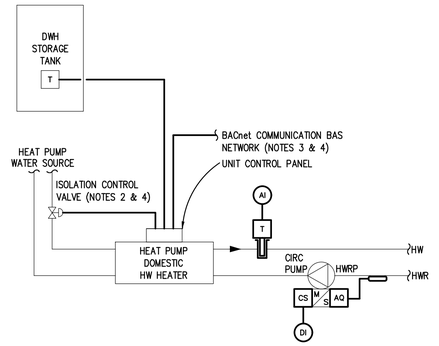
Sheet M8.05



HEAT PUMP DHW SYSTEM MONITORING & CONTROL

NOTES:

1. TC CONTRACTOR SHALL PROVIDE FIELD WIRING FROM STORAGE TANK SENSOR TO HEAT PUMP CONTROL PANEL.

2. TC CONTRACTOR SHALL PROVIDE FIELD WIRING FROM WATER SOURCE ISOLATION VALVE FURNISED BY WATER HEATER SUPPLIER AND INSTALLED BY MECHANICAL/PLUMBING CONTRACTOR.

3. TC CONTRACTOR SHALL PROVIDE BACnet COMMUNICATION WIRING FROM WATER HEATER PACKAGED CONTROLS FOR 3RD PARTY INTEGRATION WITH BUILDING AUTOMATION SYSTEM (BAS). POINTS TO MAP TO THE BAS SHALL INCLUDE, BUT NOT BE LIMITED TO: SCHEDULED START/STOP, UNIT ON/OFF STATUS, DWH TEMPTERATURE SETPOINT, DWH TEMPERATURE, AND UNIT FAILURE. COORDINATE AVAILABLE CONTROL AND MONITORING DATABASE THAT IS AVAILABLE WITH HEAT PUMP UNIT SUPPLIER

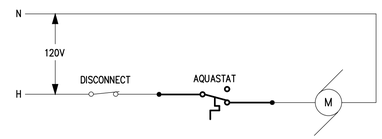
SEQUENCE OF OPERATION:

1. HEAT PUMP DOMESTIC WATER HEATER PACKAGED CONTROLS SHALL

2. DDC SHALL ENABLE DOMESTIC HW CIRC PUMP BASED ON TIME SCHEDULE. AQUASTAT SHALL CYCLE HW RETURN CIRC PUMP ON/OFF PER SETPOINT. DDC STATUS SHALL BE USED FOR VISUAL CYCLING OF PUMP AND TO TOTALIZE RUNTIME.

3. DDC SYSTEM SHALL MONITOR DOMESTIC HW SYSTEM SUPPLY TEMP FOR REMOTE SYSTEM DIAGNOSTIC CAPABILITY BY OWNER AND FOR LOW TEMPERATURE ALARM OF 120° F AND HIGH TEMPERATURE ALARM OF 135° F.

4. AQUASTAT SHALL START PUMP WHEN WATER TEMPERATURE FALLS BELOW SETPOINT. SET AQUASTAT AT 2°F BELOW SYSTEM HW SETPOINT.



DOM HW CP WIRING

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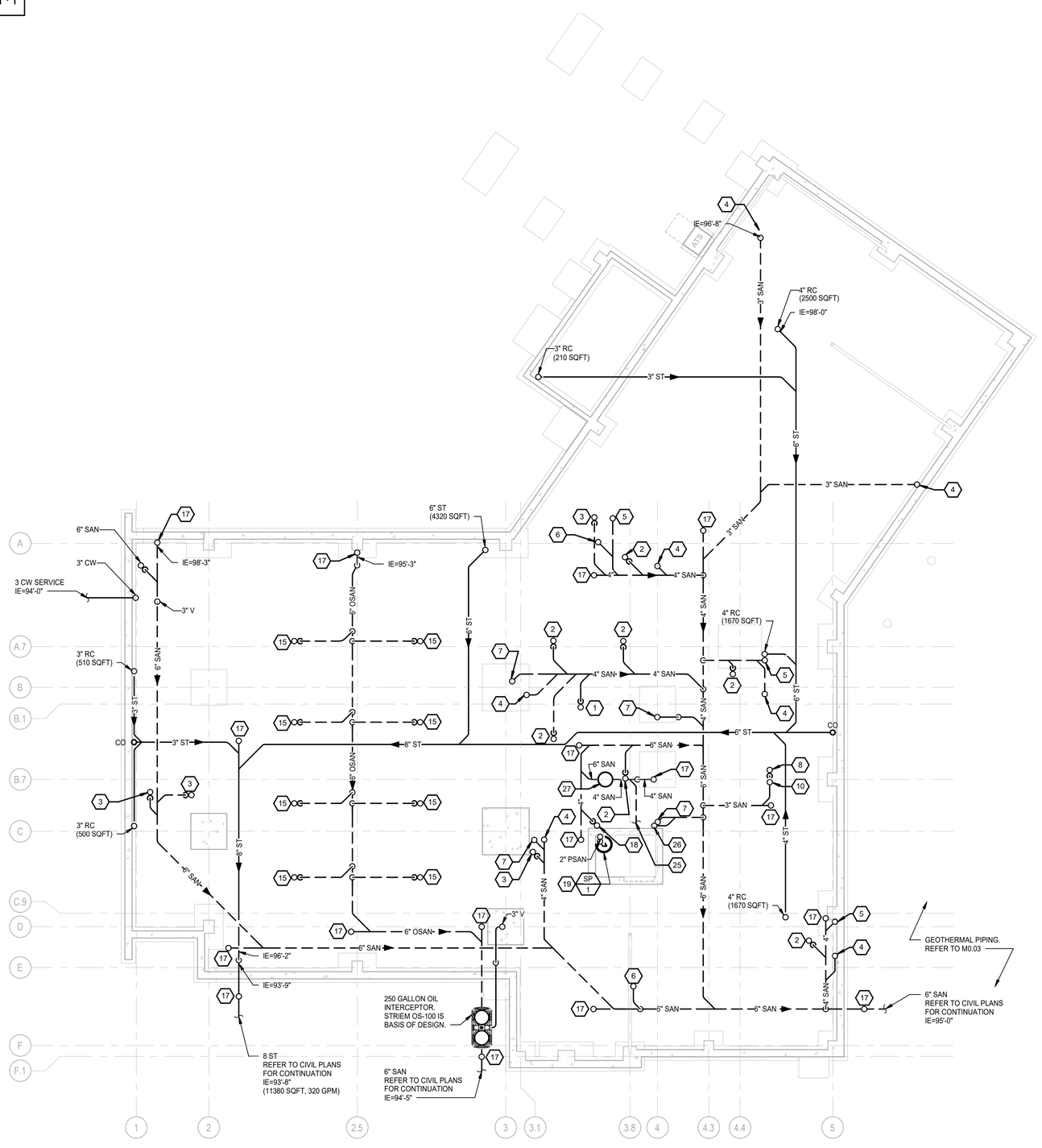

PROJECT TRUE

UNDERGROUND PLUMBING PLAN

SCALE: 1/8" = 1'-0" FINISHED FLOOR ELEVATION = 100'-0" = 795.00'

PLUMBING GENERAL NOTES:

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5 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

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9 PROVIDE CODE REQUIRED CLEARANCE FOR ALL CLEANOUTS INSTALLED IN SANITARY WASTE AND VENT PIPING.

10 MINIMUM UNDERGROUND PIPE SIZE SHALL BE 3".

11 WATER SERVICE ENTRANCE PIPING SHALL BE BURIED WITH DEPTH OF COVER OVER TOP OF PIPE OF AT LEAST 72", OR WITH TOP OF PIPE AT LEAST 12" BELOW LEVEL OF MAXIMUM FROST PENETRATION, OR AS REQUIRED BY AUTHORITIES HAVING JURISDICTION, WHICHEVER IS DEEPEST.

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17 TO CLEANOUT.

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34 PROVIDE HEAT TRACE FROM DRAIN BODY TO FROST LINE DEPTH OF 42" BELOW GRADE.

35 PROVIDE HEAT TRACE FROM DRAIN BODY TO DOWNSPOUT OUTLET OUTLET.

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PBA
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Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: ACF Checked: ACF

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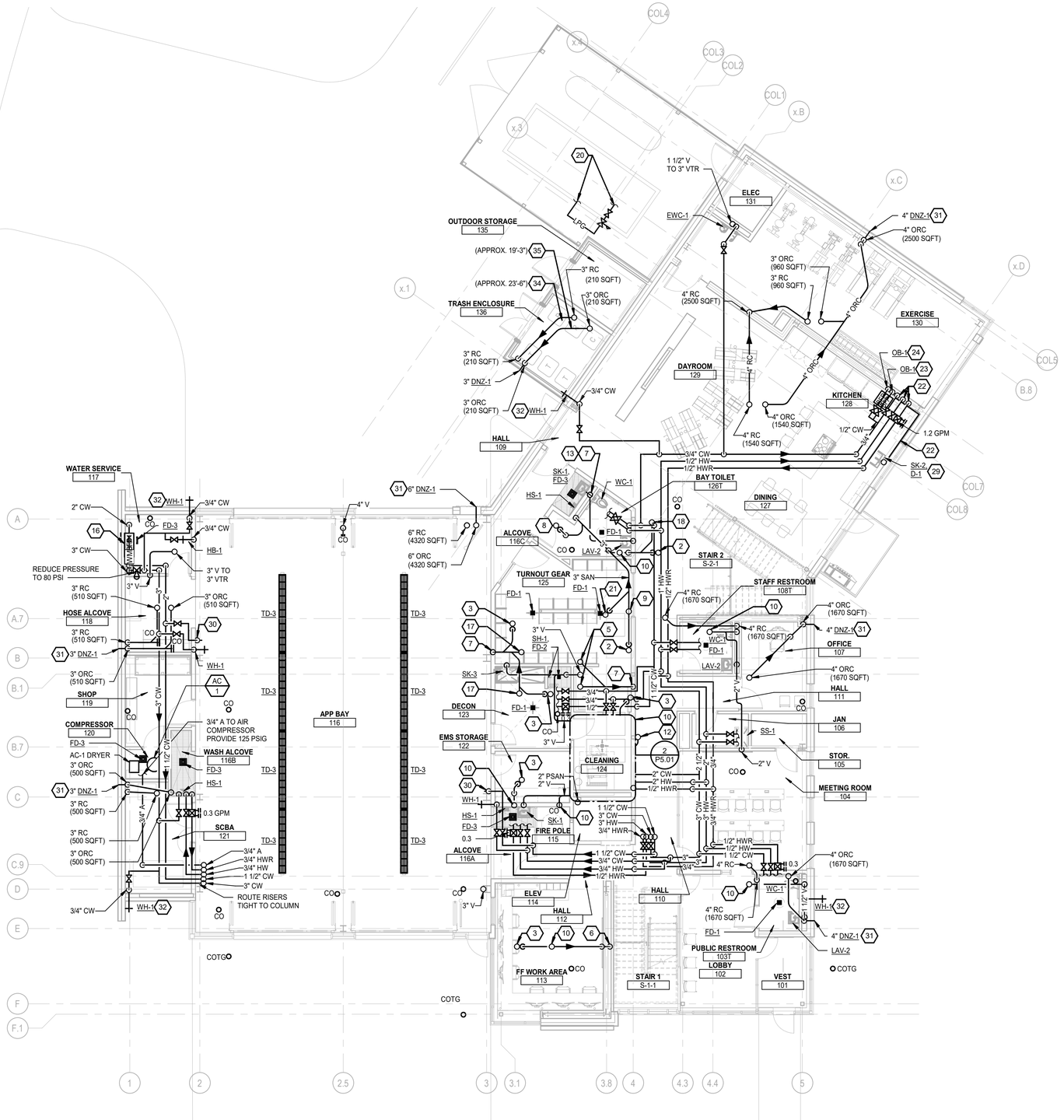

FIRST LEVEL PLUMBING PLAN

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PROJECT TRUE

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Project Number	21018

Issue	Date
SCHEMATIC DESIGN	03/04/22
DESIGN DEVELOPMENT	05/26/23
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Drawn: ACF Checked: ACF

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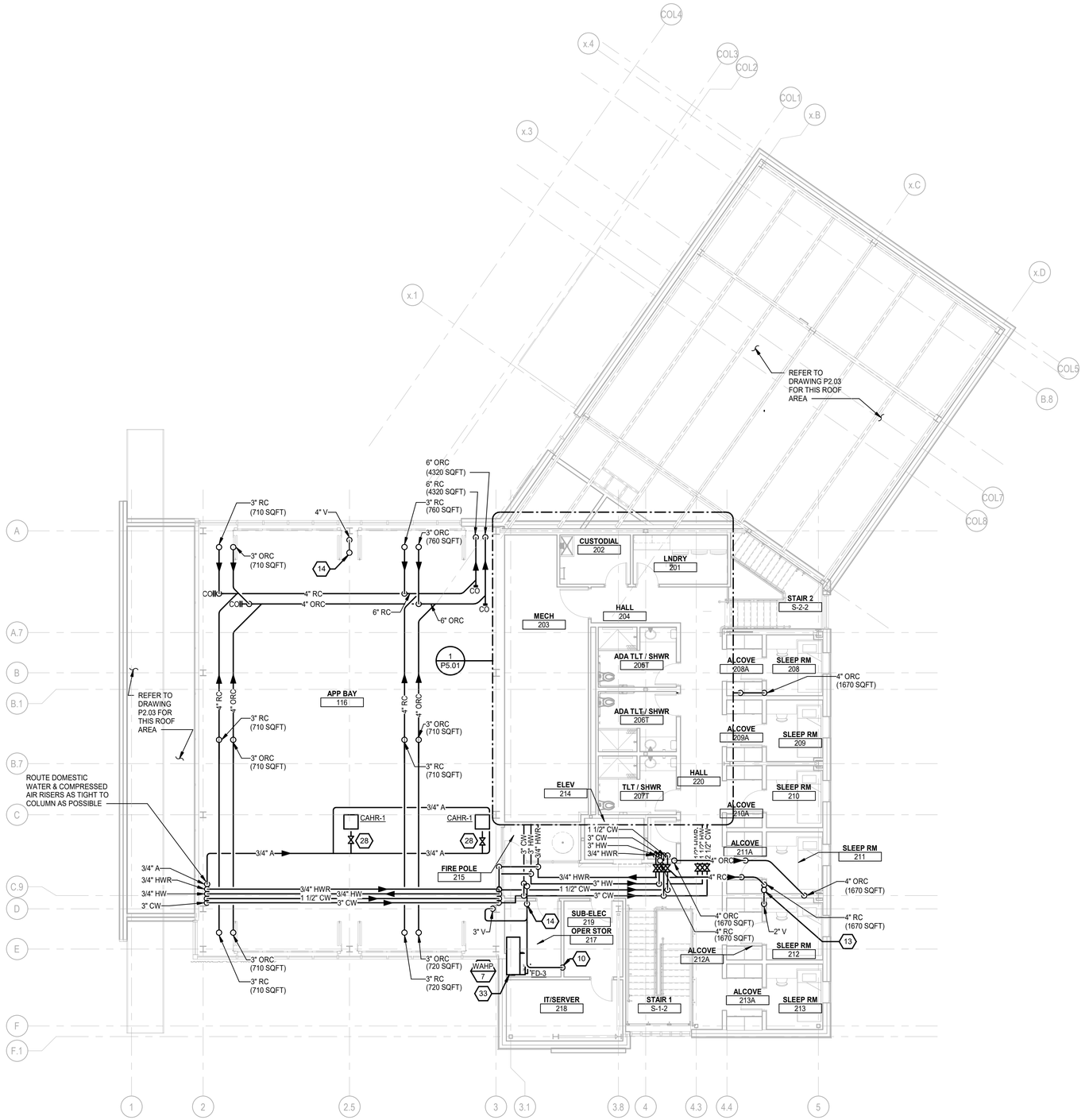

SECOND LEVEL PLUMBING PLAN

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PROJECT TRUE

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32 INSTALL WALL HYRDRANT 18" ABOVE GRADE TO TO CENTER OF INLET.

33 ROUTE 1" COLD CONDENSATE FROM HVAC UNIT TO NEAREST FLOOR DRAIN

34 PROVIDE HEAT TRACE FROM DRAIN BODY TO FROST LINE DEPTH OF 42" BELOW GRADE.

35 PROVIDE HEAT TRACE FROM DRAIN BODY TO DOWNSPOUT OUTLET OUTLET.

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021.0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
LICENSED PROFESSIONAL ENGINEER

Project Number	21018

Issue	Date
SCHEMATIC DESIGN	03/04/22
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: ACF Checked: ACF

City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

SECOND LEVEL PLUMBING PLAN

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COLLABORATIVE ARCHITECTURE
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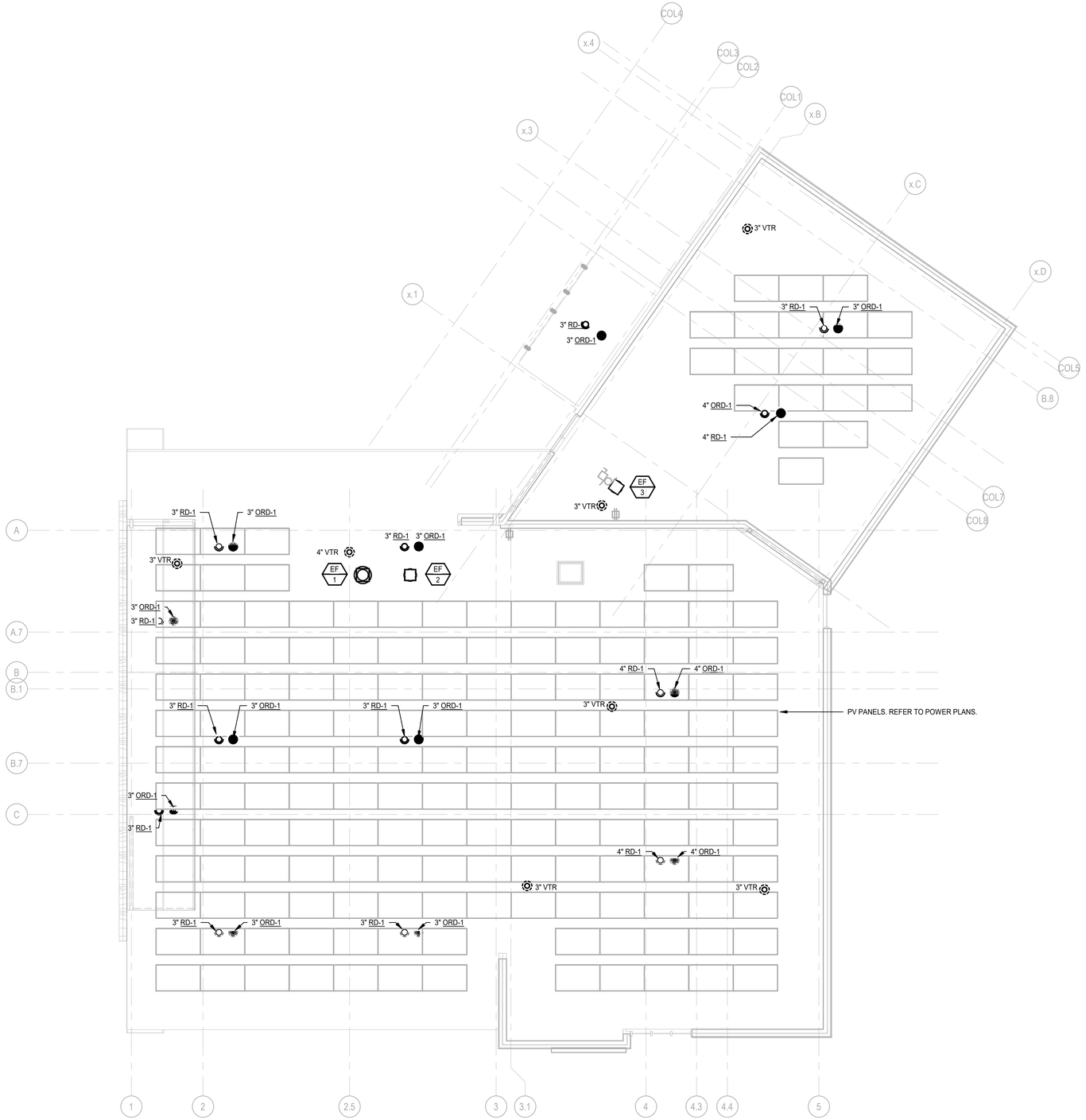
Sheet P2.02

THE FOLLOWING DIMENSION EQUALS ONE INCH WHEN PRINTED TO SCALE. 1"



ROOF PLUMBING PLAN

SCALE: 1/8" = 1'-0"

PROJECT TRUE

PLUMBING GENERAL NOTES:

1 THESE DRAWINGS ARE DIAGRAMMATIC, AND REPRESENT THE GENERAL INTENT AND ARRANGEMENT OF SYSTEMS. THEY ARE NOT TO BE CONSIDERED FABRICATION/COORDINATION/SHOP DRAWINGS. COORDINATION WITH OTHER TRADES IS REQUIRED. PROVIDE THE ADDITIONAL FITTINGS AND OFFSETS THAT WILL BE REQUIRED TO COMPLETE EACH SYSTEM AND TO AVOID INTERFERENCES WITH ALL OTHER SYSTEMS INCLUDING THE STRUCTURE, SHEET METAL, OTHER PIPING SYSTEMS, ELECTRICAL CONDUITS, BUS DUCTS, CABLE TRAY, LIGHT FIXTURES, ETC. AND/OR OTHER SPACE CONSTRAINTS.

2 INSTALL SYSTEMS SUCH THAT REQUIRED CLEARANCE AND SERVICE ACCESS SPACE IS PROVIDED AROUND ALL MECHANICAL AND ELECTRICAL EQUIPMENT, AND AROUND ANY COMPONENTS WHICH REQUIRE SERVICE ACCESS.

3 PIPING SHALL NOT BE INSTALLED ABOVE ELECTRICAL TRANSFORMERS, SWITCHBOARDS, PANELBOARDS OR MOTOR CONTROL CENTERS.

4 COORDINATE AND PROVIDE ACCESS DOORS WITHIN INACCESSIBLE CEILING, SHAFT, AND CHASE AREAS FOR ALL COMPONENTS WHICH REQUIRE SERVICE ACCESS. REFER TO ARCHITECTURAL DRAWINGS FOR CEILING TYPES.

5 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

6 REFER TO ARCHITECTURAL PLANS FOR DIMENSIONED LOCATIONS OF PLUMBING FIXTURES.

7 HOT AND COLD WATER PIPING RUN-OUTS TO LAVATORIES AND SINKS SHALL BE 1/2" UNLESS OTHERWISE NOTED.

8 PLUMBING VENT PIPING THROUGH ROOF SHALL BE LOCATED A MINIMUM OF 10'-0" FROM ANY FRESH AIR INTAKE LOCATION AND A MINIMUM OF 18" CLEAR FROM THE INSIDE FACE OF PARAPET.

9 PROVIDE CODE REQUIRED CLEARANCE FOR ALL CLEANOUTS INSTALLED IN SANITARY WASTE AND VENT PIPING.

10 MINIMUM UNDERGROUND PIPE SIZE SHALL BE 3".

11 WATER SERVICE ENTRANCE PIPING SHALL BE BURIED WITH DEPTH OF COVER OVER TOP OF PIPE OF AT LEAST 72", OR WITH TOP OF PIPE AT LEAST 12" BELOW LEVEL OF MAXIMUM FROST PENETRATION, OR AS REQUIRED BY AUTHORITIES HAVING JURISDICTION, WHICHEVER IS DEEPEST.

CONSTRUCTION KEY NOTES:

1 2" SAN TO FLOOR DRAIN.

2 3" SAN TO FLOOR DRAIN.

3 4" SAN TO FLOOR DRAIN.

4 3" SAN TRANSITION TO 1 1/2" SAN ABOVE FLOOR.

5 4" SAN TO WC.

6 3" SAN.

7 4" SAN.

8 3" SAN TO SS.

9 1 1/2" SAN TO LAV/SINK.

10 2" V.

12 2" SAN TO LAV'S.

13 2" V, 3" VTR.

14 4" V, 4" VTR.

15 4" OSAN TO TRENCH DRAIN.

16 DOMESTIC WATER SERVICE METER AND BACKFLOW ASSEMBLY. REFER TO DOMESTIC WATER METER PIPING DIAGRAM ON DRAWING P6.02 FOR FURTHER DETAIL.

17 TO CLEANOUT.

18 4" STANDPIPE DRAIN.

19 REFER TO ELEVATOR SUMP PUMP PIPING DIAGRAM ON DRAWING P6.02 FOR FURTHER DETAIL.

20 ROUTE 4" PROPANE GAS FROM STORAGE TANK TO GENERATOR. PROVIDE ISOLATION VALVE AND PRESSURE REGULATOR (IF NECESSARY). VERIFY CONNECTION LOCATIONS PRIOR TO INSTALLATION.

21 2" SAN TO TRENCH DRAIN.

22 1/2" CW, 1/2" HW & 1/2" HWR IN WALL TO SINK. ROUTE TROUGH CASEWORK CHASE.

23 ROUTE 1/2 CW TO OB-1 THRU CODE APPROVED BACKFLOW PREVENTER TO SERVE COFFEE MAKER. ROUTE IW FROM EQUIPMENT AND BFP NEAREST SINK DRAIN. REFER TO INDIRECT WASTE DRAIN DETAIL ON DRAWING P6.01. COORDINATE MOUNTING HEIGHT OF OUTLET BOX WITH EQUIPMENT.

24 ROUTE 1/2 CW TO OB-1 THRU CODE APPROVED BACKFLOW PREVENTER TO SERVE ICE MACHINE. ROUTE IW FROM BFP TO NEARET SINK DRAIN. REFER TO INDIRECT WASTE DRAIN DETAIL ON DRAWING P6.01. COORDINATE MOUNTING HEIGHT OF OUTLET BOX WITH EQUIPMENT.

25 4" SAN TO TRENCH DRAIN CATCH BASIN.

26 3" SAN TO JUST ABOVE FLOOR. TRANSITION TO 2" SAN TO WASHING MACHINE DRAIN BOX.

27 PROVIDE STRIEM AARDVARK AA-4 SOLIDS INTERCEPTOR. INCLUDE SR-24 RISER IF NECESSARY.

28 1/2 A TO HOSE REEL.

29 PROVIDE DEDICATED SUPPLY VALVE AND ROUTE 1/2" HW FROM SINK HW LINE TO DISHWASHER. ROUTE WASTE FROM DISHWASHER CONNECTION TO SINK WASTE.

30 1 1/2" CW TO WALL MOUNTED THREADED MALE CONNECTION FOR APPARATUS FILL. COORDINATE EXACT TERMINATION WITH OWNER.

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T: (734) 663 - 1910
F: (866) 732 - 2168
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P2.03

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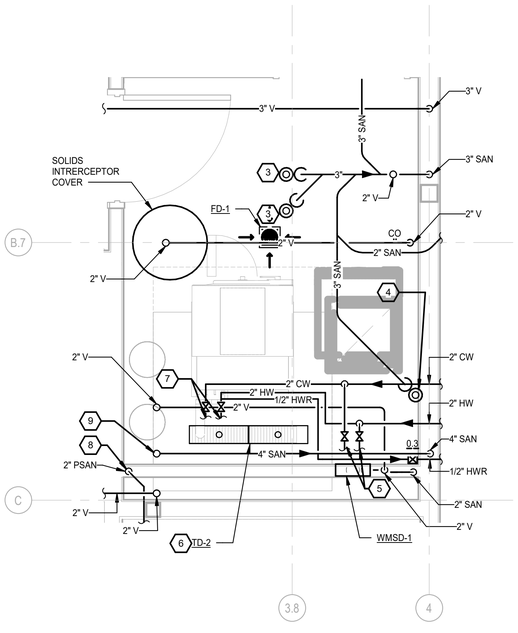
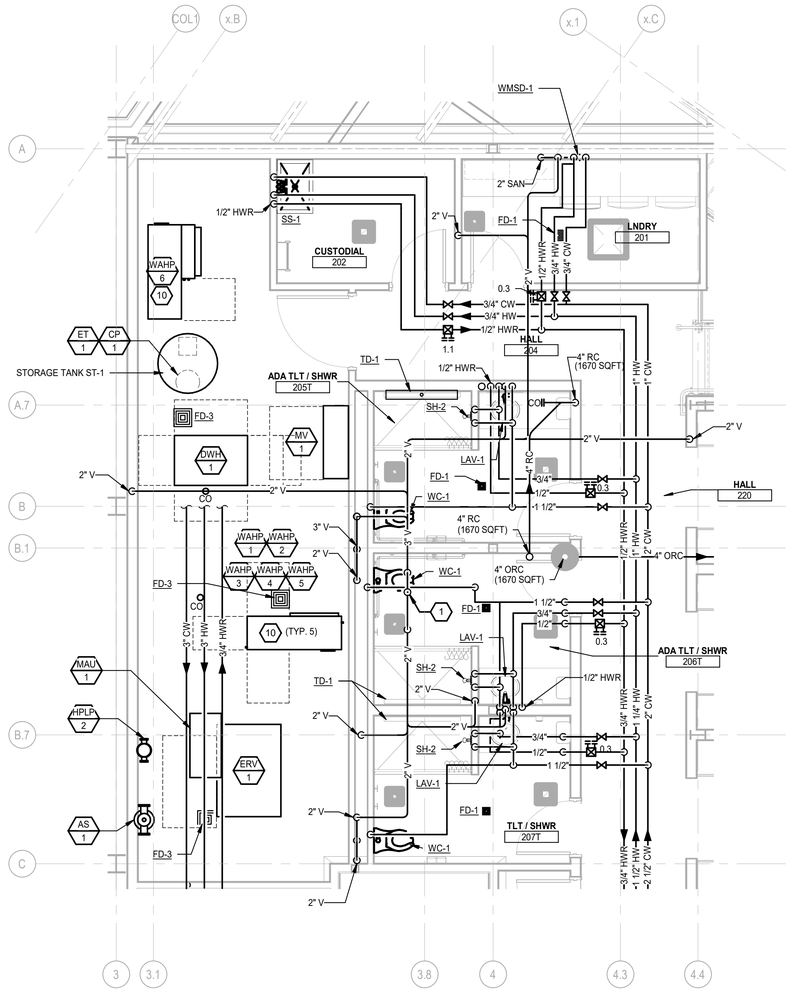
CONSTRUCTION KEY NOTES:

1 2" V, 3" VTR.
3 2" SAN TO TRENCH DRAIN.
4 3" SAN TO FLOOR DRAIN.
5 3/4" CW, 3/4" HW TO CLOTHES WASHER DRAIN BOX.
6 REFER TO MANUFACTURERS INSTALLATION INSTRUCTION FOR TRENCH DRAIN INSTALLATION REQUIREMENTS.
7 2" CW, 2" HW (105 DEGREES) TO WASHER EXTRACTOR. REFER TO MANUFACTURER'S INTALLATION INSTRUCTIONS FOR UTILITY CONNECTIONS.
8 4" STANDPIPE DRAIN.
9 4" SAN TO WATER CLOSET.
10 ROUTE 1" COLD CONDENSATE FROM HVAC UNIT TO NEAREST FLOOR DRAIN.



2 P2.01 **CLEANING 124 ENLARGED PLUMBING PLAN**
SCALE: 1/2" = 1'-0"



1 P2.02 **SECOND LEVEL ENLARGED PLUMBING PLAN**
SCALE: 1/4" = 1'-0"

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5145 Livernois, Suite 100
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City Of Ann Arbor
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2415 S HURON PKWY
ANN ARBOR, MI 48104

ENLARGED PLUMBING PLANS

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Sheet
P5.01

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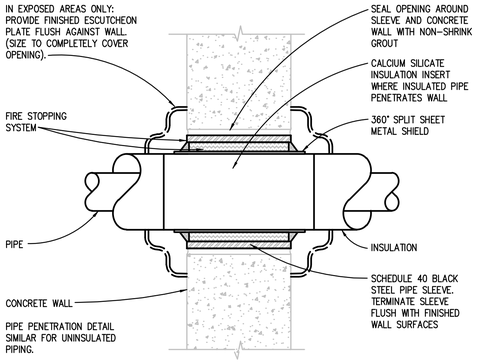
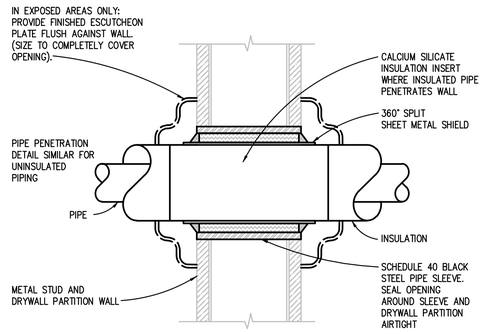


DETAIL INDICATES THE INSTALLATION REQUIREMENTS FOR A FIRE RATED ASSEMBLY. FOR A NON-FIRE RATED ASSEMBLY PACK SLEEVED OPENING WITH INSULATION MATERIAL AND CAULK WITH NON-HARDENING SEALANT.

FIRE RATED AND NON-FIRE RATED POURED CONCRETE OR BLOCK WALL PIPE PENETRATION DETAIL

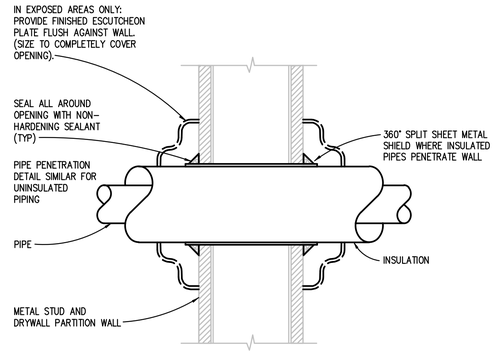
NO SCALE



DETAIL INDICATES THE INSTALLATION REQUIREMENTS FOR A FIRE RATED ASSEMBLY. FOR A NON-FIRE RATED ASSEMBLY PACK SLEEVED OPENING WITH INSULATION MATERIAL AND CAULK WITH NON-HARDENING SEALANT.

FIRE RATED AND NON-FIRE RATED METAL STUD AND DRYWALL PARTITION WALL PIPE PENETRATION DETAIL

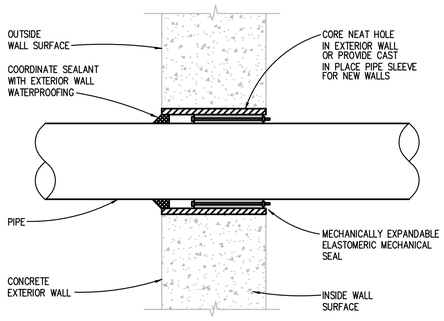
NO SCALE



THIS DETAIL DOES NOT APPLY TO HEATING PIPING 2" AND LARGER. FOR HEATING PIPING 2" AND LARGER REFER TO "FIRE RATED AND NON-FIRE RATED METAL STUD AND DRYWALL PARTITION WALL PIPE PENETRATION DETAIL"

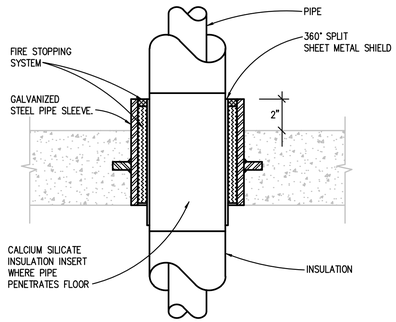
NON-FIRE RATED METAL STUD AND DRYWALL PARTITION WALL PIPE PENETRATION DETAIL

NO SCALE



EXTERIOR BELOW GRADE WALL PIPE PENETRATION DETAIL

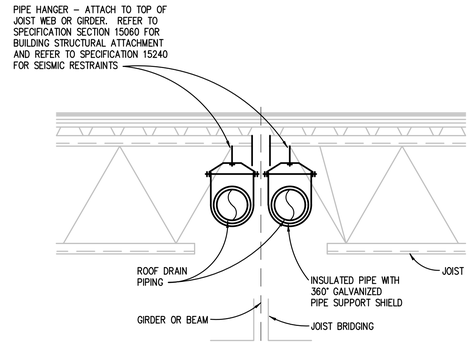
NO SCALE



NEW FLOOR PIPE PENETRATION DETAIL

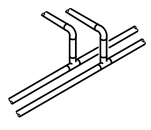
NO SCALE

NOTE: PIPES ENCASED IN WALLS EXEMPT FROM THIS DETAIL.



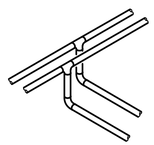
ROOF DRAIN PIPING DETAIL

NO SCALE



BRANCH CONNECTION OFF TOP

APPLIES TO THE FOLLOWING SYSTEMS:
DOMESTIC WATER



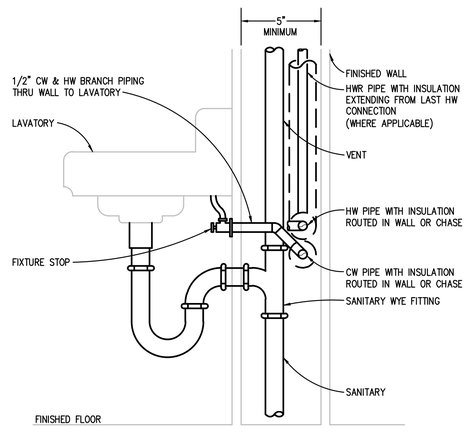
BRANCH CONNECTION OFF BOTTOM

APPLIES TO THE FOLLOWING SYSTEMS:
(NOT APPLICABLE IN PLUMBING DIVISION)

NOTE: BOTTOM AS INDICATED OR SIDE CONNECTION IS ACCEPTABLE. CONNECTION ABOVE CENTERLINE OF MAINS IS NOT ACCEPTABLE.

TYPICAL BRANCH TAKE-OFF CONNECTION PIPING DETAIL

NO SCALE



TYPICAL LAVATORY DETAIL

NO SCALE

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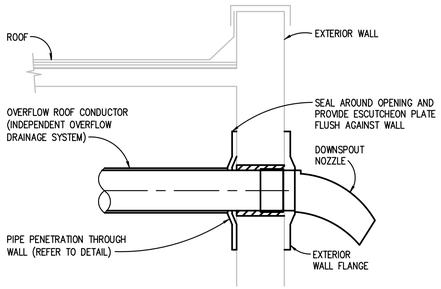
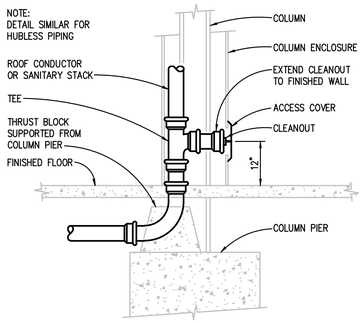
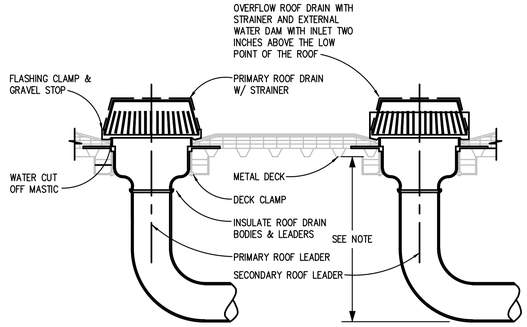


OVERFLOW DISCHARGE NOZZLE DETAIL
NO SCALE



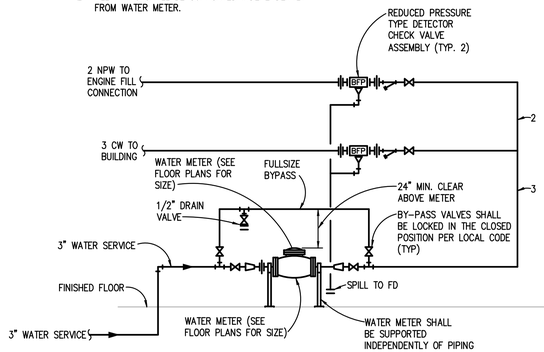
ROOF CONDUCTOR AND SANITARY STACK BASE CONNECTION DETAIL
NO SCALE



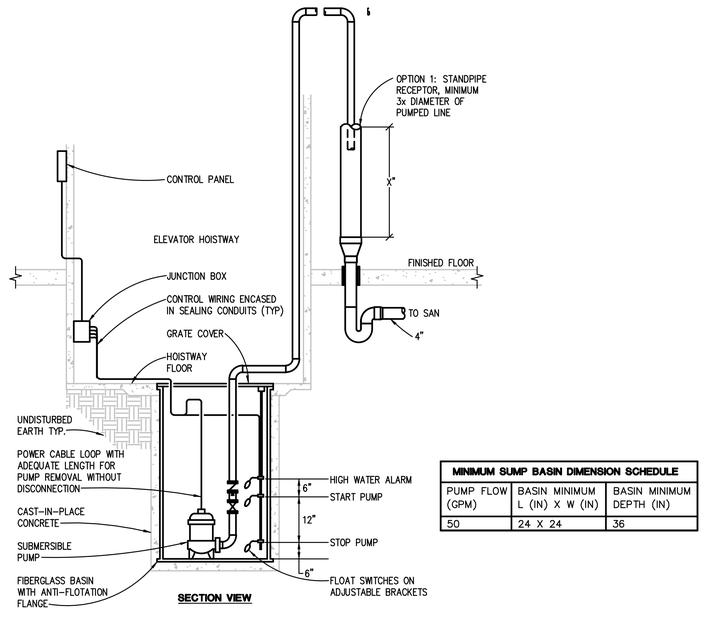
NOTE:
DIMENSION FOR 6" ROOF DRAIN FROM BOTTOM OF DECK TO BOTTOM OF PIPE SHALL BE MAXIMUM OF 20". DIMENSION FOR 8" ROOF DRAIN SHALL BE A MAXIMUM OF 22". DIMENSION FOR 10" ROOF DRAIN SHALL BE A MAXIMUM OF 26".

DOUBLE ROOF SUMP DETAIL
NO SCALE

NOTES:
1. FOR 4" AND LARGER WATER SERVICES SHALL BE ROLLED OFF AT A 45° ANGLE FROM CENTERLINE OF WATER METER.
2. ALL PIPING SHALL BE SUPPORTED INDEPENDENTLY FROM WATER METER.



DOMESTIC WATER METER PIPING DIAGRAM
NO SCALE



SECTION VIEW

MINIMUM SUMP BASIN DIMENSION SCHEDULE		
PUMP FLOW (GPM)	BASIN MINIMUM L (IN) X W (IN)	BASIN MINIMUM DEPTH (IN)
50	24 X 24	36

ELEVATOR SUMP PUMP PIPING DIAGRAM
NO SCALE

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P6.02

PLUMBING PIPING & VALVE APPLICATION SCHEDULE

PIPE SIZE (INCHES)	MATERIAL: SOFT COPPER TYPE K	HARD COPPER TYPE L	HARD COPPER TYPE M	CARBON STEEL (SCHED. 40)	CARBON STEEL (STD.)	GALV. STEEL (SCHED. 40)	STAINLESS STEEL (SCHED. 10)	PEX	PE PIPE	PE SHEATHED CARBON STEEL PIPE	CSST	PRESSURE CONNECTIONS: NO-HUB CISP	PVC TYPE DWV	PP DRAINAGE PIPE	COPPER TYPE DWV	DUCTILE IRON PIPE	SOLDERED	BRAZED	WELDED	THREADED	FLANGED	GROOVED	INSERT & CRIMP	FUSION	PRESSURE-SEAL	MECHANICALLY-FORMED TEE	MECHANICAL JOINT	PUSH-ON-JOINT	GRAVITY DWV CONNECTIONS: SOLVENT WELDED	SOLDERED	FUSION	CISP HUBLESS	HEAVY-DUTY HUBLESS	ISOLATION VALVES: BALL	AGA BALL	GENERAL SERVICE BUTTERFLY	LUBRICATED PLUG	GATE	KEYED NOTES
ABOVEGROUND DOMESTIC WATER (POTABLE AND NON-POTABLE) ON DISTRIBUTION SIDE OF METER - MIN. WORKING PRESS. & TEMP.: 125 PSIG AT 200 DEG F																																							
UP TO 4		X															X	X			X	X												X		X			A
ABOVEGROUND SANITARY WASTE & VENT - MIN. WORKING PRESS.: 10-FOOT HEAD OF WATER																																							
1-1/2 TO 15												X																					X						
ABOVEGROUND PUMPED SANITARY WASTE - MIN. WORKING PRESS.: 125 PSIG																																							
UP TO 2		X															X	X																X					
ABOVEGROUND INDIRECT SANITARY WASTE - MIN. WORKING PRESS.: 10-FOOT HEAD OF WATER																																							
UP TO 8			X												X																X								
UNDERGROUND SANITARY WASTE & VENT - MIN. WORKING PRESS.: 10-FOOT HEAD OF WATER																																							
3 TO 12												X																					X						
3 TO 12													X																		X								
UNDERGROUND PUMPED SANITARY WASTE - MIN. WORKING PRESS.: 125 PSIG																																							
UP TO 2-1/2		X															X	X																X					
ABOVEGROUND COLD CONDENSATE DRAIN - MIN. WORKING PRESSURE: 10 FT. HEAD OF WATER																																							
ALL SIZES			X												X		X	X								X													
ABOVEGROUND STORM DRAINAGE - MIN. WORKING PRESS.: 10-FOOT HEAD OF WATER																																							
3 TO 15												X																					X						
UNDERGROUND STORM DRAINAGE - MIN. WORKING PRESS.: 10-FOOT HEAD OF WATER																																							
3 TO 12												X																					X						
3 TO 12													X																		X								

GENERAL NOTES

1. 'X' INDICATES ACCEPTABLE SELECTION. IF MORE THAN ONE SELECTION IS INDICATED FOR A PIPING SYSTEM, CONTRACTOR MAY SELECT FROM THOSE INDICATED SELECTIONS.
2. DISSIMILAR-METAL PIPING JOINTS: CONSTRUCT JOINTS USING DIELECTRIC FITTINGS COMPATIBLE WITH BOTH PIPING MATERIALS.
   a. NPS 2 AND SMALLER: USE DIELECTRIC NIPPLE/WATERWAY.
   b. NPS 2-1/2 AND LARGER: USE DIELECTRIC FLANGE KITS.
3. USE UNIONS OR FLANGES AT VALVE AND EQUIPMENT CONNECTIONS.
4. PLUMBING EQUIPMENT DRAINS, VENTS, SAFETY VALVE PIPING, BLOWDOWN PIPING AND THE LIKE SHALL BE SAME PIPING MATERIAL AS ASSOCIATED PIPING SYSTEM.
5. GROOVED END VALVES MAY BE USED WITH GROOVED PIPING.

KEYED NOTES

A. GROOVED AND FLANGED FITTINGS, JOINTS, AND COUPLINGS, IF INDICATED AS AN ACCEPTABLE SELECTION, MAY BE USED IN ACCESSIBLE LOCATIONS ONLY FOR THIS PIPING SYSTEM. ACCESSIBLE LOCATIONS ARE DEFINED AS EXPOSED CONSTRUCTION OR ABOVE LAY-IN CEILINGS.
B. JOINTS ARE NOT PERMITTED ON UNDERGROUND WATER PIPING.
C. USE CAST IRON DRAINAGE PATTERN (DURHAM) FITTINGS.
D. INSTALL IN CONTAINMENT JACKET, REFER TO SPECIFICATIONS.
E. VALVES, UNIONS, AND FLANGED JOINTS MAY BE USED IN ACCESSIBLE LOCATIONS ONLY, EXCLUDING CEILINGS USED AS AIR PLENUMS. ACCESSIBLE LOCATIONS ARE DEFINED AS EXPOSED CONSTRUCTION OR ABOVE LAY-IN CEILINGS. USE ONLY STEEL WELDED FITTINGS AND WELDED JOINTS IN CEILING USED AS AIR PLENUMS.
F. NO JOINTS ALLOWED UNDERGROUND.

ABOVEGROUND PLUMBING PIPE & ACCESSORY INSULATION APPLICATION SCHEDULE

	INSULATION MATERIAL & THICKNESS (INCHES): FLEXIBLE ELASTOMERIC	FIBERGLASS	MINERAL WOOL	POLYISOCYANURATE	PHENOLIC	CELLULAR GLASS	CALCIUM SILICATE	FIELD-APPLIED JACKET MATERIAL: ALUMINUM	STAINLESS STEEL	PVC	SELF-ADHESIVE (FOR OUTDOOR APPLICATIONS)	PVDC (INDOOR)	PVDC (OUTDOOR)	KEYED NOTES
INDOOR PIPE SYSTEM AND SIZE (INCHES)														
DOMESTIC COLD WATER	1	1						X		X				A
DOMESTIC HOT WATER SUPPLY & RETURN 140 DEG F AND LESS:														
NPS 1-1/4 AND SMALLER	1	1						X		X				A
NPS 1-1/2 AND LARGER	1.5	1.5						X		X				A
STORM WATER & OVERFLOW	1	1						X		X				A
ROOF DRAIN AND OVERFLOW DRAIN BODIES	1	1												
CONDENSATE AND EQUIPMENT DRAIN PIPING BELOW 60 DEG F	0.75	1												
FLOOR DRAINS, TRAPS AND SANITARY DRAIN PIPING WITHIN 10 FEET OF DRAIN RECEIVING CONDENSATE AND EQUIPMENT DRAIN WATER BELOW 60 DEG F	0.75	1						X		X				A

UNLESS OTHERWISE INDICATED OR SCHEDULED, DO NOT INSULATE THE FOLLOWING:
- FIRE SUPPRESSION PIPING
- UNDERGROUND PIPING
- LABORATORY GAS AND VACUUM PIPING
- MEDICAL GAS AND VACUUM PIPING
- FUEL GAS PIPING
- FUEL OIL PIPING

GENERAL NOTES

1. 'X' OR THICKNESS IN INCHES INDICATES ACCEPTABLE SELECTION. IF MORE THAN ONE SELECTION IS INDICATED FOR A SYSTEM, CONTRACTOR MAY SELECT FROM THOSE INDICATED SELECTIONS.
2. INSULATE PIPING WITHIN AIR HANDLING EQUIPMENT THE SAME AS INDOOR PIPING. PROVIDE ALUMINUM OR STAINLESS STEEL JACKET.

KEYED NOTES

A. PROVIDE FIELD APPLIED JACKET FOR PIPING EXPOSED IN EQUIPMENT ROOMS, STORAGE ROOMS, JANITORS CLOSETS, RECEIVING ROOMS, TEST AREAS, CIRCULATION AREAS AND SUCH AREAS SUBJECT TO DAMAGE, WITHIN 10 FEET (3 METERS) OF FINISHED FLOOR.
B. PROVIDE MANUFACTURER'S RECOMMENDED PROTECTIVE COATING FOR FLEXIBLE ELASTOMERIC THERMAL INSULATION.

SCHEDULES GENERAL NOTES:

TYPICAL FOR ALL SCHEDULE SHEETS:

1. REFER TO ELECTRICAL STANDARD SCHEDULES, ONE LINE DIAGRAM AND PANEL SCHEDULES FOR ADDITIONAL ELECTRICAL INFORMATION
2. PROVIDE THE FOLLOWING FACTORY-WIRED ELECTRICAL OPTIONS/ACCESSORIES WHERE INDICATED IN SCHEDULE:
   - A – NON-FUSED DISCONNECT SWITCH
   - B – UNIT SHALL BE SINGLE POINT ELECTRICAL CONNECTION WITH FACTORY INSTALLED DISCONNECTING MEANS AND ALL REQUIRED STARTERS AND CONTROLS
   - C – SERVICE RECEPTACLE
   - D – FUSED DISCONNECT SWITCH
   - E – COMBINATION STARTER
   - F – UNIT SHALL HAVE (2) SINGLE POINT CONNECTIONS WITH FACTORY INSTALLED DISCONNECTING MEANS AND ALL REQUIRED STARTERS AND CONTROLS. (1) CONNECTION SHALL BE FOR CONDENSING SECTION AND (1) CONNECTION SHALL BE FOR THE REMAINDER OF THE UNIT.
3. FOR MODULATION/CONTROL TYPE COLUMN, "VFC" INDICATES VARIABLE FREQUENCY CONTROLLERS, "AUTO" INDICATES AUTOMATIC OPERATION (CONTROLLED BY TEMPERATURE CONTROLS OR SELF CONTAINED CONTROLS), "MANUAL" INDICATES HAND OPERATION.
4. IF VARIABLE FREQUENCY CONTROLLERS ARE INDICATED TO BE PROVIDED AND ARE NOT INSTALLED INTEGRAL TO THE UNIT, VARIABLE FREQUENCY CONTROLLERS SHALL BE SUPPLIED BY THE MECHANICAL CONTRACTOR (UNLESS OTHERWISE NOTED) AND INSTALLED BY THE ELECTRICAL CONTRACTOR INCLUDING THE LINE SIDE AND LOAD SIDE WIRING TO THE MOTOR AND INCLUDING MISCELLANEOUS STEEL REQUIRED FOR THE SUPPORT AND MOUNTING OF THE VFC. REFER TO FLOOR PLANS FOR LOCATION.
5. WHERE EQUIPMENT IS INDICATED TO HAVE A SINGLE POINT ELECTRICAL CONNECTION, THAT EQUIPMENT SHALL COME COMPLETE WITH FACTORY INSTALLED STARTERS, MOTOR OVERLOAD PROTECTION, CONTACTORS, FUSING AND ALL NECESSARY INTERNAL WIRING AND CONTROLS. PROVIDE A FACTORY MOUNTED UNIT DISCONNECTING MEANS WHERE THE ELECTRICAL CONTRACTOR SHALL MAKE SINGLE POINT CONNECTION. INSTALL PACKAGED EQUIPMENT SUCH THAT THE ELECTRICAL CONNECTION AND CONTROLS ARE ACCESSIBLE AND HAVE CLEARANCES MEETING THE NATIONAL ELECTRICAL CODE.
6. WHERE PACKAGED EQUIPMENT IS PROVIDED, NAMEPLATE MUST INDICATE MAXIMUM OVERCURRENT PROTECTION BY HACR RATED CIRCUIT BREAKERS OR FUSES. IF FUSE PROTECTION ONLY IS INDICATED, PROVIDE A FUSIBLE DISCONNECT AND FUSES WITH THE UNIT.
7. WHERE EQUIPMENT IS DESIGNATED BY MANUFACTURER AND MODEL NUMBER, THIS IS THE BASIS OF DESIGN. IF THE CONTRACTOR ELECTS TO PROVIDE EQUIPMENT BY OTHER SPECIFIED MANUFACTURERS OR PROPOSED ALTERNATE EQUIPMENT BY THE BASIS OF DESIGN MANUFACTURER, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY REVISIONS TO ELECTRICAL REQUIREMENTS, STRUCTURAL LOADING, OR ARCHITECTURAL APPURTENANCES AND SHALL INCLUDE THE COST OF SUCH REVISIONS IN HIS BID.
8. WHERE EQUIPMENT IS SCHEDULED TO INCLUDE A SERVICE RECEPTACLE, PROVIDE A FACTORY MOUNTED SERVICE RECEPTACLE WITH APPROPRIATE FUSES AND TRANSFORMERS CONNECTED ON THE LINE SIDE OF THE UNIT DISCONNECT. PROVIDE A NAMEPLATE ON THE DISCONNECT SWITCH INDICATING THE PRESENCE OF LIVE POWER TO THE SERVICE RECEPTACLE WHEN THE UNIT DISCONNECT IS IN THE OFF POSITION.
9. SIZE ALL EQUIPMENT FEEDERS BASED ON THE LISTED MOP (MAXIMUM OVERCURRENT PROTECTION). REFER TO THE FEEDER AND BRANCH CIRCUIT SIZING SCHEDULE ON THE ELECTRICAL STANDARD SCHEDULES SHEET.

TCA ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021-0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
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City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

PLUMBING SCHEDULES

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet P7.01

WATER SOURCE HEAT PUMP WATER HEATER SCHEDULE

UNIT IDENTIFICATION	HEATING CAPACITY @ 54°F SOURCE MBH	COOLING CAPACITY MBH	KW INPUT	RECOVERY GPH	E.W.T. °F	L.W.T. °F	MODULATION/ CONTROL TYPE	ELECTRICAL						MODEL NUMBER	KEYED NOTES
								VOLTS	PHASE	FLA	MOP	SCCR KA	OPTIONS/ ACCESSORIES		
DWH-1	118	95	12	174	40	140	AUTO	208	3	33	40	5	B	WHP125	1

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBERS ARE LOCHINVAR UNLESS OTHERWISE NOTED.

KEYED NOTES:
1. PROVIDE LOCHINVAR HP250G 250 GALLON STORAGE TANK ST-1.

DOMESTIC HOT WATER SYSTEM EXPANSION TANK SCHEDULE

UNIT IDENTIFICATION	SYSTEM SERVED	ESTIMATED TOTAL SYSTEM VOLUME GALLONS	TYPE	OPERATING PRESSURES AT EXPANSION TANK			SYSTEM OPERATING TEMPERATURES		EXPANSION VOLUME GALLONS	ACCEPTANCE FACTOR	MINIMUM TANK VOLUME GALLONS	DIMENSIONS		MODEL NUMBER	KEYED NOTES
				INITIAL PSIG	PRE-CHARGE PSIG	MAX (OPERATING) PSIG	MINIMUM °F	MAXIMUM °F				DIAMETER INCHES	HEIGHT INCHES		
ET-1	DWH-1	325	DIAPHRAGM	40	35	69.4	40	140	4.5	0.35	14.3	16	34	PTA-60V	

GENERAL NOTES:
1. MODEL NUMBERS ARE BELL & GOSSETT UNLESS OTHERWISE NOTED.
2. THE CONTRACTOR SHALL PRE-CHARGE THE TANK TO THE VALUE INDICATED IN THE SCHEDULE. FOR TANKS THAT ARE SUPPLIED PRE-CHARGED BY THE MANUFACTURER, THE CONTRACTOR SHALL CONFIRM THE PRESSURE AND MAKE ADJUSTMENTS AS REQUIRED.

THERMOSTATIC MIXING VALVE SCHEDULE

UNIT IDENTIFICATION	MINIMUM FLOW GPM	MAXIMUM FLOW GPM	PRESSURE DROP AT MAXIMUM FLOW PSIG	MODEL NUMBER	KEYED NOTES
MV-1	0.5	27	25	1NB-LF	

GENERAL NOTES:
1. MODEL NUMBERS ARE LEONARD UNLESS OTHERWISE NOTED.

PLUMBING CONNECTION SCHEDULE

UNIT IDENTIFICATION	CW INCHES	HW INCHES	SAN INCHES	OSAN INCHES	VENT INCHES	KEYED NOTES
WC-1	1 1/2	–	4	–	2	
LAV-1	1/2	1/2	1 1/2	–	1 1/2	1
LAV-2	1/2	1/2	1 1/2	–	1 1/2	1
SK-1	1/2	1/2	1 1/2	–	1 1/2	1
SK-2	1/2	1/2	1 1/2	–	1 1/2	1
SK-3	1/2	1/2	1 1/2	–	1 1/2	1
SS-1	3/4	3/4	3	–	–	
WF-1	3/4	3/4	–	–	–	
EWC-1	1/2	–	1 1/2	–	1 1/2	
HB-1	3/4	–	–	–	–	
WH-1	3/4	–	–	–	–	
SH-1	3/4	3/4	–	–	–	1
SH-2	3/4	3/4	–	–	–	1
FD-1	–	–	3	–	–	
FD-2	–	–	2	–	–	
FD-3	–	–	4 OR 6 REFER TO FLOOR PLANS	–	–	
TD-1	–	–	–	–	–	
TD-2	–	–	4	4	–	

GENERAL NOTES:
1. INDIVIDUAL WATER LINE BRANCHES, WASTE LINES, VENTS, AND TRAPS FOR CONNECTION TO INDIVIDUAL FIXTURES, FIXTURE FITTINGS, AND SPECIALTIES SHALL BE IN ACCORDANCE WITH THE FOLLOWING SCHEDULE OR AS INDICATED ON DRAWINGS, WHICHEVER IS GREATER.

KEYED NOTES:
1. PROVIDE MIXING VALVE.

SCHEDULES GENERAL NOTES:

TYPICAL FOR ALL SCHEDULE SHEETS:

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2. PROVIDE THE FOLLOWING FACTORY-WIRED ELECTRICAL OPTIONS/ACCESSORIES WHERE INDICATED IN SCHEDULE:
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   - E – COMBINATION STARTER
   - F – UNIT SHALL HAVE (2) SINGLE POINT CONNECTIONS WITH FACTORY INSTALLED DISCONNECTING MEANS AND ALL REQUIRED STARTERS AND CONTROLS. (1) CONNECTION SHALL BE FOR CONDENSING SECTION AND (1) CONNECTION SHALL BE FOR THE REMAINDER OF THE UNIT.
3. FOR MODULATION/CONTROL TYPE COLUMN, "VFC" INDICATES VARIABLE FREQUENCY CONTROLLERS, "AUTO" INDICATES AUTOMATIC OPERATION (CONTROLLED BY TEMPERATURE CONTROLS OR SELF CONTAINED CONTROLS), "MANUAL" INDICATES HAND OPERATION.
4. IF VARIABLE FREQUENCY CONTROLLERS ARE INDICATED TO BE PROVIDED AND ARE NOT INSTALLED INTEGRAL TO THE UNIT, VARIABLE FREQUENCY CONTROLLERS SHALL BE SUPPLIED BY THE MECHANICAL CONTRACTOR (UNLESS OTHERWISE NOTED) AND INSTALLED BY THE ELECTRICAL CONTRACTOR INCLUDING THE LINE SIDE AND LOAD SIDE WIRING TO THE MOTOR AND INCLUDING MISCELLANEOUS STEEL REQUIRED FOR THE SUPPORT AND MOUNTING OF THE VFC. REFER TO FLOOR PLANS FOR LOCATION.
5. WHERE EQUIPMENT IS INDICATED TO HAVE A SINGLE POINT ELECTRICAL CONNECTION, THAT EQUIPMENT SHALL COME COMPLETE WITH FACTORY INSTALLED STARTERS, MOTOR OVERLOAD PROTECTION, CONTACTORS, FUSING AND ALL NECESSARY INTERNAL WIRING AND CONTROLS. PROVIDE A FACTORY MOUNTED UNIT DISCONNECTING MEANS WHERE THE ELECTRICAL CONTRACTOR SHALL MAKE SINGLE POINT CONNECTION. INSTALL PACKAGED EQUIPMENT SUCH THAT THE ELECTRICAL CONNECTION AND CONTROLS ARE ACCESSIBLE AND HAVE CLEARANCES MEETING THE NATIONAL ELECTRICAL CODE.
6. WHERE PACKAGED EQUIPMENT IS PROVIDED, NAMEPLATE MUST INDICATE MAXIMUM OVERCURRENT PROTECTION BY HACR RATED CIRCUIT BREAKERS OR FUSES. IF FUSE PROTECTION ONLY IS INDICATED, PROVIDE A FUSIBLE DISCONNECT AND FUSES WITH THE UNIT.
7. WHERE EQUIPMENT IS DESIGNATED BY MANUFACTURER AND MODEL NUMBER, THIS IS THE BASIS OF DESIGN. IF THE CONTRACTOR ELECTS TO PROVIDE EQUIPMENT BY OTHER SPECIFIED MANUFACTURERS OR PROPOSED ALTERNATE EQUIPMENT BY THE BASIS OF DESIGN MANUFACTURER, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY REVISIONS TO ELECTRICAL REQUIREMENTS, STRUCTURAL LOADING, OR ARCHITECTURAL APPURTENANCES AND SHALL INCLUDE THE COST OF SUCH REVISIONS IN HIS BID.
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9. SIZE ALL EQUIPMENT FEEDERS BASED ON THE LISTED MOP (MAXIMUM OVERCURRENT PROTECTION). REFER TO THE FEEDER AND BRANCH CIRCUIT SIZING SCHEDULE ON THE ELECTRICAL STANDARD SCHEDULES SHEET.

SEWAGE PUMP AND SUMP PUMP SCHEDULE

UNIT IDENTIFICATION	SYSTEM SERVED	SIMPLEX OR DUPLEX	PUMP					BASIN				MODULATION/ CONTROL TYPE	ELECTRICAL				MODEL NUMBER	KEYED NOTES
			QUANTITY	FLOW EACH GPM	W.P.D. FT. HEAD	HP EACH	RPM	CONSTRUCTION	DIAMETER INCHES	DEPTH INCHES	COVER TYPE		VOLTS	PHASE	SCCR KA	OPTIONS/ ACCESSORIES		
SP-1	ELEVATOR PIT	SIMPLEX	1	50	15	0.33	1750	CONCRETE	24	36	OPEN GRATE	AUTO	115	1	5		2EC0311L	

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBERS ARE BELL & GOSSETT UNLESS OTHERWISE NOTED.

PUMP SCHEDULE

UNIT IDENTIFICATION	SYSTEM SERVED	LOCATION	TYPE	COUPLING TYPE	WATERFLOW GPM	FLUID TYPE	COLDEST SYSTEM OPERATING TEMP. °F FOR PUMP SELECTION	PUMP HEAD FT.	OVERLOAD GPM	HP	MODULATION/ CONTROL TYPE	ELECTRICAL				MODEL NUMBER	KEYED NOTES
CP-1	HWR	MECH 203	INLINE	CLOSE	3.9	WATER	40	10.5	NON-OVERLOADING	1/12	AUTO	115	1	5		ECOCIRC XL 20-35	

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBER ARE BELL & GOSSETT UNLESS OTHERWISE NOTED.
3. FLUID TYPE: W = WATER, PGXX = PROPYLENE GLYCOL SOLUTION XX PERCENTAGE OF GLYCOL, EGXX = ETHYLENE GLYCOL SOLUTION XX PERCENTAGE OF GLYCOL.
4. CONTROLLER (E.G. VARIABLE FREQUENCY CONTROLLER, MOTOR STARTER) FOR SPECIFIED EQUIPMENT SHALL BE MANUFACTURED AND MARKED PER NEC WITH A MINIMUM SHORT CIRCUIT CURRENT RATING AS INDICATED.

AIR COMPRESSOR SCHEDULE

UNIT NUMBER	SIMPLEX OR DUPLEX	TYPE	DELIVERY PRESSURE PSIG	CAPACITY S.C.F.M.	COMPRESSOR(S)						MODULATION/ CONTROL TYPE	ELECTRICAL			MODEL NUMBER	KEYED NOTES
					S.C.F.M. EACH	HP EACH	RPM	LENGTH INCHES	DIAMETER INCHES	GALLONS		VOLTS	PHASE	SCCR KA		
AC-1	SIMPLEX	RECIPROCATING	125	17.2	17.2	5	658	35	28	80	AUTO	208	1	5	QP-5	1

GENERAL NOTES:
1. REFER TO SCHEDULES GENERAL NOTES.
2. MODEL NUMBERS ARE QUINCY UNLESS OTHERWISE NOTED.

KEYED NOTES:
1. INCLUDE ZEKS HTB-18 HIGH TEMP DRYER AND ZEKS ZFC-22-G & ZFC-22-H FILTERS.

TCA
ARCHITECTURE + PLANNING + DESIGN
Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021-0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

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City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

PLUMBING SCHEDULES

A3C
COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet P7.02

ELECTRICAL SYMBOL LIST

(NOTE: SOME SYMBOLS AND ABBREVIATIONS SHOWN MAY NOT APPLY TO THIS PROJECT.)

SYMBOL	DESCRIPTION
FX (NL)	FIXTURE TYPE (NL INDICATES NIGHT LIGHT)
	LIGHTING FIXTURE
	DIRECT/INDIRECT LIGHTING FIXTURE
	EMERGENCY LIGHTING FIXTURE
	LIGHTING FIXTURE
	WALL MOUNTED LIGHTING FIXTURE
	LIGHTING FIXTURE
	RECESSED OR SURFACE MOUNTED DIRECTIONAL LIGHTING FIXTURE
	PENDANT LIGHTING FIXTURE
	WALL SCONCE
	LIGHTING TRACK
	TRACK LIGHTING FIXTURE
	POLE MOUNTED LIGHTING FIXTURE
	POLE MOUNTED LIGHTING FIXTURE - POST TOP
	BOLLARD LIGHTING FIXTURE
	EMERGENCY LIGHTING UNIT
	EXIT LIGHTING FIXTURE WITH DIRECTIONAL ARROWS (SHADED AREA INDICATES FACE)
	EXIT LIGHTING FIXTURE WITH DIRECTIONAL ARROWS (SHADED AREA INDICATES FACE)
	EXIT LIGHTING FIXTURE - WALL MOUNTED
	EXIT/EMERGENCY LIGHTING COMBO
ALCR	AUTOMATIC LOAD CONTROL RELAY
BCELTS	BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH
LC	LIGHTING CONTROL DEVICE - REFER TO LIGHTING CONTROL SCHEDULE
XX	ROOM CONTROL DESIGNATION - REFER TO LIGHTING CONTROL SCHEDULE
S	SINGLE POLE TOGGLE SWITCH
S_2	TWO POLE TOGGLE SWITCH
S_3	3 WAY TOGGLE SWITCH
S_4	4 WAY TOGGLE SWITCH
K	KEY OPERATED SWITCH
K_3	3 WAY KEY OPERATED SWITCH
K_4	4 WAY KEY OPERATED SWITCH
D	DIMMER SWITCH
D_O	DIMMER OCCUPANCY SENSOR SWITCH
D_L	LOW VOLTAGE DIMMER SWITCH
D_3	3 WAY DIMMER SWITCH
S_P	PILOT SWITCH
TWC	TWO-WAY COMMUNICATION SYSTEM CALL STATION
TWCD	TWO-WAY COMMUNICATION SYSTEM AUTO DIALER
TWCA	TWO-WAY COMMUNICATION SYSTEM ANNUNCIATOR & COMMUNICATION PANEL
TWCP	TWO-WAY COMMUNICATION SYSTEM POWER SUPPLY WITH BATTERY BACK-UP
TWCDP	TWO-WAY COMMUNICATION SYSTEM AUTO DIALER POWER SUPPLY WITH BATTERY BACK-UP
RGP	REMOTE GENERATOR ANNUNCIATOR PANEL
ATS	AUTOMATIC TRANSFER SWITCH
UPS	UNINTERRUPTIBLE POWER SUPPLY
CSX	LOW VOLTAGE CONTROL STATION "X" INDICATES TYPE

SYMBOL	DESCRIPTION
	SINGLE / DUPLEX RECEPTACLE OUTLET "X" INDICATES TYPE
	SINGLE / DUPLEX RECEPTACLE OUTLET CONTROLLED BY AUTOMATIC CONTROL DEVICE / SYSTEM
	QUAD RECEPTACLE OUTLET
	ABOVE COUNTER DUPLEX RECEPTACLE (SIMILAR FOR TAMPER RESISTANT, QUADS, EMERGENCY AND GFI RECEPTACLES)
	DUPLEX RECEPTACLE-GROUND FAULT CIRCUIT INTERRUPTER
	DEAD FRONT-GROUND FAULT CIRCUIT INTERRUPTER
	DUPLEX EMERGENCY RECEPTACLE OUTLET
	ABOVE COUNTER TAMPER RESISTANT RECEPTACLE OUTLET
	QUAD TAMPER RESISTANT RECEPTACLE OUTLET
	TAMPER RESISTANT RECEPTACLE OUTLET
	DUPLEX UPS RECEPTACLE
	DUPLEX RECEPTACLE WITH 2 USB PORTS OUTLET
	USB 4 PORT CHARGING STATION
	CEILING MOUNTED DUPLEX / QUAD RECEPTACLE
	POWER POLE
	WALL / CEILING MOUNTED SPECIAL RECEPTACLE - REFER TO ELECTRICAL STANDARD SCHEDULES
	MULTI-OUTLET SURFACE RACEWAY
"X"	MULTI-SERVICE DROP SEE ELECTRICAL DETAILS AND DIAGRAMS SHEET "X" INDICATES TYPE
PTX	POKE-THROUGH ASSEMBLY "X" INDICATES TYPE
FBX	FLOOR SERVICE FITTING "X" INDICATES TYPE
AFX	ACCESS FLOOR SERVICE FITTING "X" INDICATES TYPE
RX	CORD REEL "X" INDICATES TYPE
	DUAL SWITCHING FOR INNER/OUTER LAMPS OF FLUORESCENT LIGHT FIXTURES
	3-WAY DUAL SWITCHING FOR INNER/OUTER LAMPS OF FLUORESCENT LIGHT FIXTURES
	4-WAY DUAL SWITCHING FOR INNER/OUTER LAMPS OF FLUORESCENT LIGHT FIXTURES
S_T	DIGITAL TIME SWITCH
S_I	ILLUMINATED TOGGLE SWITCH FOR CONTROL OF LIGHTING ON CRITICAL POWER-ILLUMINATED WHEN SWITCH IS IN "OFF" POSITION
S_L	LOW VOLTAGE SWITCH
S_O	OCCUPANCY SENSOR
S_{O2}	OCCUPANCY SENSOR - REFER TO ELECTRICAL STANDARD SCHEDULE
OS X	OCCUPANCY SENSOR - REFER TO ELECTRICAL STANDARD SCHEDULES - "X" INDICATES TYPE
CP	CONTROL PANEL
	MOTOR
VFC	VARIABLE FREQUENCY CONTROLLER
	MANUAL CONTROLLER
	MAGNETIC CONTROLLER
	COMBINATION MAGNETIC CONTROLLER

SYMBOL	DESCRIPTION
	NON-FUSIBLE DISCONNECT SWITCH
	FUSIBLE DISCONNECT SWITCH
CB	ENCLOSED CIRCUIT BREAKER
	PUSH BUTTON STATION
J	JUNCTION BOX
	HARD WIRE POWER CONNECTION
	GROUND ROD
	GROUND CONNECTION
HH	HANDHOLE
X	CONDUIT SLEEVE WITH BUSHINGS LENGTH AS REQUIRED "X" INDICATES CONDUIT SIZE
	CONDUIT UP
	CONDUIT DOWN
	EMPTY BOX FOR FUTURE TELECOMMUNICATION OUTLET
	EMPTY BOX FOR FUTURE TELECOMMUNICATION OUTLET MOUNTED 8" ABOVE COUNTERTOP
	EMPTY BOX FOR FUTURE CEILING MOUNTED TELECOMMUNICATION OUTLET
X	TELECOMMUNICATION OUTLET "X" INDICATES TYPE
X	TELECOMMUNICATION OUTLET MOUNTED 8" ABOVE COUNTERTOP "X" INDICATES TYPE
X	TELECOMMUNICATION CEILING MOUNTED OUTLET "X" INDICATES TYPE
	TELECOMMUNICATION BACKBOARD
TGB	TELECOMMUNICATION GROUNDING BUS BAR
TMGB	TELECOMMUNICATION MAIN GROUNDING BUS BAR
IC	INTERCOM OUTLET
S	SPEAKER
S	SPEAKER - WALL MOUNTED
MIC	MICROPHONE
VC	VOLUME CONTROL
B	SIGNALING BELL
	SINGLE FACE CLOCK - CEILING MOUNTED
	SINGLE FACE CLOCK - WALL MOUNTED
	DOUBLE FACE CLOCK - CEILING MOUNTED
S	DOUBLE FACE COMBINATION CLOCK/SPEAKER CEILING MOUNTED
	DOUBLE FACE CLOCK - WALL MOUNTED
S	DOUBLE FACE COMBINATION CLOCK/SPEAKER WALL MOUNTED
T/C	TIME CLOCK
C	CONTACTOR
P	PHOTOCELL
TT	TWIST TIMER

REFER TO ELECTRICAL STANDARD SCHEDULES

SYMBOL	DESCRIPTION
	SECURITY CAMERA
MD	MOTION DETECTOR
K	SECURITY KEY SWITCH
DC	DOOR CONTACT
KP	KEY PAD
CR	CARD READER
DB	DURESS PUSH BUTTON STATION
DE	DELAYED EGRESS
REX	REQUEST TO EXIT STATION
PP	AUTOMATIC DOOR PUSH PAD OPERATOR
DO	DOOR OPERATOR
DA	DOOR ACTUATOR
AC	ACCESS CONTROL STATION
ACCP	ACCESS CONTROL CONTROL PANEL
ACCP	ACCESS CONTROL POWER SUPPLY
	CIRCUIT BREAKER
	DRAWOUT CIRCUIT BREAKER MANUALLY/ OPERATED
E	DRAWOUT CIRCUIT BREAKER ELECTRICALLY/ OPERATED
	SWITCH
	AUTOMATIC OR MANUAL TRANSFER SWITCH
	FUSE
	TRANSFORMER
	CURRENT TRANSFORMER
	POTENTIAL TRANSFORMER
	LIGHTNING ARRESTOR
X	PANELBOARD "X" INDICATES PANELBOARD NAME
	GROUND
	STRESS CONE TERMINATION
K	SECURITY KEY INTERLOCK
G	ENGINE GENERATOR
M	UTILITY METER
EMU	ELECTRONIC METERING UNIT
A	AMMETER
V	VOLTMETER
AS	AMMETER SWITCH
VS	VOLTMETER SWITCH
SPD	SURGE PROTECTIVE DEVICE
CR	CONTROL RELAY
TDR	TIME DELAY RELAY
	THERMAL OVERLOAD RELAY
	NORMALLY OPEN CONTACTS
	NORMALLY CLOSED CONTACTS
	N.O. PUSH BUTTON SINGLE CIRCUIT
	N.C. PUSH BUTTON SINGLE CIRCUIT
O X-X	CABLE VAULT "X-X" INDICATES TYPE

SYMBOL	DESCRIPTION
	DISTRIBUTION PANEL
GB	GROUND BUS
PB	PLUG IN BUSWAY
FB	FEEDER BUSWAY
F	MANUAL FIRE ALARM BOX
SD	SMOKE DETECTOR
DD	DUCT SMOKE DETECTOR
CO	CARBON MONOXIDE DETECTOR
RT	REMOTE TEST STATION (FOR DUCT DETECTOR)
TD	THERMAL DETECTOR
BD	PROJECTED BEAM DETECTOR
F	FIRE ALARM BELL
F	FIRE ALARM AUDIBLE NOTIFICATION APPLIANCE
XX	FIRE ALARM VISUAL NOTIFICATION APPLIANCE "XX" INDICATES CANDELA RATING IF NO RATING SHOWN, APPLIANCE IS 15cd
XX	FIRE ALARM COMBINATION VISUAL/ AUDIBLE "XX" INDICATES CANDELA RATING IF NO RATING SHOWN, APPLIANCE IS 15cd
F XX	FIRE ALARM COMBINATION VISUAL/ AUDIBLE NOTIFICATION APPLIANCE - CEILING MOUNTED "XX" INDICATES CANDELA RATING IF NO RATING SHOWN, APPLIANCE IS 15cd
XX	FIRE ALARM VISUAL NOTIFICATION APPLIANCE CEILING MOUNTED "XX" INDICATES CANDELA RATING IF NO RATING SHOWN, APPLIANCE IS 15cd
F	FIRE ALARM AUDIBLE NOTIFICATION APPLIANCE - CEILING MOUNTED
F	FIREFIGHTERS PHONE JACK
FACP	FIRE ALARM CONTROL PANEL
FAA	FIRE ALARM ANNUNCIATOR PANEL
NAC	NOTIFICATION APPLIANCE CIRCUIT EXTENDER PANEL
IM	ADDRESSABLE MONITORING MODULE
CM	ADDRESSABLE CONTROL MODULE
TS	TAMPER SWITCH
FS	FLOW SWITCH
DR	MAGNETIC DOOR RELEASE
	BRANCH CIRCUIT PANEL BOARD
	LOAD CENTER
	MOTOR CONTROL CENTER
T	TRANSFORMER

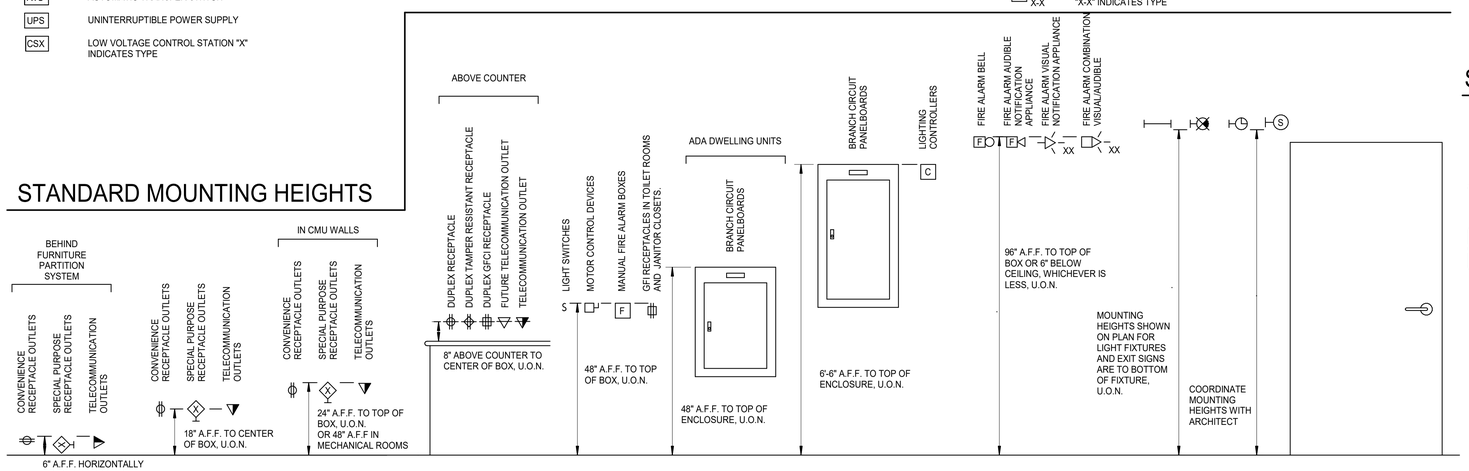
ELECTRICAL DRAWING INDEX

ELECTRICAL ABBREVIATION LIST

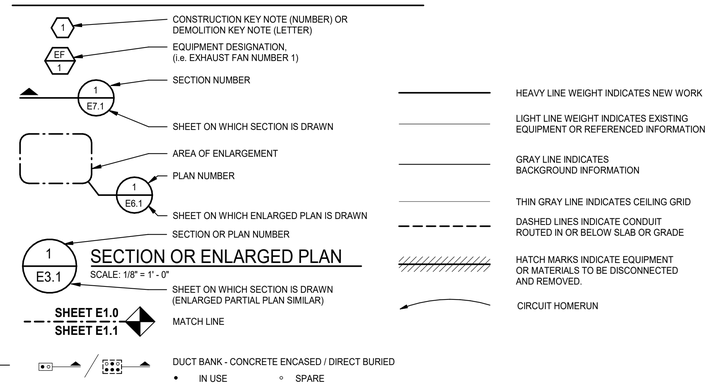
ABBREVIATION	DESCRIPTION
A	AMPERES
AER	ARC ENERGY REDUCTION
AF	AMPERES FRAME (BREAKER RATING)
AFCI	ARC FAULT CIRCUIT INTERRUPTER
A.F.F.	ABOVE FINISH FLOOR
AIC	AMPS INTERRUPTING CAPACITY
AL	AUDIENCE LEFT
ALCR	AUTOMATIC LOAD CONTROL RELAY
AR	AUDIENCE RIGHT
AT	AMPERES TRIP (BREAKER SETTING)
ATS	AUTOMATIC TRANSFER SWITCH
AUX	AUXILIARY
BCELTS	BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH
BKR	BREAKER
BPS	BOLTED PRESSURE SWITCH
C	CONDUIT
CB	CIRCUIT BREAKER
CKT	CIRCUIT
CT	CURRENT TRANSFORMER
DEMO	DEMOLITION
DIM	DIMENSION
DISC	DISCONNECT
DP	DISTRIBUTION PANEL
DS	DOWNSTAGE
DWG	DRAWING
EBU	EMERGENCY BATTERY UNIT
EC	ELECTRICAL CONTRACTOR
ELEC	ELECTRICAL
EM/ EMERG	EMERGENCY
EMT	ELECTRICAL METALLIC TUBING
EO	ELECTRICALLY OPERATED
EPO	EMERGENCY POWER OFF
EWC	ELECTRIC WATER COOLER
EXIST	EXISTING
FA	FIRE ALARM
FLA	FULL LOAD AMPS
FLR	FLOOR
FOH	FRONT OF HOUSE
FSEC	FOOD SERVICE EQUIPMENT CONTRACTOR
FU	FUSE
G/GRD/EG	GROUND
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GFP	GROUND FAULT PROTECTION
HOA	HAND-OFF-AUTO
HP	HORSEPOWER
HV	HIGH VOLTAGE
HZ	HERTZ
IG	ISOLATED GROUND
JB	JUNCTION BOX
KA	THOUSAND AMP
KV	KILOVOLT
KVA	KILOVOLT - AMPERES
KW	KILOWATT
KWH	KILOWATT - HOURS
LA	LIGHTING ARRESTOR
LP	LIGHTING PANEL
LDP	LIGHTING DISTRIBUTION PANEL

ABBREVIATION	DESCRIPTION
MAX	MAXIMUM
MCA	MINIMUM CIRCUIT AMPACITY
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MDP	MAIN DISTRIBUTION PANEL
MECH	MECHANICAL
MIN	MINIMUM
MISC.	MISCELLANEOUS
MLO	MAIN LUGS ONLY
MOP	MAXIMUM OVERCURRENT PROTECTION
MTD	MOUNTED
MTG	MOUNTING
MTR	MOTOR
N	NEUTRAL
NC	NORMALLY CLOSED
NEC	NATIONAL ELECTRICAL CODE
NF	NON-FUSIBLE
NIC	NOT IN CONTRACT
NL	NIGHT LIGHT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OC	ON CENTER
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED, OWNER INSTALLED
P	POLE
PB	PUSHBUTTON STATION
PH	PHASE
PT	POTENTIAL TRANSFORMER
PDP	POWER DISTRIBUTION PANEL
RECEPT.	RECEPTACLE
RDP	RECEPTACLE DISTRIBUTION PANEL
RP	RECEPTACLE PANEL
RSC	RIGID STEEL CONDUIT
SCCA	SHORT CIRCUIT CURRENT RATING
SCHED	SCHEDULE
SPD	SURGE PROTECTION DEVICE
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
TB	TERMINAL BOX
TELECOM	TELECOMMUNICATIONS
TR	TAMPER RESISTANT
TTP	TELEPHONE TERMINAL BACKBOARD
TYP	TYPICAL
U.O.N.	UNLESS OTHERWISE NOTED
US	UPSTAGE
V	VOLTS
W	WIRE OR WATTS
WG	WIRE GUARD
WP	WEATHERPROOF
WR	WEATHER RESISTANT
XFMR	TRANSFORMER
XP	EXPLOSION PROOF
(E)	EXISTING
(R)	RELOCATED

STANDARD MOUNTING HEIGHTS



STANDARD METHODS OF NOTATION



T C A
ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021.0121

STATE OF MICHIGAN
ERIC MICHAEL GRAETTINGER
ENGINEER
No. 6201052164
LICENSED PROFESSIONAL ENGINEER

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City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

ELECTRICAL STANDARDS AND DRAWING INDEX

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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FEEDER AND BRANCH CIRCUIT SIZING SCHEDULE - GENERAL PURPOSE

OVERCURRENT DEVICE RATING (AMPERES)	COPPER CONDUCTORS						KEYED NOTES	ALUMINUM CONDUCTORS				
	WIRE SIZE (AWG OR KCMIL)		CONDUIT SIZE					WIRE SIZE (AWG OR KCMIL)		CONDUIT SIZE		
	PHASE & NEUTRAL	GROUND	SINGLE PHASE 2 WIRE+G (1PH, 1N, 1G)	SINGLE PHASE 3 WIRE+G (2PH, 1N, 1G)	THREE PHASE 3 WIRE+G (3PH, 1G)	THREE PHASE & NEUTRAL 4 WIRE+G (3PH, 1N, 1G)		PHASE & NEUTRAL	GROUND	SINGLE PHASE 3 WIRE+G (2PH, 1N, 1G)	THREE PHASE 3 WIRE+G (3PH, 1G)	THREE PHASE & NEUTRAL 4 WIRE+G (3PH, 1N, 1G)
15-20	12	12	3/4"	3/4"	3/4"	3/4"		N/A	N/A	N/A	N/A	N/A
25-30	10	10	3/4"	3/4"	3/4"	3/4"		N/A	N/A	N/A	N/A	N/A
35-40	8	10	3/4"	3/4"	3/4"	3/4"		N/A	N/A	N/A	N/A	N/A
45-50	8 (6)	10	3/4"	3/4"	3/4"	3/4"	1	N/A	N/A	N/A	N/A	N/A
60	6 (4)	10	3/4" (1")	3/4" (1")	3/4" (1")	1" (1 1/4")	1	N/A	N/A	N/A	N/A	N/A
70	4	8	1"	1 1/4"	1 1/4"	1 1/4"		N/A	N/A	N/A	N/A	N/A
80	4 (3)	8	1"	1 1/4"	1 1/4"	1 1/4"	1	N/A	N/A	N/A	N/A	N/A
90-100	3 (2)	8	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1	1	6	1 1/2"	1 1/4"	1 1/2"
110	2 (1)	6	-	1 1/4"	1 1/4"	1 1/4" (1 1/2")	1	1/0	4	1 1/2"	1 1/2"	2"
125	1 (1/0)	6	-	1 1/4" (1 1/2")	1 1/4" (1 1/2")	1 1/2"	1	2/0	4	1 1/2"	1 1/2"	2"
150	1/0	6	-	1 1/2"	1 1/2"	1 1/2"		3/0	4	2"	2"	2 1/2"
175	2/0	6	-	2"	2"	2"		4/0	4	2"	2"	2 1/2"
200	3/0	6	-	2"	2"	2 1/2"		250	4	2"	2"	3"
225	4/0	4	-	2"	2"	2 1/2"		300	2	2 1/2"	2 1/2"	3"
250	250	4	-	2 1/2"	2 1/2"	2 1/2"		350	2	2 1/2"	2 1/2"	3"
300	350	4	-	2 1/2"	2 1/2"	3"		500	2	3"	3"	3 1/2"
350	500	3	-	3"	3"	3"		2-4/0	2-1/0	2-2"	2-2"	2-2"
400	500	3	-	3"	3"	3"		2-250	2-1/0	2-2 1/2"	2-2 1/2"	2-2 1/2"
450	2-4/0	2-2	-	2-2"	2-2"	2-2 1/2"		2-300	2-1/0	2-2 1/2"	2-2 1/2"	2-3"
500	2-250	2-2	-	2-2 1/2"	2-2 1/2"	2-2 1/2"		2-350	2-1/0	2-2 1/2"	2-2 1/2"	2-3"
600	2-350	2-1	-	2-2 1/2"	2-2 1/2"	2-3"		2-500	2-2/0	2-3"	2-3"	2-3 1/2"
700	2-500	2-1/0	-	2-3"	2-3"	2-3"		2-600	2-3/0	2-3"	2-3"	2-3 1/2"
800	2-500	2-1/0	-	2-3"	2-3"	2-3 1/2"		3-400	3-3/0	3-3"	3-3"	3-3 1/2"
1000	3-400	3-2/0	-	3-3"	3-3"	3-3"		3-600	3-4/0	-	4-3"	4-3 1/2"
1200	3-600	3-3/0	-	3-3 1/2"	3-3 1/2"	3-3 1/2"		4-500	4-250	-	4-3"	4-3 1/2"
1600	4-600	4-4/0	-	4-3 1/2"	4-3 1/2"	4-3 1/2"		5-600	5-350	-	5-3 1/2"	5-4"
2000	5-600	5-250	-	5-3 1/2"	5-3 1/2"	5-3 1/2"		6-600	6-400	-	6-3 1/2"	6-4"

GENERAL NOTES:
1. CONTRACTOR TO SIZE FEEDERS AND BRANCH CIRCUITS BASED ON THIS SCHEDULE AND OVER CURRENT DEVICE SIZE, UNLESS NOTED OTHERWISE.
2. CONTRACTOR MAY COMBINE 20A CIRCUITS AS NOTED IN SPECIFICATION.
3. CONDUCTORS ARE BASED ON THHN/THWN UP TO AND INCLUDING #4/0. LARGER THAN #4/0 ARE BASED ON TYPE XHHW.
4. CONDUIT SIZES ARE VALID FOR EMT OR RGS. CONDUIT SIZES SHALL BE ADJUSTED AS REQUIRED FOR OTHER TYPES OF CONDUIT.
5. ELECTRICAL CONTRACTOR TO COORDINATE WITH MECHANICAL CONTRACTOR AND PROVIDE REQUIRED WIRE SIZES TO ACCOMMODATE MECHANICAL EQUIPMENT LUG SIZES.
6. SIZE OF DISCONNECT SWITCH LOCATED AT EQUIPMENT SHALL BE SIZED BASED UPON OVERCURRENT PROTECTION OF THAT DEVICE.
7. OBTAIN APPROVAL FROM ENGINEER PRIOR TO INSTALLING DIFFERENT SIZE/QUANTITY OF CONDUCTORS TO OBTAIN AN EQUIVALENT AMPACITY.
8. SPLICE FROM ALUMINUM TO COPPER PRIOR TO ENTERING EQUIPMENT LISTED FOR USE WITH COPPER CONDUCTORS ONLY OR USE COPPER CONDUCTORS FOR THE ENTIRE LENGTH OF FEEDER.
9. N/A = NOT ACCEPTABLE

KEYED NOTES:
1. CONDUCTORS ARE BASED ON 90°C, 600V. INSULATED WIRE APPLIED AT 75°C FOR TERMINATION RATED 60/75°C OR 75°C. FOR TERMINATION RATED AT 60°C, USE CONDUCTORS AND CONDUIT SIZES INDICATED IN PARENTHESES.

DRY TYPE DISTRIBUTION TRANSFORMER CIRCUIT SIZING SCHEDULE

TRANSFORMER KVA	PRIMARY (480V)	SECONDARY (208Y/120 VOLT)									KEYED NOTES
	OVERCURRENT PROTECTION	OVERCURRENT PROTECTION	CONDUCTOR SIZE (AWG OR KCMIL)						GROUNDING ELECTRODE CONDUCTOR		
			PHASE & NEUTRAL		SUPPLY SIDE BONDING JUMPER		CONDUIT (4W + SSBJ)				
			COPPER	ALUMINUM	COPPER	ALUMINUM	COPPER	ALUMINUM	COPPER	ALUMINUM	
9	20A	30A	10	NA	8	NA	3/4"	NA	8	NA	
15	25A	60A	6	NA	8	NA	1"	NA	8	NA	1
30	45A	100A	3	1	8	6	1 1/4"	1 1/2"	8	6	1
45	70A	175A	2/0	4/0	4	2	2"	2 1/2"	4	2	
75	125A	300A/225A	350 / 4/0	500 / 300	2	1/0	3"	3 1/2"	2	1/0	2
112 1/2	175A	400A	600	2-250	1/0	2	3 1/2"	2-2 1/2"	1/0	1/0	
150	225A	600A	2-350	2-500	2-2	2-1/0	2-3"	2-3 1/2"	2/0	4/0	
225	350A	800A	2-600	3-400	2-1/0	3-1/0	2-3 1/2"	3-3"	3/0	4/0	
300	500A	1200A	3-600	4-500	3-1/0	4-1/0	3-3 1/2"	4-3 1/2"	3/0	250	
500	800A	1600A	4-600	5-600	4-1/0	5-3/0	4-3 1/2"	5-3 1/2"	3/0	250	

GENERAL NOTES:
1. TRANSFORMERS AND FEEDERS ARE BASED ON 480 VOLT, 3 PHASE, 3 WIRE PRIMARY AND 208Y/120 VOLT, 3 PHASE, 4 WIRE, SECONDARY.
2. ALUMINUM CONDUCTORS ARE PERMITTED ONLY IF INCLUDED IN FEEDER AND BRANCH CIRCUIT SIZING SCHEDULE.
3. PRIMARY OVERCURRENT PROTECTION IS SIZED AT 125% OF TRANSFORMER FULL LOAD CURRENT. PROVIDE PRIMARY OVERCURRENT DEVICE SELECTION TO ALLOW TRANSFORMER IN-RUSH CURRENT AND PROTECT BASED ON THE ANSI DAMAGE CURVE. IF MANUFACTURER REQUIRES PRIMARY OVERCURRENT GREATER THAN 125% (NOT TO EXCEED 250%) THEN PRIMARY FEEDER SHALL BE INCREASED ACCORDINGLY.
4. SECONDARY CONDUCTOR BASED ON TEN FOOT MAXIMUM LENGTH (NEC 240.21(C)(2)). IF CONDUCTORS ARE LONGER THAN TEN FOOT, REQUIREMENTS IN NEC 240.21(C)(6) MUST BE MET. IN NO CASE SHALL CONDUCTORS BE LONGER THAN TWENTY-FIVE FEET.

KEYED NOTES:
1. CONDUCTORS ARE BASED ON 90°C, 600V. INSULATED WIRE APPLIED AT 75°C FOR TERMINATION RATED 60/75°C OR 75°C.
2. THE SMALLER SIZE IS TO BE USED TO FEED 225A PANELBOARDS.

BRANCH CIRCUIT VOLTAGE DROP WIRING SCHEDULE FOR SINGLE PHASE CIRCUITS

BRANCH CIRCUIT RATING (A)	WIRE SIZE (AWG)	MAXIMUM BRANCH CIRCUIT LENGTH (IN FEET)				
		120V	208V	240V	277V	480V
20A	12	83	143	165	191	331
20A	10	128	222	256	295	511
20A	8	201	348	402	464	804
20A	6	313	542	625	721	1250
30A	10	85	148	170	197	341
30A	8	134	232	268	309	536
30A	6	208	361	417	481	833
30A	4	313	542	625	721	1250

GENERAL NOTES:
1. THE ABOVE TABLE VALUES ARE BASED ON COPPER CONDUCTORS, IN STEEL CONDUIT, WITH A LOAD POWER FACTOR OF 0.85 PER NEC CHAPTER 9, TABLE 9.
2. PROVIDE BRANCH CIRCUIT CONDUCTORS AS INDICATED IN THE TABLE ABOVE FOR ALL LIGHTING AND RECEPTACLE BRANCH CIRCUITS. WHERE BRANCH CIRCUITS SERVE DEDICATED EQUIPMENT, THE CONTRACTOR MAY PERFORM VOLTAGE DROP CALCULATIONS BASED ON ACTUAL EQUIPMENT CONNECTED LOAD AND PROVIDE CONDUCTORS APPROPRIATELY SIZED TO LIMIT VOLTAGE DROP TO A MAXIMUM OF 3%.
3. CONDUCTOR SIZES ARE BASED ON MAXIMUM OF 9 CURRENT CARRYING CONDUCTORS IN A SINGLE CONDUIT.
4. LIMITS FOR CONDUCTOR LENGTHS SHOWN ARE BASED ON A MAXIMUM BRANCH CIRCUIT LOADING OF 64% OF THE BRANCH BREAKER RATING AND A MAXIMUM OF 3 PERCENT VOLTAGE DROP TO COMPLY WITH ASHRAE 90.1 AND THE NEC. FOR CIRCUITS LOADED GREATER THAN 64% OF BRANCH BREAKER RATING, THE CONTRACTOR SHALL PROVIDE CONDUCTORS APPROPRIATELY SIZED TO LIMIT VOLTAGE DROP TO 3%.

FLOOR SERVICE FITTING SCHEDULE

TYPE	DESCRIPTION	MANUFACTURER (SEE NOTE #2)	MODEL	DEVICE CONFIGURATION	FLANGE/COVER MATERIAL & COLOR	SERVICE PLATE TYPE	MINIMUM DEPTH	MAXIMUM CONDUIT
FB4D	MULTI FUNCTION FOUR GANG, MULTI SERVICE, STAMPED STEEL FOR SLAB ON GRADE APPLICATIONS, RECESSED FLOOR BOX. 2 DUPLEX RECEPTACLES AND 2 TELECOM OUTLETS, CARPET/TILE INSERT COVER.	WIREMOLD	RFB4E-OG	2D / 2T	ARCHITECT SELECTED	F	3 1/2"	2"

GENERAL NOTES:
1. PROVIDE 1 1/4"C. FROM EACH TELECOM FLOOR BOX (GANG) TO ACCESSIBLE LOCATION IN CEILING.
2. OTHER ACCEPTABLE MANUFACTURERS ARE STEEL CITY, OR HUBBELL-RACO.
3. ALL PRODUCTS IN THIS SCHEDULE SHALL MEET AND EXCEED THE UL514A or UL514C SCRUB WATER EXCLUSION REQUIREMENT.
4. COORDINATE ALL TELECOM AND A/V OUTLETS WITH COMMUNICATIONS AND A/V CONTRACTORS.

PF = PARTITION FEED
D = DUPLEX RECEPTACLE
T = 2 TELECOM OPENINGS

BS = BRASS
AL = ALUMINUM
BK = BLACK
GY = GRAY (CONCRETE)
BZ = BRONZE
NK = NICKEL

FR = FLIP LID/RECTANGULAR
SL = SLIDES
F = FLIP COVER

NOTE: SOME SYMBOLS AND ABBREVIATIONS SHOWN MAY NOT APPLY TO THIS PROJECT

RACEWAY / CONDUCTOR / CABLE APPLICATION SCHEDULE

	WIRE			RACEWAY												CABLE/CORD						
	COPPER, TYPE THHN/THWN-2	COPPER, TYPE XHHW-2	ALUMINUM, TYPE XHHW-2 (100A AND ABOVE ONLY)	ELECTRICAL METALLIC TUBING (EMT)	INTERMEDIATE METAL CONDUIT (IMC)	RIGID STEEL CONDUIT (RSC)	PVC COATED RIGID STEEL CONDUIT	RIGID NON-METALLIC CONDUIT (RNC) TYPE EPC-40	RIGID NON-METALLIC CONDUIT (RNC) TYPE EPC-80	HIGH DENSITY POLYETHYLENE (HDPE) SCHEDULE 40	HIGH DENSITY POLYETHYLENE (HDPE) SCHEDULE 80	REINFORCED THERMOSET RESIN CONDUIT (RTRC) TYPE AG	REINFORCED THERMOSET RESIN CONDUIT (RTRC) TYPE BG	FLEXIBLE METAL CONDUIT (FMC)	LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC)	SURFACE RACEWAY	METAL CLAD TYPE CABLE WITH INSULATED GROUND WIRE (TYPE MC)	VFC CABLE	TRAY CABLE (TYPE TC)	TRAY CABLE EXPOSED RUNS (TYPE TC-ER)	PHOTOVOLTAIC CABLE (TYPE PV)	POWER LIMITED CABLE
FEEDERS - EXTERIOR																						
EXPOSED, SURFACE MOUNTED TO STRUCTURE		X	X		X	X	X					X										
EXPOSED, WITH FREESTANDING SUPPORT		X	X		X	X	X					X										
CONCEALED IN RETAINING WALL OR SIMILAR ELEMENT		X	X			X	X	X	X													
BELOW PARKING LOTS AND ROADWAYS		X	X				X		X		X		X									
BELOW GREEN SPACE		X	X				X	X		X			X									
WITHIN 5' OF FOUNDATION WALL		X	X			X	X															
ROOFTOPS (WHEN APPROVED BY ENGINEER)		X	X		X	X	X															
FEEDERS - INTERIOR																						
CONCEALED, ACCESSIBLE CEILINGS	X		X	X	X																	
CONCEALED, INACCESSIBLE CEILINGS	X		X	X	X																	
CONCEALED IN GYPSUM BOARD PARTITION WALLS	X		X	X	X																	
CONCEALED IN CMU WALLS	X		X	X	X																	
EXPOSED, BELOW 10' AFF AND SUBJECT TO DAMAGE	X		X		X	X	X															
EXPOSED, BELOW 10' AFF AND NOT SUBJECT TO DAMAGE	X		X	X	X																	
EXPOSED, ABOVE 10' AFF UNFINISHED SPACES	X		X	X	X																	
EXPOSED, FINISHED SPACES	X		X													X						
BELOW SLAB ON GRADE	X		X			X	X	X	X													
DAMP AND WET LOCATIONS	X		X		X	X	X	X														
BRANCH CIRCUITS - EXTERIOR																						
EXPOSED, SURFACE MOUNTED TO STRUCTURE		X			X	X	X		X													
EXPOSED, WITH FREESTANDING SUPPORT		X			X	X	X															
CONCEALED IN RETAINING WALL OR SIMILAR ELEMENT		X				X	X	X														
BELOW PARKING LOTS AND ROADWAYS		X				X	X	X		X												
BELOW GREEN SPACE		X						X														
WITHIN 5' OF FOUNDATION WALL		X				X	X															
ROOFTOPS (WHEN APPROVED BY ENGINEER)		X			X	X	X															
BRANCH CIRCUITS - INTERIOR																						
CONCEALED, ACCESSIBLE CEILINGS	X			X	X												X					
CONCEALED, INACCESSIBLE CEILINGS	X			X	X																	
CONCEALED IN GYPSUM BOARD PARTITION WALLS	X			X	X										X		X					
CONCEALED IN CMU WALLS	X			X	X																	
EXPOSED, BELOW 10' AFF AND SUBJECT TO DAMAGE	X				X	X	X															
EXPOSED, BELOW 10' AFF AND NOT SUBJECT TO DAMAGE	X			X	X											X						
EXPOSED, ABOVE 10' AFF UNFINISHED SPACES	X			X	X																	
EXPOSED, FINISHED SPACES	X															X						
BELOW SLAB ON GRADE	X						X															
EMBEDDED IN ELEVATED CONCRETE SLAB	X						X															
DAMP AND WET LOCATIONS	X				X	X	X	X								X						
SPECIAL APPLICATIONS																						
SERVICE ENTRANCE - UNDERGROUND		X	X				X	X	X	X	X											
SERVICE ENTRANCE - ABOVE GROUND		X	X	X	X	X																
CONNECTION BETWEEN VFC AND MOTORS (KEYED NOTE 1)																		X				
CLASS 1 CONTROL CIRCUITS	X			X	X	X													X	X		
CLASS 2 CONTROL CIRCUITS	X			X	X	X													X	X		X
CLASS 3 CONTROL CIRCUITS	X			X	X	X													X	X		X
CONNECTIONS TO TRANSFORMERS, MOTORS AND VIBRATING EQUIPMENT		X														X						
PHOTOVOLTAIC PANELS																					X	

GENERAL NOTES:
1. TRANSITION FROM PVC/HDPE AND PROVIDE RIGID STEEL OR RTRC SWEEPS WHERE CONDUITS PENETRATE WALLS, CONCRETE SLABS, CONCRETE BASES, AND ASPHALT.
2. REFER TO SPECIFICATIONS FOR RESTRICTIONS ON MC/AC CABLE INSTALLATION.
3. EMT SHALL NOT BE USED ON THE EXTERIOR OF A BUILDING OR IN AREAS SUBJECT TO DAMAGE BELOW 10' AFF.
4. INSTALL SURFACE RACEWAYS ONLY WHERE SHOWN ON DRAWINGS.

KEYED NOTES:
1. NON-ARMORED CABLE SHALL BE INSTALLED IN RACEWAY. ARMORED CABLE SHALL BE INSTALLED IN TRAY OR FREE-AIR AS APPLICABLE.
2. CONDUIT AND BUILDING WIRE ALLOWED WHEN ENCASED IN MINIMUM 2" CONCRETE.
3. EMERGENCY FEEDERS IN OCCUPANCIES THAT ARE UNDER 700.10(D) SHALL HAVE A TWO HOUR RATING. RATING SHALL BE OBTAINED BY ROUTING CONDUIT AND BUILDING WIRE IN SPRINKLERED SPACE, IN A TWO HOUR SHAFT, OUTSIDE OF THE BUILDING, IN A LISTED TWO HOUR RATED RACEWAY, OR UNDER A MINIMUM OF 2" OF CONCRETE; OR BY USING A LISTED TWO-HOUR RATED CABLE ASSEMBLY.

SPECIAL RECEPTACLES

TYPE	DESCRIPTION
Type 2	250V, 20A, SINGLE PHASE, LOCKING RECEPTACLE, 2 POLE, 3 WIRE (NEMA L6-20R)
Type 7	125/250V SINGLE PHASE RECEPTACLE, 3 POLE, 4 WIRE (NEMA 14-30R)
Type 8	125/250V SINGLE PHASE RECEPTACLE, 3 POLE, 4 WIRE (NEMA 14-50R)

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PBA
Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021.0121

STATE OF MICHIGAN
ERIC MICHAEL GRAETTINGER
ENGINEER
No. 6201052164
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: SMB Checked: SMB

City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

ELECTRICAL STANDARD SCHEDULES

A3C
COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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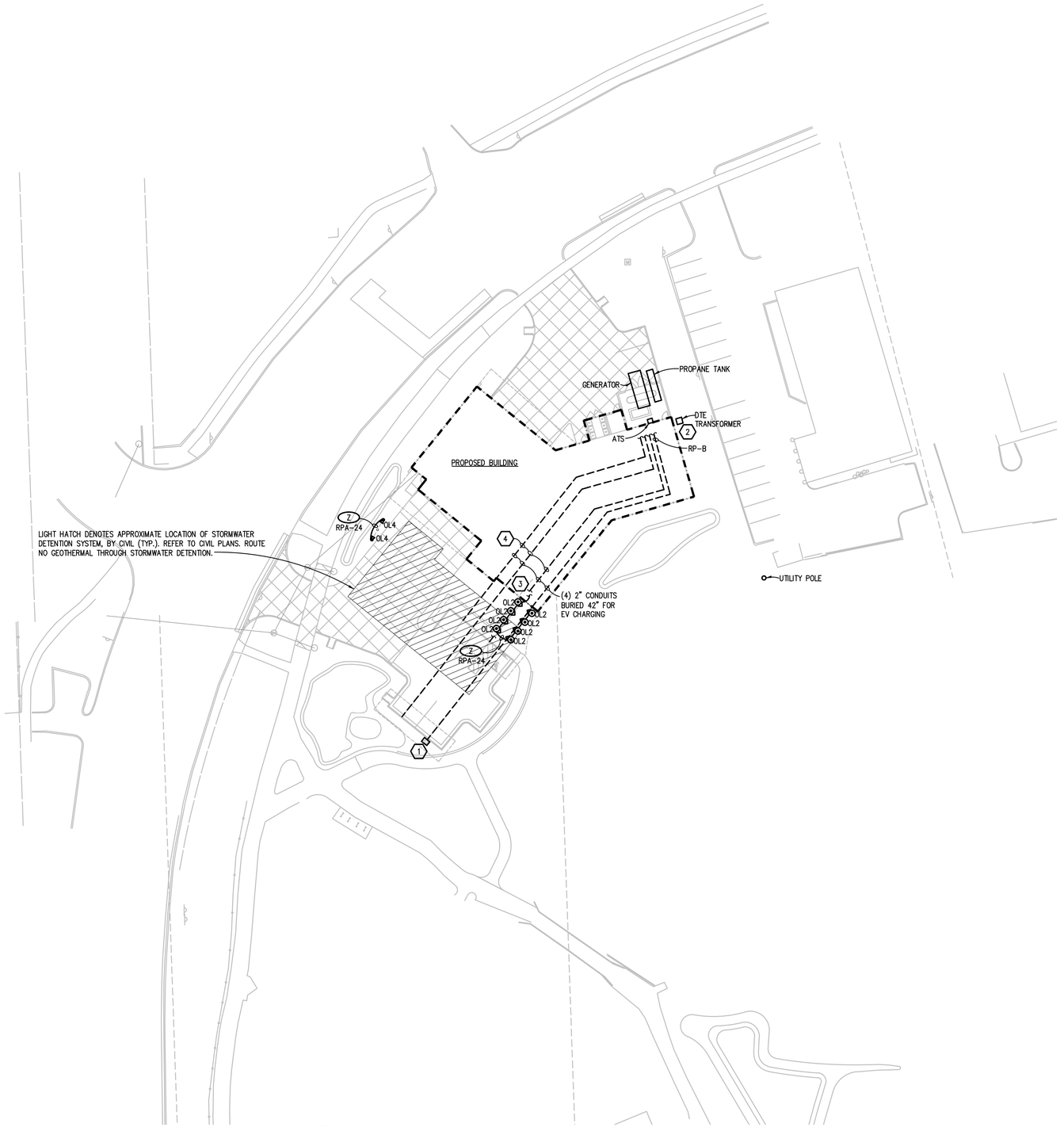
THE FOLLOWING DIMENSION EQUALS ONE INCH WHEN PRINTED TO SCALE. 1"



ELECTRICAL SITE PLAN
SCALE: 1" = 30'

SITE PLAN GENERAL NOTES:

1. THESE NOTES ARE GENERIC GUIDELINES ONLY. ELECTRICAL CONTRACTOR'S PERSONNEL ON SITE SHALL BE THOROUGHLY FAMILIAR WITH THE PUBLISHED SPECIFICATIONS FOR EXACT DESCRIPTIONS OF SCOPE, METHODS, AND MATERIAL.
2. THESE DRAWINGS REPRESENT THE GENERAL EXTENT AND ARRANGEMENT OF SYSTEMS. COORDINATE EXACT EQUIPMENT LOCATIONS, ELEVATIONS, AND FINAL CONNECTION REQUIREMENTS. PROVIDE EACH SYSTEM COMPLETE, INCLUDING ALL NECESSARY COMPONENTS, FITTINGS AND OFFSETS.
3. CONDUCT A SURVEY TO IDENTIFY ALL UNDERGROUND UTILITIES. CALL 811 PRIOR TO EXCAVATION.
4. UTILITIES SHOWN ON THESE DRAWINGS ARE FOR REFERENCE ONLY. COORDINATE EXACT LOCATION OF ALL EXISTING UTILITIES, AND ROUTING OF ALL NEW UNDERGROUND UTILITIES PRIOR TO EXCAVATION.
5. DEWATER TRENCHES PRIOR TO INSTALLATION OF CONDUITS. PROVIDE WATER TIGHT FITTINGS ON ALL UNDERGROUND CONDUITS.
6. COORDINATE DEMOLITION WORK, AND ELECTRICAL AND TELEPHONE SERVICES TO THE SITE, WITH THE RESPECTIVE LOCAL UTILITY COMPANY REPRESENTATIVES PRIOR TO COMMENCEMENT OF WORK. INCLUDE ALL ASSOCIATED COST/FEES BY THE UTILITY COMPANIES IN THE BID PRICE.
7. INSTALL UNDERGROUND CONDUITS 42" BELOW FINISHED GRADE, MINIMUM, UNLESS NOTED OTHERWISE.
8. COORDINATE SERVICE SHUT-DOWNS WITH ALL TRADES INVOLVED ON SITE AND OBTAIN WRITTEN AUTHORIZATION FROM OWNER 72 HOURS PRIOR TO ANY ELECTRICAL AND/OR TELEPHONE SHUT-DOWN.
9. REMOVE ALL DE-ENERGIZED CONDUCTORS FROM SITE AT COMPLETION OF THE PROJECT.
10. OUTDOOR LIGHTING BRANCH CIRCUIT WIRING SHALL BE MINIMUM #8 AWG CONDUCTORS (XHHW-2), IN MINIMUM 1" DIA. CONDUIT, UNLESS NOTED OTHERWISE.
11. SPARE CONDUITS SHALL INCLUDE PULL STRING AND SHALL BE TERMINATED WITH A CAP.
12. EXCAVATE THE ENTIRE LENGTH OF TRENCH TO PROPERLY SET DUCT ELEVATIONS.

(#) CONSTRUCTION KEY NOTES:

1. EV CHARGER PROVIDED BY OWNER. COORDINATE FINAL BREAKER SIZE AT PANEL WITH EV MANUFACTURER.
2. DTE TO CONFIRM UTILITY POLE MOUNTED OR PAD MOUNTED TRANSFORMER INSTALLATION. ELECTRICAL CONTRACTOR TO PROVIDE ALTERNATE COST FOR TRANSFORMER PAD IF REQUIRED.
3. COORDINATE LOCATION OF LOW VOLTAGE POWER SUPPLY.
4. PROVIDE ADDITIONAL CONDUITS FOR FUTURE EV CHARGERS.

Know what's **below.**
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F: (866) 732 - 2168
www.a3c.com
COLLABORATIVE ARCHITECTURE

Sheet E0.03

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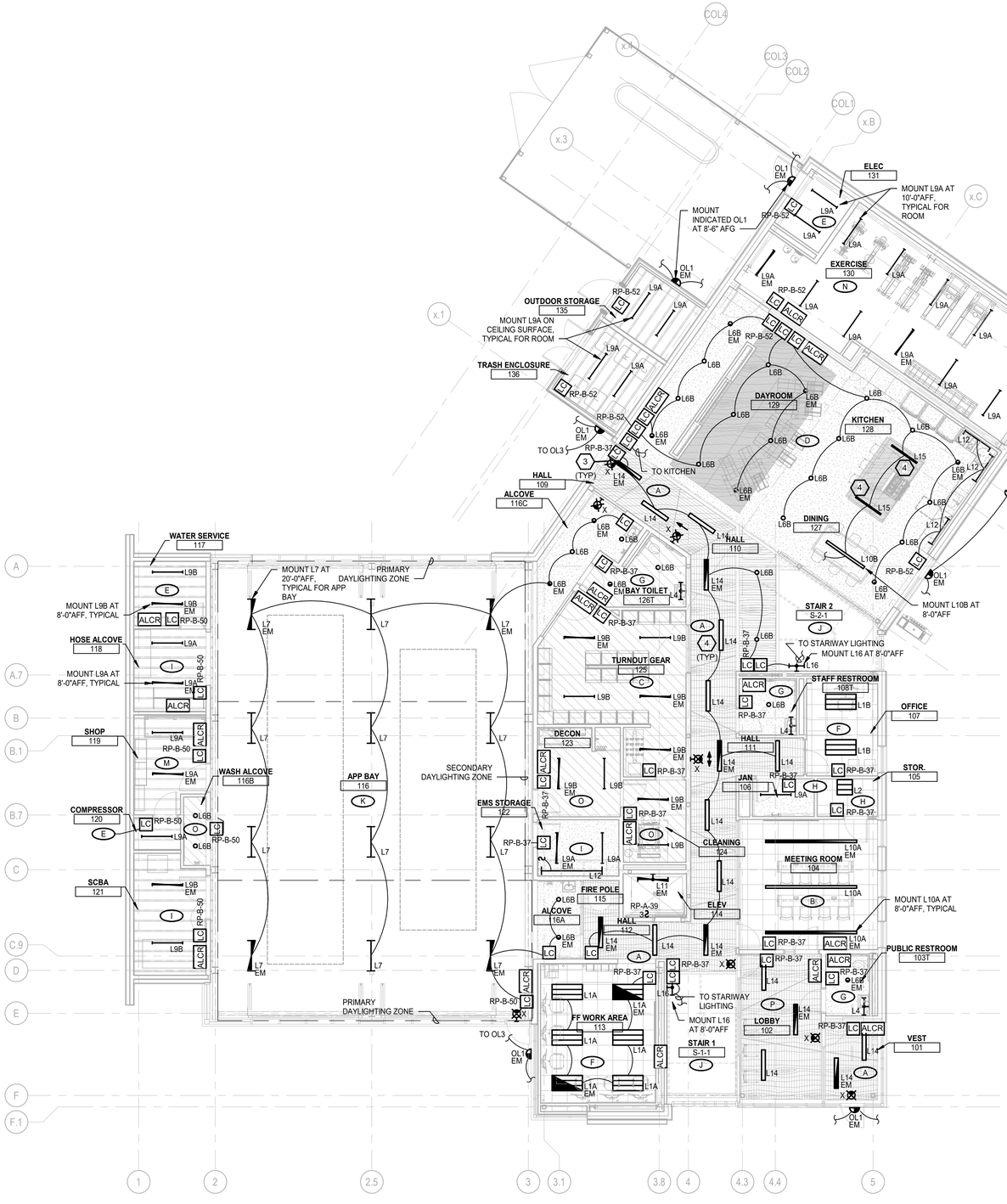

PROJECT TRUE

FIRST LEVEL LIGHTING PLAN

SCALE: 1/8" = 1'-0"

ELECTRICAL GENERAL NOTES:

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3 COORDINATE AND PROVIDE ACCESS DOORS WITHIN INACCESSIBLE CEILING, SHAFT, AND CHASE AREAS FOR ALL COMPONENTS WHICH REQUIRE SERVICE ACCESS. REFER TO ARCHITECTURAL DRAWINGS FOR CEILING TYPES.

4 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

5 TRANSFORMER SECONDARY CONDUCTORS SHALL BE SIZED IN ACCORDANCE WITH TRANSFORMER CIRCUIT SIZING SCHEDULE SHOWN ON "ELECTRICAL STANDARD SCHEDULES DRAWING" UNLESS OTHERWISE NOTED.

6 MOTOR CIRCUIT PROTECTION SHALL BE SIZED IN ACCORDANCE WITH MOTOR CIRCUIT SIZING SCHEDULES SHOWN ON "ELECTRICAL STANDARD SCHEDULES DRAWING" UNLESS OTHERWISE NOTED.

7 COORDINATE THE MOUNTING HEIGHTS OF DEVICES WITH ARCHITECTURAL ELEVATIONS AND THE TRADES INSTALLING THE WORK.

8 COORDINATE EXACT LOCATIONS OF ALL FLOOR SERVICE FITTINGS AND POKE-THROUGH ASSEMBLIES WITH FINAL FURNITURE LAYOUT DRAWINGS.

9 REFER TO MECHANICAL SCHEDULE SHEETS FOR ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT. PROVIDE ALL CONNECTIONS, STARTERS, DISCONNECTS, ETC. AS REQUIRED BY SCHEDULES AND WHERE NOTED ELSEWHERE. VERIFY REQUIREMENTS OF ALL MECHANICAL EQUIPMENT WITH SHOP DRAWINGS SUBMITTALS. NOTIFY ENGINEER OF ANY CONFLICTS BETWEEN EQUIPMENT SUBMITTALS AND ELECTRICAL DRAWINGS. WHERE CIRCUIT SIZES ARE SHOWN ON THE ELECTRICAL DRAWINGS THAT DIFFER FROM WHAT IS INDICATED ON THE MECHANICAL SCHEDULES, PROVIDE THE CIRCUIT OF HIGHER AMPACITY.

10 REFER TO TEMPERATURE CONTROLS SHEETS FOR REQUIRED FIRE ALARM CONTROL MODULES, DUCT SMOKE DETECTORS, AND MOTOR CONTROLLERS. PROVIDE ALL ACCESSORIES INDICATED.

11 THE FIRE ALARM DEVICES SHOWN ON PLAN ARE A PARTIAL REPRESENTATION OF THE FIRE ALARM SYSTEM. PROVIDE THE DESIGN AND INSTALLATION OF A COMPLETE AND FUNCTIONAL FIRE ALARM SYSTEM IN ACCORDANCE WITH THE SPECIFICATIONS, DRAWINGS, AND ALL APPLICABLE CODES. THE FIRE ALARM VENDOR SHALL PROVIDE LAYOUT DRAWINGS INDICATING THE REQUIRED QUANTITIES AND LOCATIONS OF MANUAL PULL STATIONS, NOTIFICATION APPLIANCES, SMOKE AND HEAT DETECTORS, CONTROL MODULES, INTERFACE MODULES, MODULES FOR SPRINKLER FLOW AND TAMPER SWITCHES, ALL CONTROL PANELS, POWER SUPPLIES, AND ADDITIONAL DEVICES AND EQUIPMENT REQUIRED. COORDINATE LOCATIONS OF DEVICES WITH ARCHITECTURAL FINISHES AND REFLECTED CEILING PLANS, INCLUDING ADDITIONAL SMOKE AND HEAT DETECTORS REQUIRED FOR NON-SMOOTH CEILING APPLICATIONS. INCLUDE ALLOWANCES FOR ADJUSTMENT OF DEVICES BY THE ARCHITECT AT THE TIME OF SUBMITTAL TO COORDINATE WITH BUILDING FINISHES AND OTHER CEILING ELEMENTS.

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CONSTRUCTION KEY NOTES:

1 CIRCUIT L8 TO FIRE STATION EMERGENCY NOTIFICATION SYSTEM. LIGHTS SHALL TURN ON UPON ACTIVATION OF THE SYSTEM. COORDINATE EXACT REQUIREMENTS WITH NOTIFICATION SYSTEM MANUFACTURER.

2 MOUNT L11 FIXTURES AT 4'-0" FROM PIT AND 8'-0" FROM EACH LANDING, TOTALING 3 FIXTURES. ALL ELEVATOR LIGHTING TO SHARE SAME BRANCH CIRCUIT AND CONTROLS.

3 EXIT SIGNS TO BE CIRCUITED TO EMERGENCY LIGHTING INVERTER, TYPICAL FOR ALL.

4 FIXTURES TO BE MOUNTED FLUSH WITH BOTTOM OF LINEAR WOOD CEILNG.

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Project Number	21018

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City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

FIRST LEVEL LIGHTING PLAN

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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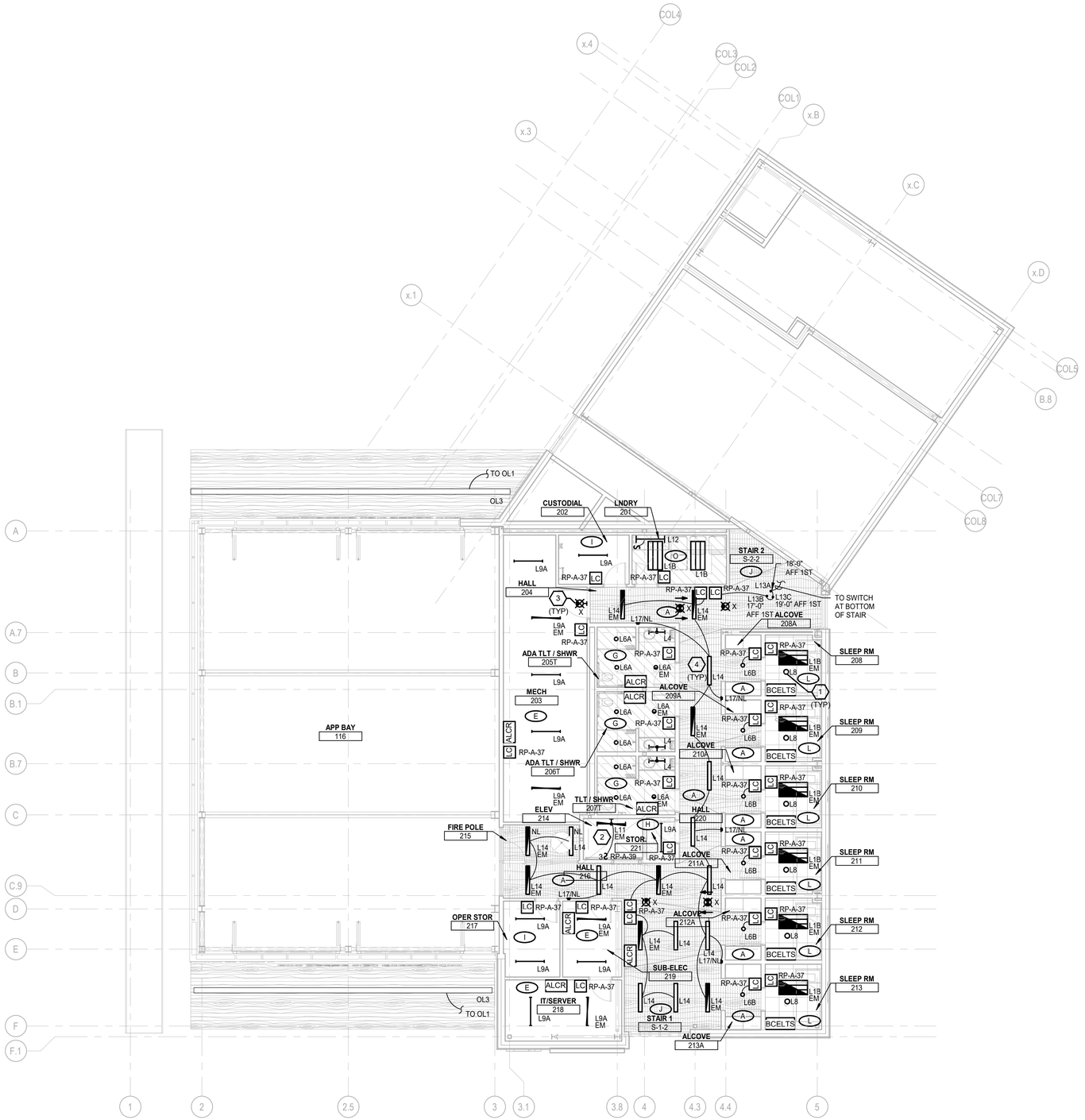

SECOND LEVEL LIGHTING PLAN

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PROJECT TRUE

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City Of Ann Arbor
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ANN ARBOR, MI 48104
T: (734) 663 - 1910
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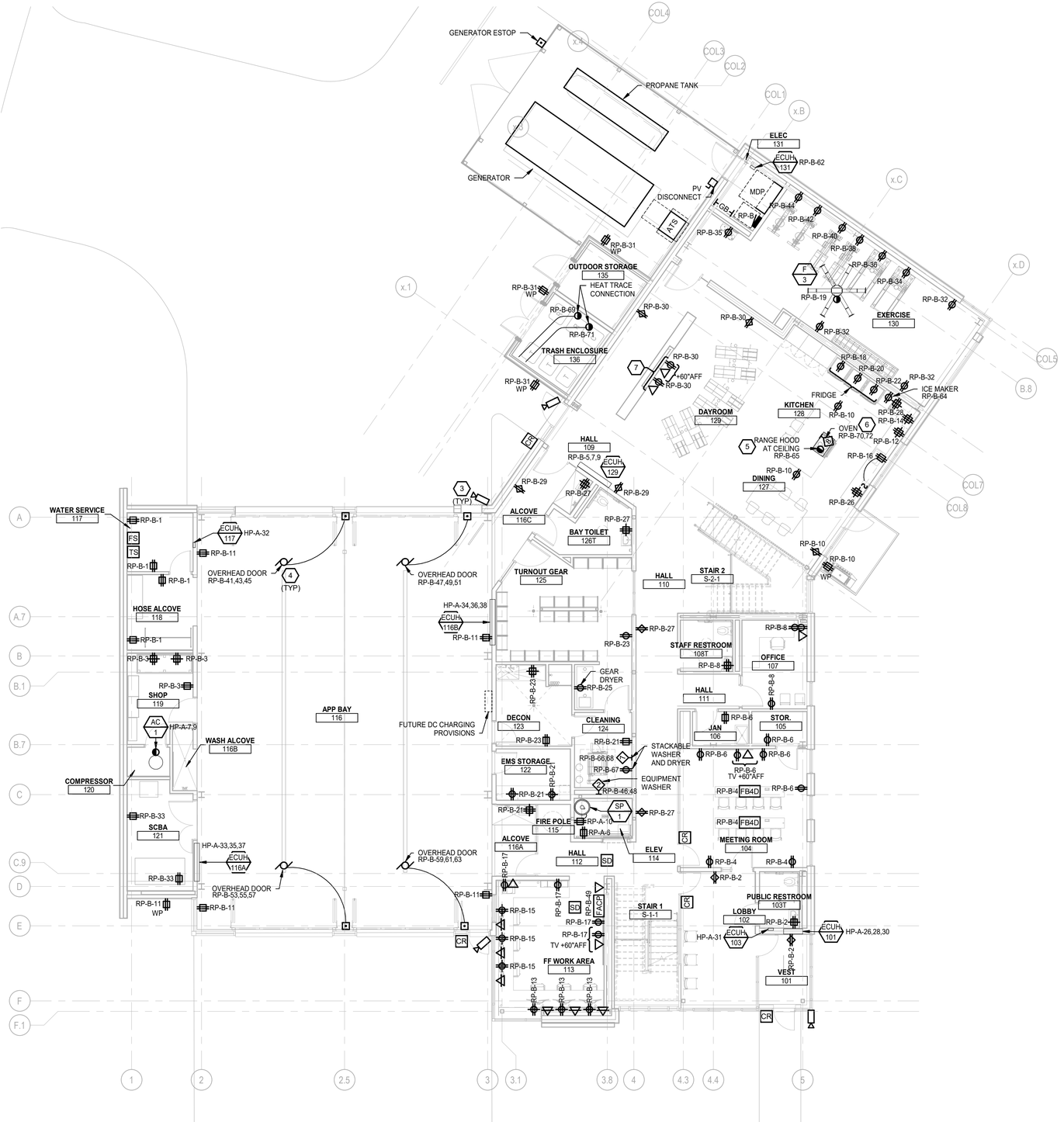

FIRST LEVEL POWER AND AUXILIARY PLAN

SCALE: 1/8" = 1'-0"

PROJECT TRUE

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CONSTRUCTION KEY NOTES:

1 PROVIDE ONE DUCT DETECTOR FOR EACH STACKED WAHP UNIT: FIVE TOTAL.

2 4' CLEAR EDGE DISTANCE FROM ROOF PARAPET AND OTHER OBSTICLES. (TYP)

3 ELECTRICAL CONTRACTOR TO PROVIDE CONDUIT AND BOX ROUGH INS FOR SECURITY DEVICES. COORDINATE EXACT REQUIREMENTS WITH SECURITY CONTRACTOR.

4 COORDINATE EXACT POWER REQUIREMENTS WITH DOOR MANUFACTURER.

5 RANGE DISCONNECT RELAY PROVIDED WITH HOOD. INSTALL DISCONNECT AS REQUIRED BY MANUFACTURER. RANGE TO SHUT DOWN DURING FIRE SUPPRESSION ACTIVATION.

6 COORDINATE FINAL POWER CONNECTION FOR OVEN WITH MANUFACTURER.

7 POWER AND DATA TO BE FED FROM BELOW.

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2415 S HURON PKWY
ANN ARBOR, MI 48104

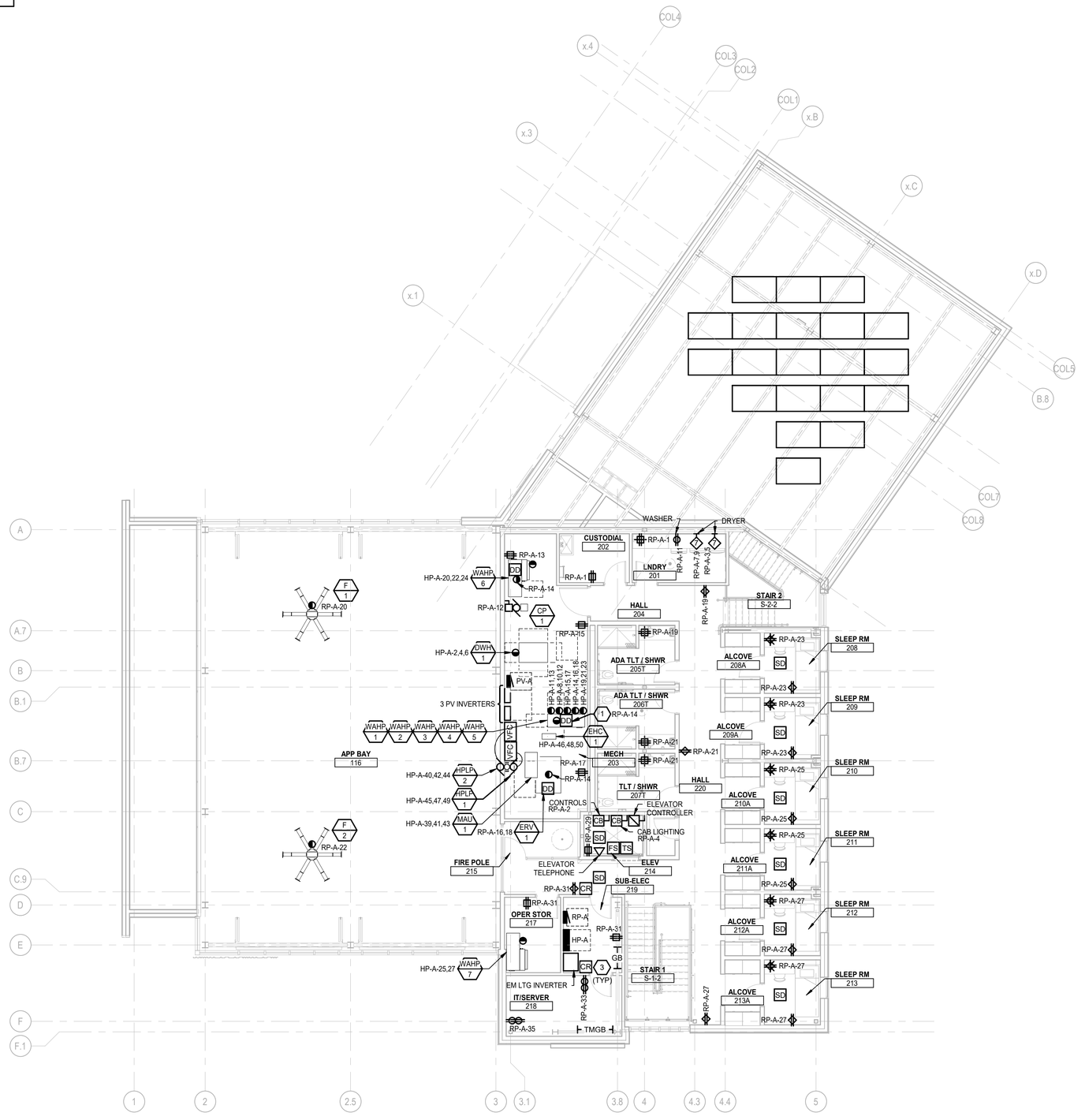
FIRST LEVEL POWER PLAN

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet E3.01

10/11/2024 11:01:00 AM BIM 360://20-43 Ann Arbor FS4/2021-0121-AAFS4-MEP-V21.rvt

THE FOLLOWING DIMENSION EQUALS ONE INCH WHEN PRINTED TO SCALE. 1"



PROJECT TRUE

SECOND LEVEL POWER AND AUXILIARY PLAN

SCALE: 1/8" = 1'-0"

ELECTRICAL GENERAL NOTES:

1 THESE DRAWINGS REPRESENT THE GENERAL EXTENT AND ARRANGEMENT OF SYSTEMS. COORDINATE EXACT EQUIPMENT LOCATIONS, ELEVATIONS, AND FINAL CONNECTION REQUIREMENTS. PROVIDE EACH SYSTEM COMPLETE, INCLUDING ALL NECESSARY COMPONENTS, FITTINGS AND OFFSETS.

2 INSTALL SYSTEMS SUCH THAT REQUIRED CLEARANCE AND SERVICE ACCESS SPACE IS PROVIDED AROUND ALL MECHANICAL AND ELECTRICAL EQUIPMENT, AND AROUND ANY COMPONENTS WHICH REQUIRE SERVICE ACCESS.

3 COORDINATE AND PROVIDE ACCESS DOORS WITHIN INACCESSIBLE CEILING, SHAFT, AND CHASE AREAS FOR ALL COMPONENTS WHICH REQUIRE SERVICE ACCESS. REFER TO ARCHITECTURAL DRAWINGS FOR CEILING TYPES.

4 PROVIDE SUPPLEMENTARY STEEL AS REQUIRED FOR THE PROPER SUPPORT OF ALL SYSTEMS.

5 TRANSFORMER SECONDARY CONDUCTORS SHALL BE SIZED IN ACCORDANCE WITH TRANSFORMER CIRCUIT SIZING SCHEDULE SHOWN ON "ELECTRICAL STANDARD SCHEDULES DRAWING" UNLESS OTHERWISE NOTED.

6 MOTOR CIRCUIT PROTECTION SHALL BE SIZED IN ACCORDANCE WITH MOTOR CIRCUIT SIZING SCHEDULES SHOWN ON "ELECTRICAL STANDARD SCHEDULES DRAWING" UNLESS OTHERWISE NOTED.

7 COORDINATE THE MOUNTING HEIGHTS OF DEVICES WITH ARCHITECTURAL ELEVATIONS AND THE TRADES INSTALLING THE WORK.

8 COORDINATE EXACT LOCATIONS OF ALL FLOOR SERVICE FITTINGS AND POKE-THROUGH ASSEMBLIES WITH FINAL FURNITURE LAYOUT DRAWINGS.

9 REFER TO MECHANICAL SCHEDULE SHEETS FOR ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT. PROVIDE ALL CONNECTIONS, STARTERS, DISCONNECTS, ETC. AS REQUIRED BY SCHEDULES AND WHERE NOTED ELSEWHERE. VERIFY REQUIREMENTS OF ALL MECHANICAL EQUIPMENT WITH SHOP DRAWINGS SUBMITTALS. NOTIFY ENGINEER OF ANY CONFLICTS BETWEEN EQUIPMENT SUBMITTALS AND ELECTRICAL DRAWINGS. WHERE CIRCUIT SIZES ARE SHOWN ON THE ELECTRICAL DRAWINGS THAT DIFFER FROM WHAT IS INDICATED ON THE MECHANICAL SCHEDULES, PROVIDE THE CIRCUIT OF HIGHER AMPACITY.

10 REFER TO TEMPERATURE CONTROLS SHEETS FOR REQUIRED FIRE ALARM CONTROL MODULES, DUCT SMOKE DETECTORS, AND MOTOR CONTROLLERS. PROVIDE ALL ACCESSORIES INDICATED.

11 THE FIRE ALARM DEVICES SHOWN ON PLAN ARE A PARTIAL REPRESENTATION OF THE FIRE ALARM SYSTEM. PROVIDE THE DESIGN AND INSTALLATION OF A COMPLETE AND FUNCTIONAL FIRE ALARM SYSTEM IN ACCORDANCE WITH THE SPECIFICATIONS, DRAWINGS, AND ALL APPLICABLE CODES. THE FIRE ALARM VENDOR SHALL PROVIDE LAYOUT DRAWINGS INDICATING THE REQUIRED QUANTITIES AND LOCATIONS OF MANUAL PULL STATIONS, NOTIFICATION APPLIANCES, SMOKE AND HEAT DETECTORS, CONTROL MODULES, INTERFACE MODULES, MODULES FOR SPRINKLER FLOW AND TAMPER SWITCHES, ALL CONTROL PANELS, POWER SUPPLIES, AND ADDITIONAL DEVICES AND EQUIPMENT REQUIRED. COORDINATE LOCATIONS OF DEVICES WITH ARCHITECTURAL FINISHES AND REFLECTED CEILING PLANS, INCLUDING ADDITIONAL SMOKE AND HEAT DETECTORS REQUIRED FOR NON-SMOOTH CEILING APPLICATIONS. INCLUDE ALLOWANCES FOR ADJUSTMENT OF DEVICES BY THE ARCHITECT AT THE TIME OF SUBMITTAL TO COORDINATE WITH BUILDING FINISHES AND OTHER CEILING ELEMENTS.

12 REFER TO LIGHTING CONTROL SCHEDULE FOR ROOM CONTROL AND EMERGENCY LIGHTING CIRCUIT CONTROL REQUIREMENTS. DESIGNATION FOR ROOM IS INDICATED AS A LETTERED OVAL SYMBOL.

CONSTRUCTION KEY NOTES:

1 PROVIDE ONE DUCT DETECTOR FOR EACH STACKED WAHP UNIT: FIVE TOTAL.

2 4' CLEAR EDGE DISTANCE FROM ROOF PARAPET AND OTHER OBSTICLES. (TYP)

3 ELECTRICAL CONTRACTOR TO PROVIDE CONDUIT AND BOX ROUGH INS FOR SECURITY DEVICES. COORDINATE EXACT REQUIREMENTS WITH SECURITY CONTRACTOR.

4 COORDINATE EXACT POWER REQUIREMENTS WITH DOOR MANUFACTURER.

5 RANGE DISCONNECT RELAY PROVIDED WITH HOOD. INSTALL DISCONNECT AS REQUIRED BY MANUFACTURER. RANGE TO SHUT DOWN DURING FIRE SUPPRESSION ACTIVATION.

6 COORDINATE FINAL POWER CONNECTION FOR OVEN WITH MANUFACTURER.

7 POWER AND DATA TO BE FED FROM BELOW.

TCA
ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021.0121

STATE OF MICHIGAN
ERIC MICHAEL GRAETTINGER
ENGINEER
No. 6201052164
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
SCHEMATIC DESIGN	03/04/22
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: SMB Checked: SMB

City Of Ann Arbor
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Sheet E3.02

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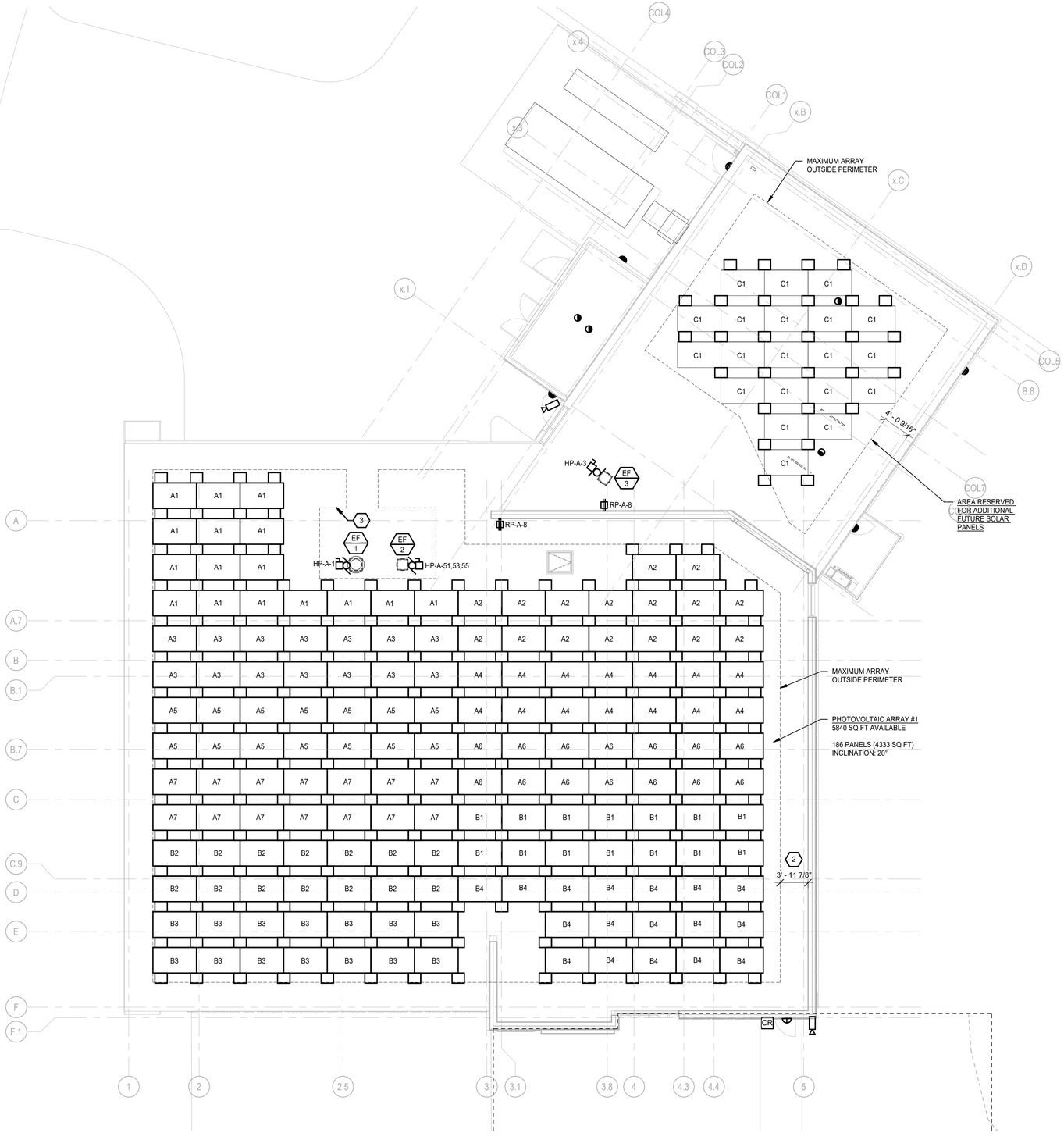

ROOF ELECTRICAL PLAN - MAIN BUILDING

SCALE: 1/8" = 1'-0"

PROJECT TRUE

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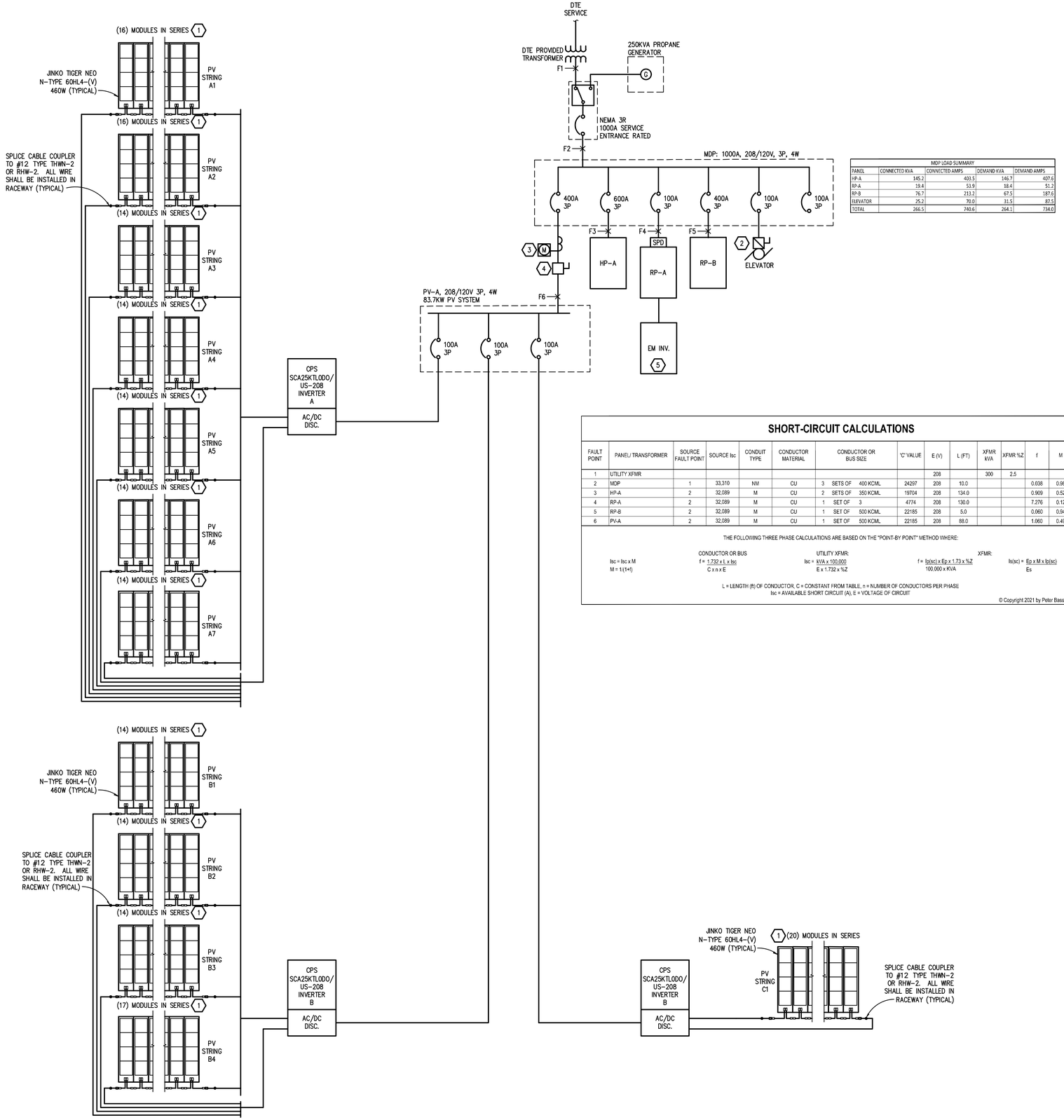
Sheet E4.01



MDP LOAD SUMMARY

PANEL	CONNECTED KVA	CONNECTED AMPS	DEMAND KVA	DEMAND AMPS
HP-A	145.2	403.5	146.7	407.6
RP-A	19.4	53.9	18.4	51.2
RP-B	76.7	213.2	67.5	187.6
ELEVATOR	25.2	70.0	31.5	87.5
TOTAL	266.5	740.6	264.1	734.0

SHORT-CIRCUIT CALCULATIONS

FAULT POINT	PANEL/ TRANSFORMER	SOURCE FAULT POINT	SOURCE Isc	CONDUIT TYPE	CONDUCTOR MATERIAL	CONDUCTOR OR BUS SIZE	'C' VALUE	E (V)	L (FT)	XFMR kVA	XFMR %Z	f	M	Isc
1	UTILITY XFMR							208		300	2.5			33,310
2	MDP	1	33,310	NM	CU	3 SETS OF 400 KCMIL	24297	208	10.0			0.038	0.98	32,089
3	HP-A	2	32,089	M	CU	2 SETS OF 350 KCMIL	19704	208	134.0			0.909	0.52	16,813
4	RP-A	2	32,089	M	CU	1 SET OF 3	4774	208	130.0			7.276	0.12	3,877
5	RP-B	2	32,089	M	CU	1 SET OF 500 KCMIL	22185	208	5.0			0.060	0.94	30,266
6	PV-A	2	32,089	M	CU	1 SET OF 500 KCMIL	22185	208	88.0			1.060	0.49	15,578

THE FOLLOWING THREE PHASE CALCULATIONS ARE BASED ON THE "POINT-BY POINT" METHOD WHERE:

Isc = Isc x M
M = 1/(1+f)

CONDUCTOR OR BUS: f = 1.732 x L x Isc / C x n x E

UTILITY XFMR: Isc = kVA x 100,000 / E x 1.732 x %Z

XFMR: f = Ip(sc) x Ep x 1.73 x %Z / 100,000 x KVA

Is(sc) = Ep x M x Ip(sc) / Es

L = LENGTH (ft) OF CONDUCTOR, C = CONSTANT FROM TABLE, n = NUMBER OF CONDUCTORS PER PHASE
Isc = AVAILABLE SHORT CIRCUIT (A), E = VOLTAGE OF CIRCUIT

DIAGRAM GENERAL NOTES:

1. THESE DRAWINGS REPRESENT THE GENERAL EXTENT AND ARRANGEMENT OF SYSTEMS. COORDINATE EXACT EQUIPMENT LOCATIONS, ELEVATIONS, AND FINAL CONNECTION REQUIREMENTS. PROVIDE EACH SYSTEM COMPLETE, INCLUDING ALL NECESSARY COMPONENTS, FITTINGS AND OFFSETS.
2. FEEDER AND BRANCH CIRCUIT CONDUCTORS SHALL BE SIZED IN ACCORDANCE WITH THE "FEEDER AND BRANCH CIRCUIT SIZING SCHEDULE-GENERAL PURPOSE" ON THE "ELECTRICAL STANDARD SCHEDULES DRAWING" UNLESS SPECIFICALLY NOTED OTHERWISE.
3. TRANSFORMER SECONDARY CONDUCTORS SHALL BE SIZED IN ACCORDANCE WITH THE "TRANSFORMER CIRCUIT SIZING SCHEDULE-GENERAL PURPOSE" ON THE "ELECTRICAL STANDARD SCHEDULES DRAWING" UNLESS SPECIFICALLY NOTED OTHERWISE.
4. MOTOR CIRCUIT PROTECTION SHALL BE SIZED IN ACCORDANCE WITH THE MOTOR CIRCUIT SIZING SCHEDULES ON THE "ELECTRICAL STANDARD SCHEDULES DRAWING" UNLESS SPECIFICALLY NOTED OTHERWISE.
5. BASIS OF DESIGN IS SCHNEIDER ELECTRIC DISTRIBUTION EQUIPMENT AND ASCO TRANSFER SWITCHES. IF THE CONTRACTOR ELECTS TO PROVIDE EQUIPMENT FROM OTHER APPROVED MANUFACTURERS, THE CONTRACTOR SHALL BE RESPONSIBLE TO COORDINATE THE LAYOUT AND CLEARANCE REQUIREMENTS IN ALL SPACES CONTAINING ELECTRICAL EQUIPMENT AND PROVIDE EQUIPMENT MEETING THE SPECIFICATIONS AND ACHIEVING CODE REQUIRED CLEARANCES WITHIN THE SPACE PROVIDED.
6. SELECTIVE COORDINATION (PER NEC ARTICLES 517.31(G), 700.32 AND 701.27) IS BASED ON SCHNEIDER ELECTRIC DISTRIBUTION EQUIPMENT AND ASCO TRANSFER SWITCHES. ELECTRICAL CONTRACTOR SHALL SUBMIT SELECTIVE COORDINATION STUDY WITH TIME CURRENT CHARACTERISTIC CURVES (AND TABLES FOR TESTED PAIR INSTANTANEOUS COORDINATION) FOR THE EMERGENCY SYSTEMS. ELECTRICAL CONTRACTORS SHALL RECEIVE APPROVED SHOP DRAWINGS BACK FROM ENGINEER OF RECORD PRIOR TO PURCHASING OR INSTALLING ANY ELECTRICAL DISTRIBUTION EQUIPMENT. BREAKERS MUST BE COORDINATED WITH AUTOMATIC TRANSFER SWITCHES 3-CYCLE WITHSTAND RATING. ALTERNATE MANUFACTURERS SHALL MEET SELECTIVE COORDINATION CRITERIA AT NO ADDITIONAL COST TO THE PROJECT.
7. VARIABLE FREQUENCY CONTROLLERS (VFC) FURNISHED BY MECHANICAL TRADES. ELECTRICAL CONTRACTOR SHALL INSTALL VFC, PROVIDE POWER FEEDER FROM DISTRIBUTION EQUIPMENT TO VFC AND PROVIDE POWER FEEDER FROM VFC TO MOTOR. REFER TO SPECIFICATIONS FOR APPLICATION OF VFC POWER CABLE FROM VFC TO MOTOR.

(#) CONSTRUCTION KEY NOTES:

1. PROVIDE RAPID SHUT DOWN MODULES AS REQUIRED BY NEC 690.12 SIMILAR TO TIGO TS4-A-F.
2. COORDINATE FINAL BREAKER REQUIREMENTS WITH ELEVATOR MANUFACTURER.
3. PROVIDE PV GENERATION METER WITHIN 5FT OF INCOMING SERVICE METER.
4. PROVIDE 400A DISCONNECT SWITCH WITHIN 5FT OF PV GENERATION METER.
5. PROVIDE EMERGENCY LIGHTING INVERTER SIMILAR TO IIS-2250.

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DESIGN DEVELOPMENT	05/26/23
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Drawn: SMB Checked: SMB

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ONE LINE DIAGRAM

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Sheet E5.01

PANELBOARD HP-A

#	LOAD TYPE	DESCRIPTION	CB TYPE	CB	A		B		C		CB	CB TYPE	DESCRIPTION	LOAD TYPE	#
1	M	EF-1		20	1656	4000									2
3	M	EF-3		15			1656	4000			50		DWH-1	NC	4
5	--	SPARE	--	20					0	4000					6
7	NC	AC-1		40	3203	1873									8
9							3203	1873			25		WAHP-2	NC	10
11	NC	WAHP-1		15					957	1873					12
13					957	1069									14
15	NC	WAHP-3		15			583	1069			15		WAHP-4	NC	16
17									583	1069					18
19	NC	WAHP-5		25	1777	2966									20
21							1777	2966			45		WAHP-6	NC	22
23									1777	2966					24
25	NC	WAHP-7		15	583	2114									26
27							583	2114			25		ECUH-101	E	28
29	--	SPARE	--	20					0	2114					30
31	E	ECUH-103		20	1500	1500					20		ECUH-117	E	32
33	E	ECUH-116A		70			6317	8418			90		ECUH-116B	E	34
35					6317	8418			6317	8418					36
37															38
39	NC	MAU-1		40			3483	1273			15		HPLP-2	M	40
41									3483	1273					42
43					3483	1273									44
45	M	HPLP-1		15			1273	6167			70		EHC-1	E	46
47									1273	6167					48
49					1273	6167									50
51	M	EF-2		20			2005	0			20	--	SPARE	--	52
53									2005	0	20	--	SPARE	--	54
55					2005	0					20	--	SPARE	--	56
57	--	SPARE	--	20			0	0			20	--	SPARE	--	58
59	--	SPARE	--	20					0	0	20	--	SPARE	--	60
61	--	SPARE	--	20	0	0					20	--	SPARE	--	62
63	--	SPARE	--	20			0	0			20	--	SPARE	--	64
65	--	SPARE	--	20					0	0	20	--	SPARE	--	66
67	--	SPARE	--	20	0	0					20	--	SPARE	--	68
69	--	SPARE	--	20			0	0			20	--	SPARE	--	70
71	--	SPARE	--	20					0	0	20	--	SPARE	--	72
73	--	SPARE	--	20	0	0					20	--	SPARE	--	74
75	--	SPARE	--	20			0	0			20	--	SPARE	--	76
77	--	SPARE	--	20					0	0	20	--	SPARE	--	78
79	--	SPARE	--	20	0	0					20	--	SPARE	--	80
81	--	SPARE	--	20			0	0			20	--	SPARE	--	82
83	--	SPARE	--	20					0	0	20	--	SPARE	--	84
					52134		48759		44275						
					ØA		ØB		ØC						

PANELBOARD INFORMATION	
VOLTAGE:	208Y/120V
BUS AMPACITY:	600A
MAIN TYPE:	MLO
MINIMUM A.I.C.:	22,000
MOUNTING:	SURFACE

PANELBOARD LOCATION

BRANCH CIRCUIT CONNECTED LOAD		DEMAND FACTOR	CALCULATED LOAD	FEEDER AND OVERCURRENT...
CONTINUOUS LOAD (C):	0	100%	0	125% 0
ELECTRIC HEAT (E)	72046	100%	72046	125% 90057.5
NON-CONTINUOUS LOAD (NC):	56155	100%	56155	100% 56155
KITCHEN LOAD (K):	0		0	100% 0
RECEPT BASE LOAD (R):	0	100%	0	100% 0
RECEPT DEMAND LOAD (R):	0	50%	0	100% 0
LIGHTING LOAD (L):	0	100%	0	125% 0
ADDITIONAL TRACK LIGHTING...				100% 0
MOTORS, HIGHEST LOAD (M):	6016	125 %	7520	100% 7520
MOTORS, REMAINING	10950	100 %	10950	100 % 10950
NOTE: DEMAND AND SIZING INFORMATION IS CALCULATED...		TOTAL (kVA):	**146.67**	
		TOTAL...	**407.12**	TOTAL... **457.11**

NOTES

PANELBOARD RP-A

#	LOAD TYPE	DESCRIPTION	CB TYPE	CB	A		B		C		CB	CB TYPE	DESCRIPTION	LOAD TYPE	#
1	R	RECEPT - LNDRY 201, CUSTODIAL 202		20	360	200					20		ELEVATOR CONTROLS	NC	2
3	R	RECEPT - LNDRY 201 DRYER	GFCI	20			1000	200			20		ELEVATOR CAB LIGHTING	L	4
5									1000	180	20		RECEPT - ELEV 114	R	6
7	R	RECEPT - LNDRY 201 DRYER	GFCI	20	1000	360					20		RECEPT - ROOFTOP	R	8
9							1000	864			20		SP-1	R	10
11	R	RECEPT - LNDRY 201 WASHER	GFCI	20					1200	528	15		CP-1	M	12
13	R	RECEPT - MECH 203		20	180	350					20		MECH EQUIPMENT DUCT DETECTORS	NC	14
15	R	RECEPT - MECH 203		20			180	1664			20		ERV-1	NC	16
17	R	RECEPT - MECH 203		20					180	1664					18
19	R	RECEPT - HALL 204, RM 205T		20	360	528					20		F-1	NC	20
21	R	RECEPT - HALL 220, RM 206T, 207T		20			540	528			20		F-2	NC	22
23	R	RECEPT - SLEEP RM 208-209	AFCI	20					720	170	20		LIGHTING - OUTDOOR SITE	L	24
25	R	RECEPT - SLEEP RM 210-211	AFCI	20	720	0					20	--	SPARE	--	26
27	R	RECEPT - SLEEP RM 212-213, HALL...	AFCI	20			900	0			20	--	SPARE	--	28
29	R	RECEPT - ELEV 214		20					180	0	20	--	SPARE	--	30
31	R	RECEPT - RM 217, 219, HALL 220		20	540	0					20	--	SPARE	--	32
33	R	RECEPT - IT/SERVER 218		20			360	0			20	--	SPARE	--	34
35	R	RECEPT - IT/SERVER 218		20					360	0	20	--	SPARE	--	36
37	L	LIGHTING - RM 204-220		20	1268	0					20	--	SPARE	--	38
39	L	LIGHTING - ELEVATOR		20			113	0			20	--	SPARE FOR TC CONTROLS	--	40
41	--	SPARE	--	20					0	0	20	--	SPARE FOR TC CONTROLS	--	42
					5866		7349		6182						
					ØA		ØB		ØC						

PANELBOARD INFORMATION	
VOLTAGE:	208Y/120V
BUS AMPACITY:	225A
MAIN TYPE:	MLO
MINIMUM A.I.C.:	10,000
MOUNTING:	SURFACE

* PROVIDE INTEGRAL SPD

PANELBOARD LOCATION

BRANCH CIRCUIT CONNECTED LOAD		DEMAND FACTOR	CALCULATED LOAD	FEEDER AND OVERCURRENT...
CONTINUOUS LOAD (C):	0	100%	0	125% 0
ELECTRIC HEAT (E)	0	100%	0	125% 0
NON-CONTINUOUS LOAD (NC):	4934	100%	4934	100% 4934
KITCHEN LOAD (K):	0		0	100% 0
RECEPT BASE LOAD (R):	10000	100%	10000	100% 10000
RECEPT DEMAND LOAD (R):	2184	50%	1092	100% 1092
LIGHTING LOAD (L):	1751.76	100%	1751.76	125% 2189.7
ADDITIONAL TRACK LIGHTING...				100% 0
MOTORS, HIGHEST LOAD (M):	528	125 %	660	100% 660
MOTORS, REMAINING	0	100 %	0	100 % 0
NOTE: DEMAND AND SIZING INFORMATION IS CALCULATED...		TOTAL (kVA):	**18.44**	
		TOTAL...	**51.18**	TOTAL... **52.39**

NOTES

PANELBOARD RP-B

#	LOAD TYPE	DESCRIPTION	CB TYPE	CB	A		B		C		CB	CB TYPE	DESCRIPTION	LOAD TYPE	#
1	R	RECEPT - RM 117, 188		20	720	540					20		RECEPT - RM 101, 102, 103T	R	2
3	R	RECEPT - SHOP 119		20			540	720			20		RECEPT - MEETING RM 104	R	4
5									4816	1080	20		RECEPT - RM 104-106	R	6
7	E	ECUH-129		60	4816	720					20		RECEPT - RM 107, 108T	R	8
9							4816	720			20		RECEPT - DINING 127, EXT 127	R	10
11	R	RECEPT - APP BAY 116, EXT 116		20					900	1000	30		RECEPT - KITCHEN 128	K	12
13	R	RECEPT - FF WORK AREA 113		20	540	1000					20		RECEPT - KITCHEN 128	K	14
15	R	RECEPT - FF WORK AREA 113		20			540	1200			20		DISPOSAL - KITCHEN 128	K	16
17	R	RECEPT - FF WORK AREA 113		20					720	800	20	GFCI	FRIDGE - KITCHEN 128	K	18
19	NC	F-3		20	528	800					20	GFCI	FRIDGE - KITCHEN 128	K	20
21	R	RECEPT - ROM 116A, 122		20			720	800			20	GFCI	FRIDGE - KITCHEN 128	K	22
23	R	RECEPT - RM 123, 125		20					540	0	20	--	SPARE	--	24
25	R	GEAR DRYER 125		20	1920	1000					20		RECEPT - KITCHEN 128	K	26
27	R	RECEPT - HALL 110, RM 126T		20			720	1000			20		RECEPT - KITCHEN 128	K	28
29	R	RECEPT - HALL 109, ALCOVE 115C		20					360	740	20		RECEPT - DAYROOM 129	R	30
31	R	RECEPT - EXT 109, ELEC 131		20	540	540					20		RECEPT - EXERCISE 130	R	32
33	R	RECEPT - SCBA 121		20			360	1000			20		RECEPT - EXERCISE 130	R	34
35	R	EWC-1	GFCI	20					180	1000	20		RECEPT - EXERCISE 130	R	36
37	L	LIGHTING - RM 101-115, 122-126		20	1296	1000					20		RECEPT - EXERCISE 130	R	38
39	NC	LIGHTING - EXTERIOR		20			150	1000			20		RECEPT - EXERCISE 130	R	40
41									1333	1000	20		RECEPT - EXERCISE 130	R	42
43	M	OVERHEAD DOOR 1		20	1333	1000					20		RECEPT - EXERCISE 130	R	44
45							1333	600			20	GFCI	CLEANING 124 WASHER	R	46
47									1333	600					48
49	M	OVERHEAD DOOR 2		20	1333	1465					20		LIGHTING - RM 116-121	L	50
51							1333	586			20		LIGHTING - RM 127-136	L	52
53									1333	342	20		EXTERIOR LIGHTING - BUILDING...	L	54
55	M	OVERHEAD DOOR 3		20	1333	20					20		EXTERIOR LIGHTING - PATH	L	56
57							1333	3328			40		EV CHARGER	E	58
59									1333	3328					60
61	M	OVERHEAD DOOR 4		20	1333	1500					20		ECUH-131	E	62
63							1333	180			20	GFCI	ICE MAKER - KITCHEN 128	K	64
65	M	M - KITCHEN 128 RANGE HOOD		20					1000	1000	20	GFCI	RECEPT - CLEANING 124 DRYER	R	66
67	R	RECEPT - CLEANING 124 WASHER	GFCI	20	1200	1000									68
69	E	PIPE HEAT TRACE		20			500	0			20	GFCI	OVEN - KITCHEN 128	K	70
71	E	PIPE HEAT TRACE		20					400	0					72
73	--	SPARE	--	20	0										74
75	--	SPARE	--	20			0	0			20	--	SPARE	--	76
77	--	SPARE	--	20					0	0	20	--	SPARE	--	78
79	--	SPARE	--	20	0	0					20	--	SPARE FOR GEN BLOCK HEATER	--	80
81	--	SPARE	--	20			0	0			20	--	SPARE FOR TC CONTROLS	--	82
83	--	SPARE	--	20					0	0	20	--	SPARE FOR TC CONTROLS	--	84
					27478		24813		25139						
					ØA		ØB		ØC						

PANELBOARD INFORMATION	
VOLTAGE:	208Y/120V
BUS AMPACITY:	400A
MAIN TYPE:	MLO
MINIMUM A.I.C.:	35,000
MOUNTING:	SURFACE

PANELBOARD LOCATION

BRANCH CIRCUIT CONNECTED LOAD		DEMAND FACTOR	CALCULATED LOAD	FEEDER AND OVERCURRENT...
CONTINUOUS LOAD (C):	0	100%	0	125% 0
ELECTRIC HEAT (E)	23503	100%	23503	125% 29378.75
NON-CONTINUOUS LOAD (NC):	678	100%	678	100% 678
KITCHEN LOAD (K):	7780	65.00%	5057	100% 5057
RECEPT BASE LOAD (R):	10000	100%	10000	100% 10000
RECEPT DEMAND LOAD (R):	14760	50%	7380	100% 7380
LIGHTING LOAD (L):	3709.29	100%	3709.29	125% 4636.61
ADDITIONAL TRACK LIGHTING...				100% 0
MOTORS, HIGHEST LOAD (M):	4000	125 %	5000	100% 5000
MOTORS, REMAINING	13000	100 %	13000	100 % 13000
NOTE: DEMAND AND SIZING INFORMATION IS CALCULATED...		TOTAL (kVA):	**68.33**	
		TOTAL...	**189.66**	TOTAL... **208.54**

NOTES

T C A
ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021.0121

STATE OF MICHIGAN
ERIC MICHAEL GRAETTINGER
ENGINEER
No. 6201052164
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: SMB Checked: SMB

City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

PANEL SCHEDULES

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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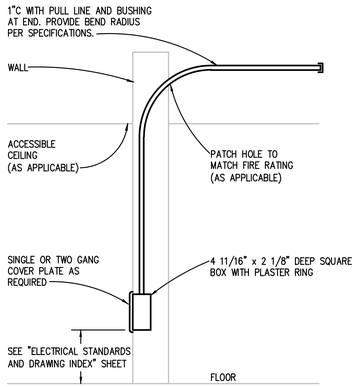
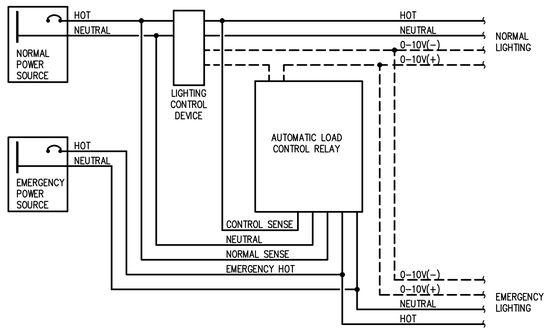


TELECOMMUNICATION OUTLET DETAIL

NO SCALE

NOTES:

1. IF CEILING IN ROOM IS NOT ACCESSIBLE, ROUTE CONDUIT TO NEAREST ACCESSIBLE CEILING IN DIRECTION OF AND WITH PATHWAY OR ACCESS TO TELECOMMUNICATION ROOM.

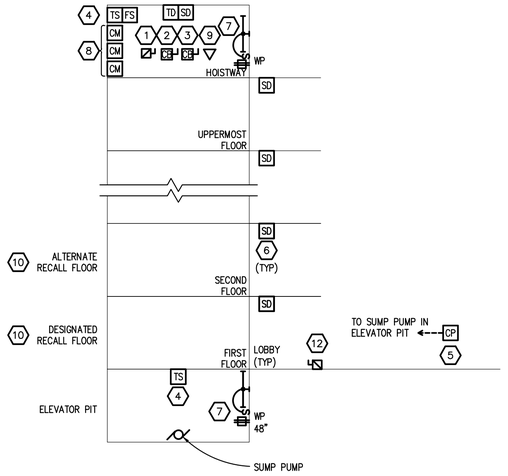


AUTOMATIC LOAD CONTROL RELAY FOR 0-10V DIMMING

NO SCALE

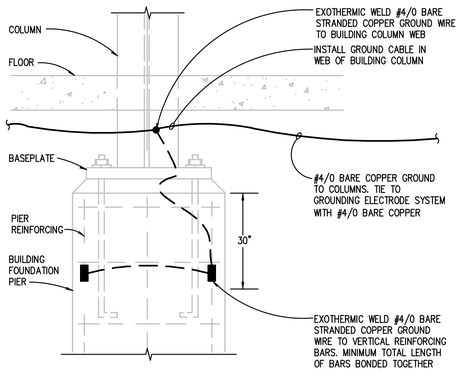
NOTES:

1. BASIS OF DESIGN IS LVS CONTROLS EPC-2-D. REFER TO SPECIFICATIONS FOR APPROVED MANUFACTURERS. ADJUST WIRING AS NECESSARY FOR OTHER APPROVED MANUFACTURERS.
2. PROVIDE ONE AUTOMATIC LOAD CONTROL RELAY FOR EACH CONTROL CIRCUIT.



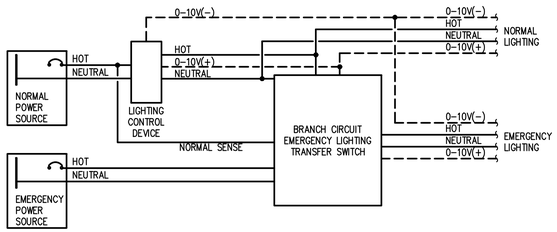
ELEVATOR DETAIL - MACHINE ROOMLESS

NO SCALE



COLUMN GROUNDING DETAIL

NO SCALE

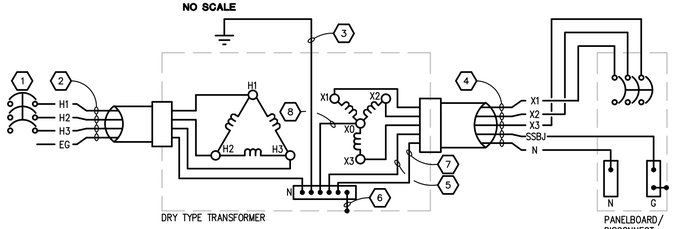


BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH FOR 0-10V DIMMING

NO SCALE

NOTES:

1. BASIS OF DESIGN IS LVS CONTROLS EPC-D-F-ATS. REFER TO SPECIFICATIONS FOR APPROVED MANUFACTURERS. ADJUST WIRING AS NECESSARY FOR OTHER APPROVED MANUFACTURERS.
2. PROVIDE ONE BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH PER SWITCHING CIRCUIT.

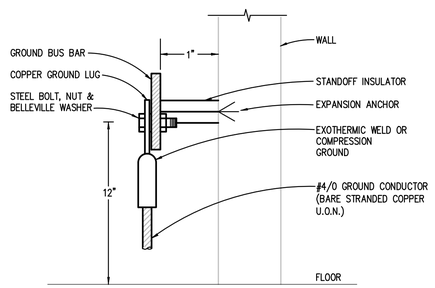


DRY TYPE DISTRIBUTION TRANSFORMER GROUNDING ARRANGEMENT

NO SCALE

(#) KEYED NOTES:

1. 480V, 3ø PRIMARY CIRCUIT BREAKER BASED ON DRY TYPE DISTRIBUTION TRANSFORMER CIRCUIT SIZING SCHEDULE ON ELECTRICAL STANDARD SCHEDULE DRAWING UNLESS OTHERWISE NOTED.
2. PRIMARY FEEDER BASED ON FEEDER AND BRANCH CIRCUIT SIZING TABLE ON ELECTRICAL STANDARD SCHEDULE DRAWING UNLESS OTHERWISE NOTED.
3. GROUNDING ELECTRODE CONDUCTOR TO NEAREST GROUNDING ELECTRODE (i.e. METAL IN GROUND SUPPORT STRUCTURE, METAL WATER PIPE, GROUND RING, OR GROUND BUS). SEE DRY TYPE DISTRIBUTION TRANSFORMER CIRCUIT SIZING SCHEDULE ON ELECTRICAL STANDARD SCHEDULE DRAWING FOR SIZE UNLESS OTHERWISE NOTED.
4. 208Y/120V, 3ø, 4W SECONDARY FEEDER BASED ON DRY TYPE DISTRIBUTION TRANSFORMER CIRCUIT SIZING SCHEDULE ON ELECTRICAL STANDARD SCHEDULE DRAWING UNLESS OTHERWISE NOTED.
5. SUPPLY SIDE BONDING JUMPER.
6. SYSTEM BONDING JUMPER.
7. GROUNDED CONDUCTOR (NEUTRAL).
8. NEUTRAL CONDUCTOR PROVIDED WITH EQUIPMENT.



GROUND BUS DETAIL

NO SCALE

GENERAL NOTES:

1. DETAIL SHOWS GENERAL EXTENT OF WORK AND SHOULD NOT BE CONSIDERED A FABRICATION DRAWING. REFER TO PLANS FOR LOCATIONS OF ROOMS, ELEVATOR SHAFT(S), ETC. COORDINATE REQUIREMENTS WITH ELEVATOR MANUFACTURER AND INSTALLER.
2. PIT LIGHTING SHALL BE IP66, WET LOCATION LISTED. PIT TO BE ILLUMINATED TO 10 FOOT-CANDLES AT FLOOR. (ASME A17.1 2010, 2.2.5.1, 2.8.2.3.4)
3. HOISTWAY MACHINE SPACE LIGHTING SHALL BE IP66, WET LOCATION LISTED AND BE ILLUMINATED TO 19 FOOTCANDLES. (ASME A17.1 2010, 2.7.5.1)
4. ELEVATOR HOISTWAY TO BE DEDICATED FOR ELEVATOR EQUIPMENT ONLY. (ASME A17.1 2010, SECTION 2.8)
5. ELEVATOR THRESHOLD LIGHTING TO BE 10 FOOT-CANDLES MINIMUM. (ASME A17.1 2010, 2.11.10.2)
6. HOISTWAY MACHINE SPACE AND ELEVATOR PIT LIGHTING AND RECEPTACLES SHALL BE SERVED FROM SEPARATE BRANCH CIRCUITS. HOISTWAY MACHINE SPACE LIGHTING AND RECEPTACLES MUST BE SERVED FROM SEPARATE BRANCH CIRCUITS. THE ELEVATOR PIT RECEPTACLES AND LIGHTING CAN BE SERVED FROM THE SAME CIRCUIT AS LONG AS THE LIGHTING IS CONNECTED TO THE LINE SIDE AHEAD OF THE GFCI DEVICE (NEC 620.23, 630.24).
7. ELEVATOR EMERGENCY PHONE MUST BE MONITORED 24 HOURS A DAY BY AUTHORIZED PERSONAL, HAVE THE ABILITY TO BE CALLED REMOTELY, AND STAY OPERATIONAL DURING EMERGENCY CONDITIONS (ASME A17.1 2010 2.27.1.1.1-2.27.1.1.5).
8. REFER TO NEW WORK PLANS FOR ALL CIRCUITING, LIGHTING FIXTURE TYPES, AND LIGHTING FIXTURE QUANTITIES.

(#) KEYED NOTES:

1. DISCONNECT SWITCH OR ENCLOSED CIRCUIT BREAKER CAPABLE OF BEING LOCKED OFF FOR ELEVATOR CONTROLLER. GROUND CONDUCTOR TO BE SAME SIZE AS PHASE CONDUCTORS. COORDINATE EXACT MOUNTING LOCATION AND REQUIREMENTS WITH ELEVATOR CONTRACTOR.
2. PROVIDE 20A/1P ENCLOSED CIRCUIT BREAKER CAPABLE OF BEING LOCKED OFF FOR ELEVATOR CAB LIGHTING. COORDINATE EXACT MOUNTING LOCATION AND REQUIREMENTS WITH ELEVATOR CONTRACTOR.
3. PROVIDE 20A/1P ENCLOSED CIRCUIT BREAKER CAPABLE OF BEING LOCKED OFF FOR ELEVATOR AND AUXILIARY CONTROLS. COORDINATE EXACT MOUNTING LOCATION AND REQUIREMENTS WITH ELEVATOR CONTRACTOR.
4. PROVIDE FIRE ALARM SYSTEM COMPONENTS AS REQUIRED AND PROVIDE CONNECTIONS TO EACH TAMPER AND FLOW SWITCH PROVIDED WITH THE FIRE PROTECTION SYSTEM. COORDINATE EXACT LOCATIONS, QUANTITIES, AND REQUIREMENTS WITH FIRE SUPPRESSION CONTRACTOR.
5. PROVIDE REQUIRED CONDUIT, WIRING, AND CONNECTIONS BETWEEN SUMP PUMP CONTROL PANEL(S) AND SUMP PUMP(S). COORDINATE REQUIREMENTS WITH MECHANICAL TRADES AND SUMP PUMP MANUFACTURER.
6. THE LOBBY ELEVATOR SMOKE DETECTORS SHALL BE WITHIN 21' OF THE DOOR CENTERLINE. FOR LOBBIES WITH CEILINGS HIGHER THAN 15', THE SMOKE DETECTOR SHALL BE INSTALLED WITHIN 60" OF THE TOP OF THE ELEVATOR DOOR. (NFPA 72 2019 21.3.5)
7. COORDINATE GFCI RECEPTACLE, LIGHT SWITCH AND LIGHT FIXTURE PLACEMENT IN PIT/HOISTWAY WITH ELEVATOR MANUFACTURER DRAWINGS AND TRADES. LIGHT SWITCH TO BE LOCATED AT TOP OF LADDER. CIRCUIT GFCI RECEPTACLE AND LIGHT FIXTURE AS INDICATED ON PLAN.
8. FIRE ALARM CONTROL MODULES FOR ELEVATOR RECALL. REFER TO FIRE ALARM MATRIX FOR CONTROL MODULE FUNCTIONALITY. CONTROL MODULES TO BE LOCATED WITHIN 3' OF ELEVATOR CONTROLLER (NFPA 72 2019 21.2.4).
9. PROVIDE TELEPHONE LINE FOR ELEVATOR EMERGENCY PHONE. REFER TO SPECIFICATIONS FOR CABLE TYPE.
10. COORDINATE EXACT DESIGNATED AND ALTERNATE RECALL FLOOR WITH ARCHITECT AND ELEVATOR MANUFACTURER AND INSTALLER.
11. AUXILIARY DISCONNECT MEANS FOR ELEVATOR CONTROLLER WHEN CONTROLLER LOCATED ON ELEVATOR CAR. (ASME A17.1 5.3.1.18.5)

TCA ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021-0121

STATE OF MICHIGAN
ERIC MICHAEL GRAETTINGER
ENGINEER
No. 6201052164
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
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Drawn: SMB Checked: SMB

City Of Ann Arbor
NEW FIRE STATION 4
2415 S.HURON PKWY
ANN ARBOR, MI 48104

ELECTRICAL DETAILS AND DIAGRAMS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

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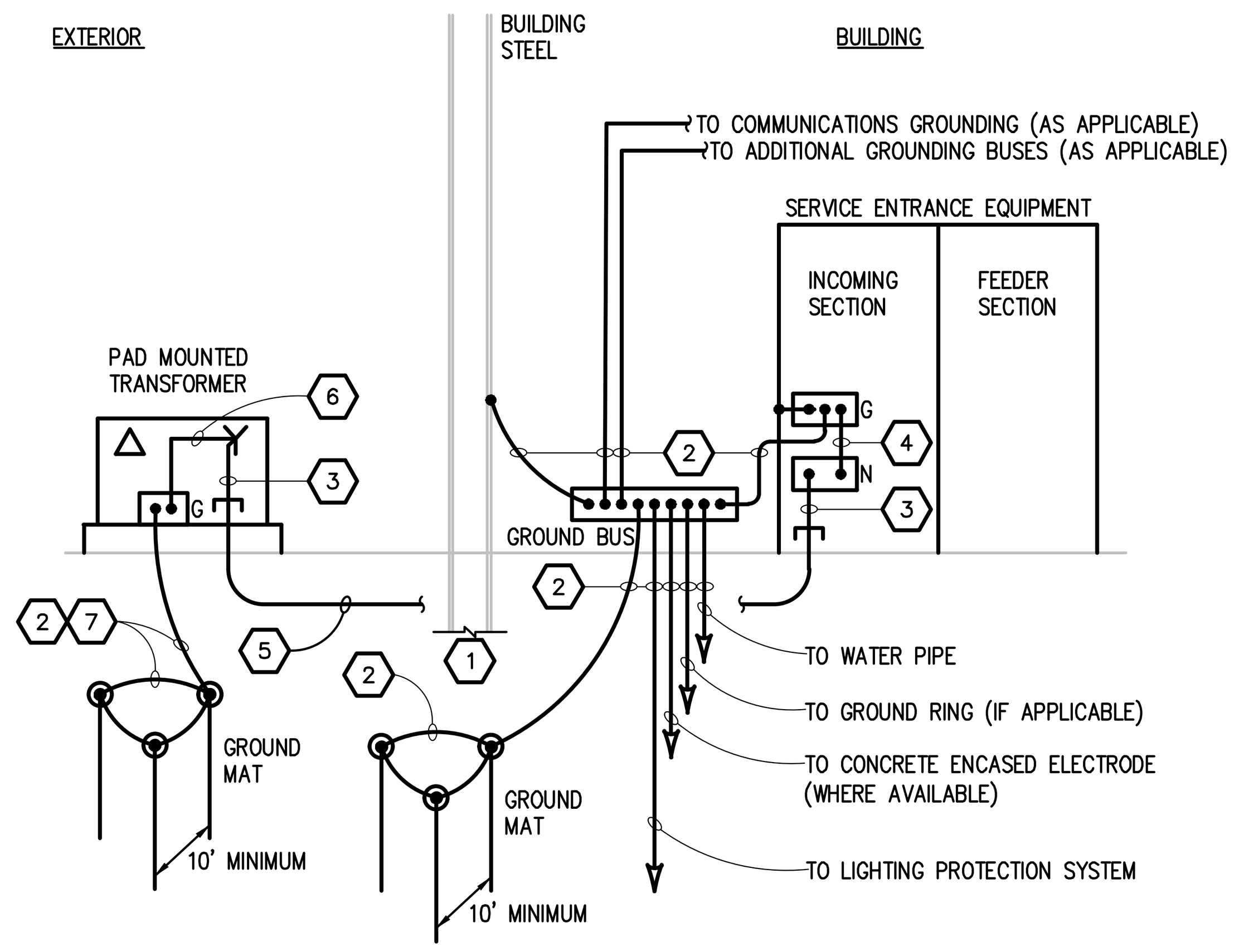
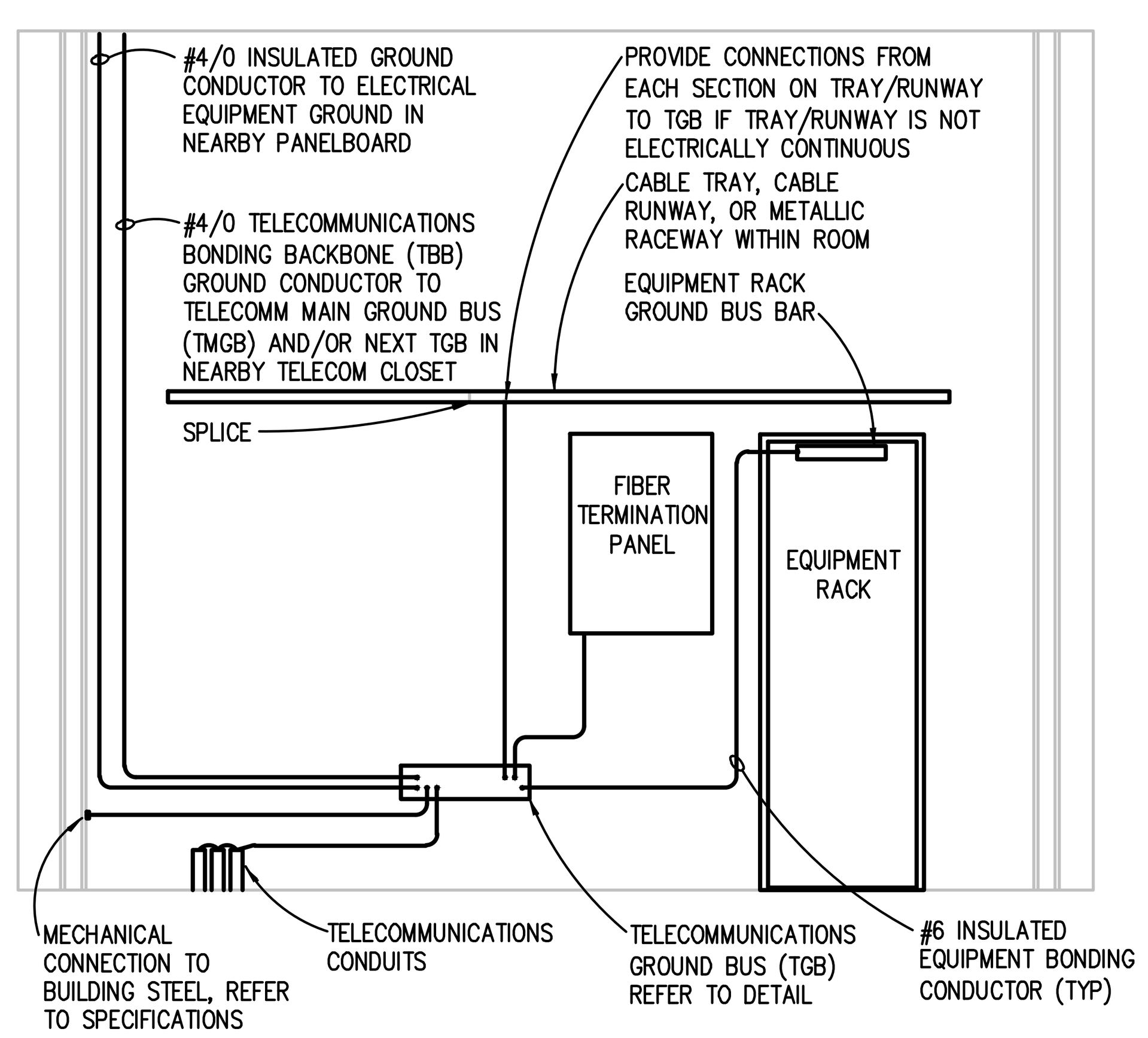


TYPICAL SECONDARY SERVICE ENTRANCE GROUNDING

NO SCALE

 # KEYED NOTES:

1. METAL IN-GROUND SUPPORT STRUCTURE IN DIRECT CONTACT WITH EARTH VERTICALLY FOR A MINIMUM OF 10FT, WHERE AVAILABLE.
2. GROUNDING ELECTRODE CONDUCTOR, #4/0 COPPER.
3. GROUNDED CONDUCTOR (NEUTRAL), SEE ONE LINE DIAGRAM.
4. MAIN BONDING JUMPER, PROVIDED BY MANUFACTURER AS PART OF LISTED EQUIPMENT SIZED PER NEC 250.28 AND 250.102.
5. SERVICE ENTRANCE PHASE CONDUCTORS AND GROUNDED CONDUCTOR IN CONDUIT. SEE ONE LINE DIAGRAM.
6. CONNECTION FROM GROUNDED SERVICE CONDUCTOR TO GROUNDING ELECTRODE AT THE TRANSFORMER PER NEC 250.24. COORDINATE WITH UTILITY.
7. COORDINATE REQUIREMENTS WITH UTILITY COMPANY PRIOR TO INSTALLATION. PROVIDE ALL NECESSARY GROUND RODS AND CONDUCTORS TO MEET UTILITY COMPANY REQUIREMENTS.



TELECOMMUNICATIONS ROOM GROUNDING DETAIL

NO SCALE

NOTES:

1. ALL GROUNDING SHALL COMPLY WITH NEC ARTICLE 250 AND TIA/EIA-607.
2. CONNECT ALL EQUIPMENT RACKS TO TGB WITH A SEPARATE EQUIPMENT BONDING CONDUCTOR.

			SYSTEM OUTPUTS																																
			ANNUNCIATION												NOTIFICATION									FIRE SAFETY											
			INITIATE FIRE ALARM SIGNAL	INITIATE CARBON MONOXIDE ALARM SIGNAL	IDENTIFY ALARM AT FACP	IDENTIFY ALARM AT REMOTE ANNUNCIATOR(S)	ANNUNCIATE SUPERVISORY SIGNAL AT FACP	ANNUNCIATE SUPERVISORY SIGNAL AT REMOTE ANNUNCIATOR(S)	ANNUNCIATE TROUBLE SIGNAL AT FACP	ANNUNCIATE TROUBLE SIGNAL AT REMOTE ANNUNCIATOR(S)	RING TROUBLE BELL (WHEN PROVIDED)	ACTIVATE ELEVATOR LOBBY "FLASH HAT" WARNING	ACTIVATE IN ELEVATOR IN-CAR WARNING SIGNAL	DISPLAY ELEVATOR RECALL STATUS AT ANNUNCIATOR	OPERATE ALARM NOTIFICATION APPLIANCES CONTINUOUSLY	ACTIVATE VOICE/ALARM COMMUNICATION SYSTEM	TRANSMIT ALARM SIGNAL TO REMOTE ALARM RECEIVING STATION	TRANSMIT SUPERVISORY SIGNAL TO REMOTE ALARM RECEIVING STATION	TRANSMIT TROUBLE SIGNAL TO REMOTE ALARM RECEIVING STATION	TRANSMIT ALARM SIGNAL TO BUILDING AUTOMATION SYSTEM	TRANSMIT TROUBLE SIGNAL TO BUILDING AUTOMATION SYSTEM	RECORD EVENTS IN THE SYSTEM MEMORY	DISPLAY STATUS ON SMOKE CONTROL PANEL	UNLOCK ELECTRIC DOOR LOCKS IN DESIGNATED EGRESS PATHS	DISABLE SOUND MASKING, PAGING, OR AUDIO SYSTEMS	RELEASE FIRE AND SMOKE DOORS	TURN ON EGRESS LIGHTING TO FULL BRIGHTNESS	DISABLE AUTOMATIC DOORS	OPEN AUTOMATIC SMOKE EXHAUST DOORS AND MAKE-UP DAMPERS	ACTUATE SMOKE EXHAUST SYSTEM (5 SECOND DELAY)	SHUTDOWN HVAC UNIT SERVING ZONE IN ALARM VIA CONTROL MODULE (INTERLOCK)	SWITCH HVAC EQUIPMENT CONTROLS TO FIRE ALARM MODE	CLOSE SMOKE DAMPERS IN AIR DUCT SYSTEM SERVING ZONE WHERE ALARM WAS INITIATED	RECALL ELEVATOR TO DESIGNATED RECALL LEVEL	ILLUMINATE HOISTWAY LIGHTING
SYSTEM INPUTS	INITIATION	MANUAL FIRE BOX OPERATION	●		●	●									●	●	●			●				●	●	●	●								
		SMOKE DETECTOR OPERATION	●		●	●									●	●	●			●				●	●	●	●								
		CARBON MONOXIDE DETECTOR OPERATION		●											●	●	●			●				●	●	●	●								
		DUCT DETECTOR OPERATION	●		●	●									●	●	●			●				●	●	●	●				●	●	●		
		AUTOMATIC SPRINKLER SYSTEM WATER FLOW OPERATION	●		●	●									●	●	●			●				●	●	●	●								
		SMOKE DETECTION IN AREA SERVED BY SMOKE EXHAUST	●		●	●									●	●	●			●				●	●	●	●		●	●					
		CARBON MONOXIDE DETECTION IN AREA SERVED BY SMOKE EXHAUST		●											●	●	●			●				●	●	●	●		●	●					
		SPRINKLER SYSTEM OPERATION IN THE AREA SERVED BY SMOKE EXHAUST SYSTEM	●		●	●									●	●	●			●				●	●	●	●		●	●					
		SMOKE EXHAUST FAN OPERATING																					●												
		SMOKE DETECTION IN ELEVATOR LOBBY – DESIGNATED RECALL LEVEL	●		●	●								●	●	●	●			●				●	●	●	●								
		SMOKE DETECTION IN ELEVATOR LOBBY – ALL OTHER LEVELS	●		●	●								●	●	●	●			●				●	●	●	●							●	
		SMOKE DETECTION IN ELEVATOR HOISTWAY	●		●	●						●	●	●	●	●	●			●				●	●	●	●							●	
		WATERFLOW IN ELEVATOR HOISTWAY	●		●	●						●		●	●	●	●			●				●	●	●	●							●	
		ALARM SIGNAL FROM SUPPRESSION SYSTEM	●		●	●									●	●	●			●		●		●	●	●	●								
		SUPERVISORY SIGNAL FROM SUPPRESSION SYSTEM					●	●			●							●				●													
		TROUBLE SIGNAL FROM SUPPRESSION SYSTEM							●	●	●								●		●	●													
		SMOKE DETECTION IN AREA SERVED BY SUPPRESSION SYSTEM	●		●	●									●	●	●			●		●		●	●	●	●		●	●					
		FIRE EXTINGUISHING SYSTEM OPERATION	●		●	●									●	●	●			●		●		●	●	●	●								
		FIRE STANDPIPE SYSTEM OPERATION	●		●	●									●	●	●			●		●		●	●	●	●								
		FIRE PROTECTION SYSTEM VALVE TAMPER OPERATION					●	●			●							●				●													
		DRY PIPE SPRINKLER LOW AIR PRESSURE SWITCH ACTIVATION					●	●			●							●				●													
		PREACTION SPRINKLER LOW AIR PRESSURE SWITCH ACTIVATION					●	●			●							●				●													
		PHASE II RECALL INITIATED BY ELEVATOR CONTROL SYSTEM																																	●
	STATUS	OPEN CIRCUIT, SHORT CIRCUIT, OR GROUND FAULT ON INITIATING DEVICE, SIGNALING LINE, OR NOTIFICATION APPLIANCE CIRCUIT.							●	●	●								●		●	●													
		OPENING, TAMPERING, OR REMOVAL OF ALARM-INITIATING DEVICES							●	●	●								●		●	●													
		OPENING, TAMPERING, OR REMOVAL OF SUPERVISORY SIGNAL INITIATING DEVICES							●	●	●								●		●	●													
		LOSS OF PRIMARY POWER OF FACP							●	●	●								●		●	●													
		GROUND OR SIGNAL BREAK IN FACP INTERNAL CIRCUITS							●	●	●								●		●	●													
		ABNORMAL AC VOLTAGE AT THE FACP							●	●	●								●		●	●													
		STANDBY BATTERY CIRCUITRY BREAK							●	●	●								●		●	●													
		FAILURE OF BATTERY CHARGING SYSTEM							●	●	●								●		●	●													
		ABNORMAL POSITION OF ANY SWITCH AT THE FACP							●	●	●								●		●	●													
		ABNORMAL POSITION OF ANY SWITCH AT THE ANNUNCIATOR							●	●	●								●		●	●													
		GENERATOR FAULT							●	●	●								●		●	●													
		GENERATOR SWITCH IN NON AUTOMATIC POSITION							●	●	●								●		●	●													
		GENERATOR RUNNING					●	●										●				●													
		KNOX BOX OPEN					●	●										●				●													
		SMOKE EXHAUST FAN FAILURE					●	●										●				●	●					●							

FIRE ALARM MATRIX

NO SCALE

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ARCHITECTURE + PLANNING + DESIGN

Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021-0121

STATE OF MICHIGAN
ERIC MICHAEL GRAETTINGER
ENGINEER
No. 6201052164
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: SMB Checked: SMB

City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

ELECTRICAL DETAILS AND DIAGRAMS

A3C
COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet
E7.02

INTERIOR LIGHTING CONTROL SCHEDULE

PLAN REFERENCE	ROOM TYPE	LOCAL CONTROL			CONTROL ON / OFF	SENSOR TYPE	TURN ON LIGHTING TO %	BI-LEVEL CONTROL	DAYLIGHT			NO DETECTION PARTIAL OFF		NO DETECTION FULL OFF (MIN)	TIME-CLOCK SCHEDULE	EMERGENCY LIGHTING CIRCUIT CONTROL	HVAC CONTROL	NOTES
		SWITCH TYPE	SWITCH CONTROL	SCENE CONTROL					SIDE LIGHT	TOP LIGHT	MAINTAIN FC LEVEL	REDUCE TO (%)	AT(MIN)					
A	CORRIDOR (ALL OTHER CORRIDORS)	LOW VOLTAGE	ON-OFF	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	FULL 100%	NA	NA	NA	NA	50	10	20	NA	ALCR	NA	
B	CONFERENCE/MEETING/MULTIPURPOSE ROOM	LOW VOLTAGE	ON-OFF-DIM	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	NA	NA	NA	NA	NA	NA	20	NA	ALCR	YES	
C	LOCKER ROOM	LOW VOLTAGE	ON-OFF-DIM	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	INTERMEDIATE STEP 70%	NA	NA	NA	NA	NA	20	NA	ALCR	NA	
D	LOUNGE/BREAKROOM (ALL OTHER LOUNGES/BREAKROOMS)	LOW VOLTAGE	ON-OFF-DIM	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	INTERMEDIATE STEP 70%	NA	NA	NA	NA	NA	20	NA	ALCR	YES	
E	ELECTRICAL/MECHANICAL ROOM	LINE VOLTAGE	ON-OFF	NA	MANUAL ON / MANUAL OFF	NA	FULL 100%	NA	NA	NA	NA	NA	NA	NA	NA	ALCR	NA	
F	OFFICE (ENCLOSED AND >250 SQFT)	LOW VOLTAGE	ON-OFF-DIM	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	INTERMEDIATE STEP 70%	NA	NA	NA	NA	NA	20	NA	NA	NA	
G	RESTROOM (ALL OTHER RESTROOMS)	LOW VOLTAGE	ON-OFF	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	FULL 100%	NA	NA	NA	NA	NA	NA	20	NA	ALCR	NA	
H	STORAGE ROOM (< 50 SQFT)	LOW VOLTAGE	ON-OFF	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	NA	NA	NA	NA	NA	NA	20	NA	ALCR	NA	
I	STORAGE ROOM (≥ 50 FT2 AND ≤ 1000 SQFT)	LOW VOLTAGE	ON-OFF	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	NA	NA	NA	NA	NA	NA	20	NA	ALCR	NA	
J	STAIRWELL	LOW VOLTAGE	ON-OFF-DIM	NA	MANUAL ON / SENSOR OFF	DUAL TECHNOLOGY	FULL 100%	INTERMEDIATE STEP 70%	NA	NA	NA	50	10	20	NA	BCELTS	NA	
K	VEHICULAR MAINTENANCE AREA	LOW VOLTAGE	ON-OFF-DIM	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	INTERMEDIATE STEP 70%	YES	NA	30	NA	NA	20	NA	ALCR	NA	
L	FIRE STATION - SLEEPING QUARTERS	LOW VOLTAGE	ON-OFF-DIM	NA	MANUAL ON / MANUAL OFF	NA	NA	CONTINUOUS DIM	NA	NA	NA	NA	NA	NA	NA	NA	NA	
M	WORKSHOP	LOW VOLTAGE	ON-OFF-DIM	NA	MANUAL ON / SENSOR OFF	DUAL TECHNOLOGY	FULL 100%	INTERMEDIATE STEP 50%	NA	NA	NA	NA	NA	20	NA	NA	NA	
N	GYMNASIUM/FITNESS CENTER (IN AN EXERCISE AREA)	LOW VOLTAGE	ON-OFF-DIM	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	CONTINUOUS DIM	NA	NA	NA	NA	NA	20	NA	ALCR	YES	
O	LAUNDRY/WASHING AREA	LOW VOLTAGE	ON-OFF-DIM	NA	SENSOR ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	INTERMEDIATE STEP 70%	NA	NA	NA	NA	NA	20	NA	ALCR	NA	
P	LOBBY (ALL OTHER LOBBIES)	LOW VOLTAGE	ON-OFF-DIM	NA	MANUAL ON / SENSOR OFF	DUAL TECHNOLOGY	PARTIAL 50%	CONTINUOUS DIM	NA	NA	NA	NA	NA	20	NA	ALCR	NA	

NA = NOT APPLICABLE

NOTE:
1. REFER TO PLANS FOR LOCATION OF LOCAL CONTROL..
2. REFER TO PLANS FOR SCENE CONTROL.
3. REFER TO PLANS FOR PRIMARY AND SECONDARY DAYLIGHT ZONES.
4. PROVIDE EMERGENCY LIGHTING CIRCUIT CONTROL (BCELTS OR ALCR) PER SWITCHING CIRCUIT AS REQUIRED.
5. CONTRACTOR SHALL PROVIDE FLOOR PLAN INDICATING SENSOR AND EQUIPMENT LOCATIONS OF CHOSEN CONTROL SYSTEM.
6. REFER TO LUMINAIRE SCHEDULE FOR FIXTURE CHARACTERISTICS.
7. LIGHTING SENSOR SHALL HAVE CONTACT FOR HVAC CONTROL WHEN A "YES" SELECTION IS MADE IN THE HVAC CONTROL COLUMN.
8. REFER TO TEMPERATURE CONTROL DRAWINGS AND DIAGRAMS FOR ADDITIONAL SENSOR REQUIREMENTS.
9. PROVIDE WIRING CONTROL DIAGRAM FOR APPLICABLE CONTROL SYSTEM(S).

EXTERIOR LIGHTING CONTROL SCHEDULE

PLAN REFERENCE	ROOM TYPE	LOCAL CONTROL		CONTROL ON / OFF	SENSOR TYPE	TURN ON LIGHTING TO %	TIME-CLOCK SCHEDULE	EMERGENCY LIGHTING CIRCUIT CONTROL	NOTES
		SWITCH TYPE	SWITCH CONTROL						
Y	EXTERIOR BUILDING MOUNT	LINE VOLTAGE	ON-OFF	MIX	PHOTOCELL	FULL 100%	OFF MIDNIGHT TO 6AM	ALCR	PROVIDE PHOTOCELL DAYLLIGHT CONTROL TO TURN LIGHTING ON AND OFF BASED ON AVAILBLE DAYLIGHT. TIME CLOCK TO CONTROL FROM MIDNIGHT TO 6AM.
Z	EXTERIOR SITE	LINE VOLTAGE	ON-OFF	MIX	PHOTOCELL	FULL 100%	OFF MIDNIGHT TO 6AM	NA	PROVIDE PHOTOCELL DAYLLIGHT CONTROL TO TURN LIGHTING ON AND OFF BASED ON AVAILBLE DAYLIGHT. TIME CLOCK TO CONTROL FROM MIDNIGHT TO 6AM.

NOTE:
1. REFER TO PLANS FOR LOCATION OF LOCAL CONTROL.
2. REFER TO PLANS FOR SCENE CONTROL.
3. REFER TO PLANS FOR PRIMARY AND SECONDARY DAYLIGHT ZONES.
4. PROVIDE EMERGENCY LIGHTING CIRCUIT CONTROL (BCELTS OR ALCR) PER SWITCHING CIRCUIT AS REQUIRED.
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9. PROVIDE WIRING CONTROL DIAGRAM FOR APPLICABLE CONTROL SYSTEM(S).

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T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet
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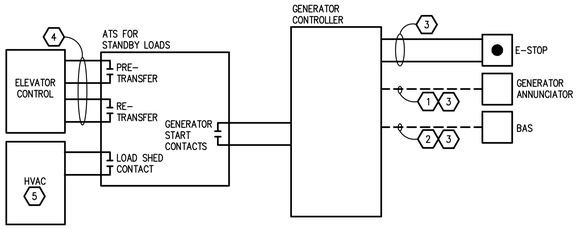

GENERATOR AND ATS CONTROL WIRING CONNECTION DETAIL - OPTIONAL STANDBY ONLY

NO SCALE

NOTES:
1. VERIFY ALL WIRE AND CABLE SPECIFICATIONS WITH GENERATOR SUBMITTAL DRAWINGS, WIRING DIAGRAMS, AND MANUFACTURERS REQUIREMENTS.

(#) KEYED NOTES:

1. PROVIDE SHIELDED TWISTED PAIR (PER MANUFACTURERS RECOMMENDATIONS) AND 2#14 FOR ANNUNCIATOR DC POWER.
2. PROVIDE SHIELDED TWISTED PAIR FOR COMMUNICATION LINK. COORDINATE WITH BAS INTEGRATOR.
3. PROVIDE 2 HOUR CABLE ASSEMBLY OR EQUIVALENT MEANS OF PROTECTION FOR START SIGNAL WIRING.
4. PROVIDE CONDUIT FOR INDICATED WIRING. UNLESS OTHERWISE NOTED, ALL CONTROL WIRING SHALL BE #14 THHN/THWN.
5. PROVIDE DRY CONTACT FROM ATS FOR DDC MONITORING. REFER TO TC DRAWINGS FOR ADDTIONAL INFORMATION.

INTERIOR LUMINAIRE SCHEDULE

TYPE	DESCRIPTION	MANUFACTURER(S)	WATTAGE	VOLTAGE	LIGHT CHARACTERISTICS	CONTROLS	REMARKS
L1A	2X4 TROFFER	LITHONIA LIGHTING – 2BLT4	34.52	MVOLT	LED, 3500K, 82CRI, 3000L	1% 0–10V DIMMING	
L1B	2X4 TROFFER	LITHONIA LIGHTING – 2BLT4	34.52	MVOLT	LED, 3500K, 82CRI, 4800L	1% 0–10V DIMMING	
L2	2X2 TROFFER	LITHONIA LIGHTING – 2BLT2	24.7	MVOLT	LED, 3500K, 82CRI, 3300L	1% 0–10V DIMMING	
L4	WALL MOUNT VANITY	VISA LIGHTING – CB5518	15	MVOLT	LED, 3500K, 83CRI, 1700L	1% 0–10V DIMMING	
L6A	6" RECESSED DOWNLIGHT	LITHONIA LIGHTING – LDN6	5.8	MVOLT	LED, 3500K, 80CRI, 500L	1% 0–10V DIMMING	
L6B	6" RECESSED DOWNLIGHT	LITHONIA LIGHTING – LDN6	10.4	MVOLT	LED, 3500K, 80CRI, 1000L	1% 0–10V DIMMING	
L7	4' LINEAR	LITHONIA LIGHTING – VAP LED	99	MVOLT	LED, 3500K, 80CRI, 12000L	1% 0–10V DIMMING	
L8	6" RECESSED DOWNLIGHT	LITHONIA LIGHTING – LCP	N.A	120	LED, RED RETROFIT A-LAMP, 3500K	N/A	
L9A	4' UTILITY LINEAR	LITHONIA LIGHTING – CLX	19	MVOLT	LED, 3500K, 80CRI, 3000L	1% 0–10V DIMMING	
L9B	4' UTILITY LINEAR	LITHONIA LIGHTING – CLX	24.75	MVOLT	LED, 3500K, 80CRI, 4000L	1% 0–10V DIMMING	
L10A	12' LINEAR	FOCAL POINT – SEEM 2	22	UNV	LED, 3500K, 80CRI, 375L/FT DIRECT, 250L/FT INDIRECT	1% 0–10V DIMMING	
L10B	6' LINEAR	FOCAL POINT – SEEM 2	22	UNV	LED, 3500K, 80CRI, 375L/FT DIRECT, 250L/FT INDIRECT	1% 0–10V DIMMING	
L11	4' UTILITY LINEAR	LITHONIA LIGHTING – FEM LED	37.8	MVOLT	LED, 3500K, 80CRI, 6000L	1% 0–10V DIMMING	
L12	LINEAR UNDER CABINET	VODE LIGHTING – ZIPONE 707	6.6/FT	MVOLT	LED, 3500K, 80CRI, 836L/FT	1% 0–10V DIMMING	
L13A	18" SUSPENDED DOWNLIGHT	VISA LIGHTING – CP6000 SEQUENCE MINI	10	MVOLT	LED, 3500K, 80CRI, 1100L	1% 0–10V DIMMING	
L13B	24" SUSPENDED DOWNLIGHT	VISA LIGHTING – CP6000 SEQUENCE MINI	14	MVOLT	LED, 3500K, 80CRI, 1500L	1% 0–10V DIMMING	
L13C	12" SUSPENDED DOWNLIGHT	VISA LIGHTING – CP6000 SEQUENCE MINI	7	MVOLT	LED, 3500K, 80CRI, 700L	1% 0–10V DIMMING	
L14	6" LINEAR PENDANT	FINELITE BETTER LIGHTING – HP-6	28.8	120	LED, 3500K, 80CRI, 733L	1% 0–10V DIMMING	
L15	2" LINEAR PENDANT	FINELITE BETTER LIGHTING – HP-2	28.8	120	LED, 3500K, 80CRI, 322L/FT	1% 0–10V DIMMING	
L16	2" WALL MOUNT LINEAR	FINELITE BETTER LIGHTING – HP-2	7/FT	120	LED, 3600k, 80CRI, 612L/FT	1% 0–10V DIMMING	
L17	STEP LIGHTING	BRUCK – HORIZONTAL LOUVER LED STEP LIGHT	10	120	LED, 3000K, 190 LUMENS	1% 0–10V DIMMING	
X	EXIT SIGNAGE, ARCHITECT TO SELECT FINISHES	LITHONIA LIGHTING – EDG/EDGR	3	277	LED, AC ONLY	NA	

GENERAL NOTES:
1. REFER TO SPECIFICATIONS FOR DETAILED LIGHT FIXTURE CUT SHEETS.
2. WATTAGE LISTED IS FROM THE BASIS OF DESIGN MANUFACTURER.
3. FINISH TO BE APPROVED BY INTERIOR DESIGNER, ARCHITECT OR CLIENT.
4. ALL LUMINAIRES TO BE AS SPECIFIED OR EQUAL APPROVED BY PBA AND/OR ILLUMINART.

EXTERIOR LUMINAIRE SCHEDULE

TYPE	DESCRIPTION	MANUFACTURER(S)	WATTAGE	VOLTAGE	LIGHT CHARACTERISTICS	CONTROLS	REMARKS
OL1	TRAPEZODIAL WALL PACK	SIGNIFY – GARDCO 111L	12	MVOLT	LED, 4000K, 70CRI, 200mA, SINGLE FUSING, TYPE 2 WIDE THROW	1% 0–10V DIMMING	
OL2	PATH LIGHTING	ALCON LIGHTING – MODEL SPRUCE 9066	2	15	LED, 4000K, 125L	N/A	
OL3	RECESSED LINEAR	COOPER LIGHTING – NEO-RAY	3.0/FT	MVOLT	LED, 4000K, 80CRI, 350L/FT	1% 0–10V DIMMING	
OL4	LED FLOODLIGHT	LITHONIA LIGHTING – D-SERIES DSXF2	75	MVOLT	LED, 4000K, 70CRI, P2 PERFORMANCE PACKAGE	1% 0–10V DIMMING	

GENERAL NOTES:
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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No: 2021-0121

STATE OF MICHIGAN
ERIC MICHAEL GRAETTINGER
ENGINEER
No. 6201052164
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: SMB Checked: SMB

City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

ELECTRICAL DETAILS AND DIAGRAMS

A3C
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
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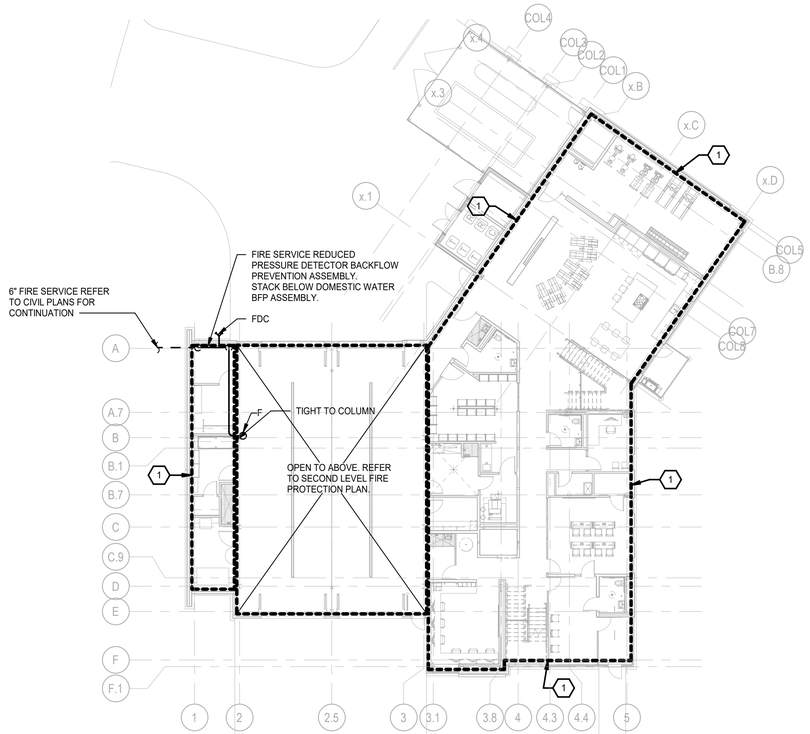
COLLABORATIVE ARCHITECTURE

Sheet E7.04

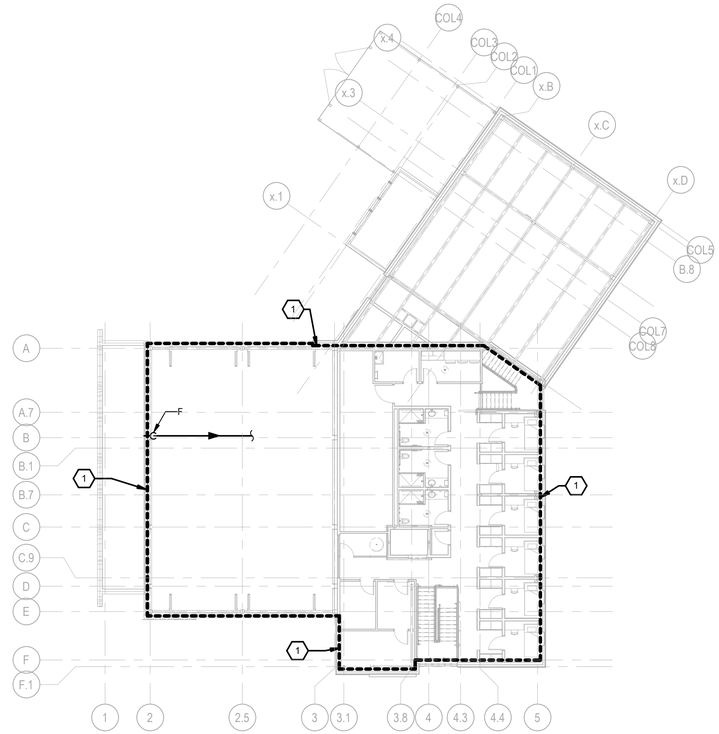
THE FOLLOWING DIMENSION EQUALS ONE INCH WHEN PRINTED TO SCALE. 1"



FIRST LEVEL FIRE PROTECTION PLAN

SCALE: 1/16" = 1'-0"

PROJECT TRUE



SECOND LEVEL FIRE PROTECTION PLAN

SCALE: 1/16" = 1'-0"

PROJECT TRUE

FIRE PROTECTION GENERAL NOTES:

1 THESE DRAWINGS ARE DIAGRAMMATIC, AND REPRESENT THE GENERAL INTENT AND ARRANGEMENT OF SYSTEMS. THEY ARE NOT TO BE CONSIDERED FABRICATION/COORDINATION/SHOP DRAWINGS. COORDINATION WITH OTHER TRADES IS REQUIRED. PROVIDE THE ADDITIONAL FITTINGS AND OFFSETS THAT WILL BE REQUIRED TO COMPLETE EACH SYSTEM AND TO AVOID INTERFERENCES WITH ALL OTHER SYSTEMS INCLUDING THE STRUCTURE, SHEET METAL, OTHER PIPING SYSTEMS, ELECTRICAL CONDUITS, BUS DUCTS, CABLE TRAY, LIGHT FIXTURES, ETC. AND/OR OTHER SPACE CONSTRAINTS.

2 INSTALL SYSTEMS SUCH THAT REQUIRED CLEARANCE AND SERVICE ACCESS SPACE IS PROVIDED AROUND ALL MECHANICAL AND ELECTRICAL EQUIPMENT, AND AROUND ANY COMPONENTS WHICH REQUIRE SERVICE ACCESS.

3 NO SPRINKLER PIPING SHALL BE ROUTED THROUGH ELECTRICAL EQUIPMENT ROOMS, TELECOMMUNICATION EQUIPMENT ROOMS, ELEVATOR EQUIPMENT ROOMS OR SIMILAR ROOMS. ONLY SPRINKLER PIPING SERVING SPRINKLERS HEADS IN THOSE ROOMS SHALL BE ALLOWED.

4 PIPING SHALL NOT BE INSTALLED ABOVE ELECTRICAL TRANSFORMERS, SWITCHBOARDS, PANELBOARDS OR MOTOR CONTROL CENTERS.

5 MINIMUM RUN-OUT PIPE SIZE TO SPRINKLER HEADS SHALL BE 1".

6 ACCORDING TO THE MOST RECENT FLOW TEST INFORMATION, THE STATIC PRESSURE AVAILABLE AT THE CITY WATER MAIN AT THE STREET IS 90 PSIG. RESIDUAL PRESSURE WITH 1061 GPM FLOWING IS 82 PSIG. CONTRACTOR SHALL MAKE HIS OWN PRESSURE AND FLOW TEST PRIOR TO SYSTEM DESIGN.

7 FIRE PROTECTION WATER SERVICE ENTRANCE PIPING SHALL BE BURIED WITH DEPTH OF COVER OVER TOP OF PIPE OF AT LEAST 72", OR WITH TOP OF PIPE AT LEAST 12" BELOW LEVEL OF MAXIMUM FROST PENETRATION, OR AS REQUIRED BY AUTHORITIES HAVING JURISDICTION, WHICHEVER IS DEEPEST.

CONSTRUCTION KEY NOTES:

1 PROVIDE A FULLY FUNCTIONING FIRE PROTECTION SYSTEM IN ACCORDANCE WITH NFPA 13, THE LOCAL AUTHORITY HAVING JURISDICTION AND THE OWNERS INSURING AGENCY IN OUTLINED AREA INDICATED. REFER TO DIVISION 21 SPECIFICATIONS FOR FIRE PROTECTION REQUIREMENTS.

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Peter Basso Associates Inc
CONSULTING ENGINEERS
5145 Livernois, Suite 100
Troy, Michigan 48098-3276
Tel: 248-879-5666
Fax: 248-879-0007
www.PeterBassoAssociates.com
PBA Project No.: 2021.0121

STATE OF MICHIGAN
AARON CHRISTOPHER FRANTZ
ENGINEER
No. 6201068182
LICENSED PROFESSIONAL ENGINEER

Project Number 21018

Issue	Date
SCHEMATIC DESIGN	03/04/22
DESIGN DEVELOPMENT	05/26/23
BIDS/PERMITS	10/11/24

Drawn: ACF Checked: ACF

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FIRE PROTECTION PLANS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet FP1.01

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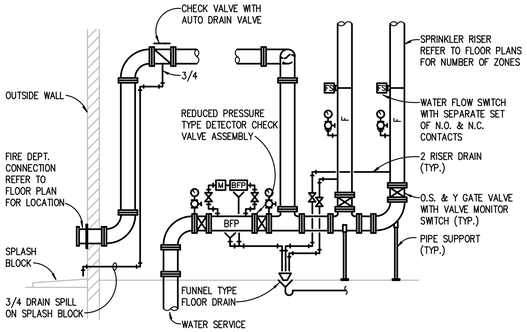
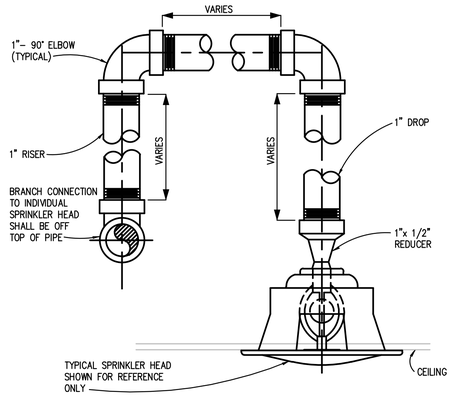
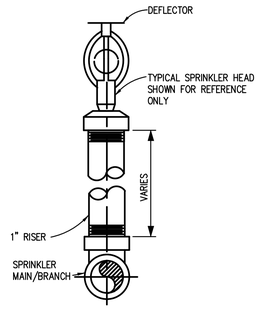


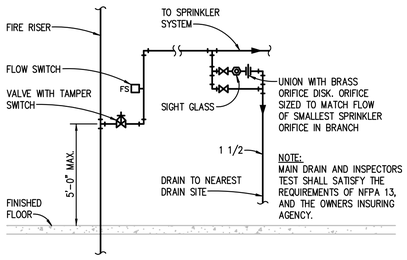
AUTOMATIC SPRINKLER RISER PIPING DIAGRAM
NO SCALE



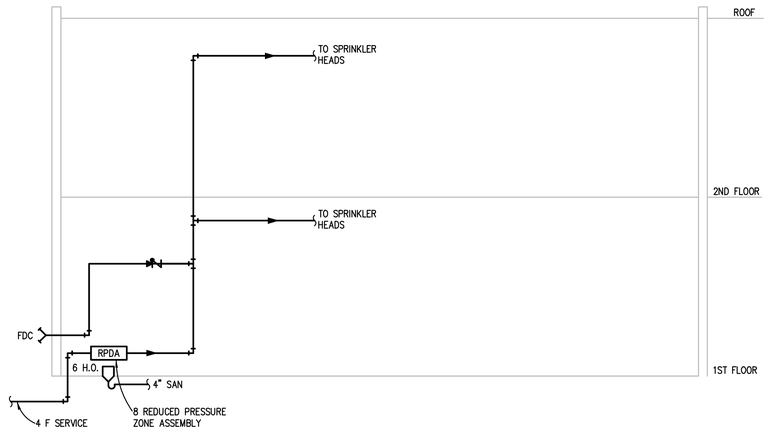
TYPICAL SPRINKLER PIPING DETAIL
NO SCALE



TYPICAL UPRIGHT SPRINKLER PIPING DETAIL
NO SCALE



DRAIN/INSPECTORS TEST DETAIL
NO SCALE



FIRE PROTECTION RISER DIAGRAM
NO SCALE

FLOW TEST DATA	
STATIC	90 PSI
RESIDUAL	82 PSI
FLOW	1061 GPM
ESTIMATED FLOW @ 20 PSI	7055 GPM
TEST DATE	12-10-2021
FLOW TEST BY	ANN ARBOR FD-BOMMARITO/BROWN

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City Of Ann Arbor
NEW FIRE STATION 4
2415 S HURON PKWY
ANN ARBOR, MI 48104

FIRE PROTECTION DETAILS

A3C COLLABORATIVE ARCHITECTURE
115 1/2 E. LIBERTY STREET
ANN ARBOR, MI 48104
T: (734) 663 - 1910
F: (866) 732 - 2168
www.a3c.com

Sheet FP6.01

Project Manual

Ann Arbor Fire Station 4

A3C Project No. 21018

Issue Date: October 11, 2024

Issued For: Bid/Permit

SECTION 00 0102
PROJECT INFORMATION

PART 1 GENERAL

1.01 PROJECT IDENTIFICATION

A. Project Name: City of Ann Arbor Fire Station Number 4, located at: 2415 S. Huron Pkwy., Ann Arbor, MI 48104.

Project Location Address 1.

Project Location City, Project Location StateProject Location ZIP.

B. The Owner, hereinafter referred to as CIty of Ann Arbor

C. Owner's Project Manager: Chief Michael Kennedy.
   1. Department: Ann Arbor Fire Department.
   2. Address: 111 North Fifth Avenue.
   3. City, State, Zip: Ann Arbor, MI 48104.
   4. E-mail: mkennedy@a2gov.org.

1.02 PROJECT DESCRIPTION

A. Summary Project Description:

B. The Ann Arbor Fire Station 4 project is a 12,000 square foot, 2-story, fire station to replace the existing outdated facility. The Fire Station 4 project will be constructed through a design-bid-build project delivery method.

C. The Ann Arbor Fire Station 4 project will be designed to achieve a net zero energy consumption rating calculated on an annualized basis. Under this basis of calculation, the goal of this project is that the building would supply more energy than it would consume within a given year. A photovoltaic array on the roof of the building will generate electrical energy and the excess would be supplied to the electrical grid. The building will be fully electrified. Energy consumption will be reduced using ground source heat pumps tied to a geothermal field and an efficient building envelope.

D. Contract Scope: Construction and demolition.

E. Contract Terms: Lump sum (fixed price, stipulated sum).

1.03 PROJECT CONSULTANTS

A. The Architect, hereinafter referred to as Architect: A3C Collaborative Architecture, Don Barry, Principal.
   1. Address: 115 ½ E. Liberty.
   2. City, State, Zip: Ann Arbor, MI 48104.
   3. Phone/Fax: 734-663-1910.
   4. E-mail: dbarry@a3c.com.

1.04 PROCUREMENT TIMETABLE

A. The Owner reserves the right to change the schedule or terminate the entire procurement process at any time.

1.05 PROCUREMENT DOCUMENTS

A. Availability of Documents: Complete sets of procurement documents may be obtained:
   1. From Owner at the Project Manager's address listed above.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 00 0110
TABLE OF CONTENTS

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SECTION 01 1000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: City of Ann Arbor Fire Station Number 4

B. Owner's Name: CIty of Ann Arbor.

C. Architect's Name: A3C Collaborative Architecture.

D. The Project consists of the construction of A new Ann Arbor Fire Station 4 to replace the existing outdated facility.

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price.

1.03 OWNER OCCUPANCY

A. Owner intends to occupy the Project upon Substantial Completion.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.04 CONTRACTOR USE OF SITE AND PREMISES

A. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

END OF SECTION

SECTION 01 2300
ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

1.02 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03 SCHEDULE OF ALTERNATES

A. Alternate No. 1 - _____:

1. Alternate Item: All project work in Scheffler Park across Mallett's Creek to the south. See Civil and Landscape drawings for further clarification.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.
   6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. No specific form is required. Contractor's Substitution Request documentation must include the following:
      a. Project Information:
         1) Official project name and number, and any additional required identifiers established in Contract Documents.
         2) Owner's, Architect's, and Contractor's names.
      b. Substitution Request Information:
         1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
         2) Indication of whether the substitution is for cause or convenience.
         3) Issue date.

4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
5) Description of Substitution.
6) Reason why the specified item cannot be provided.
7) Differences between proposed substitution and specified item.
8) Description of how proposed substitution affects other parts of work.

c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
1) Physical characteristics.
2) In-service performance.
3) Expected durability.
4) Visual effect.
5) Sustainable design features.
6) Warranties.
7) Other salient features and requirements.
8) Include, as appropriate or requested, the following types of documentation:
(a) Product Data:
(b) Samples.
(c) Certificates, test, reports or similar qualification data.
(d) Drawings, when required to show impact on adjacent construction elements.

d. Impact of Substitution:
1) Savings to Owner for accepting substitution.
2) Change to Contract Time due to accepting substitution.

E. Limit each request to a single proposed substitution item.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:
1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Architect will consider requests for substitutions only within 15 days after date of Agreement.

B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

C. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
3. Bear the costs engendered by proposed substitution of:
a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

D. Substitutions will not be considered under one or more of the following circumstances:
1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
2. Without a separate written request.
3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

END OF SECTION

SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.

B. Preconstruction meeting.

C. Progress meetings.

D. Number of copies of submittals.

E. Requests for Interpretation (RFI) procedures.

F. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 00 7200 - General Conditions: Dates for applications for payment.

B. Section 00 7300 - Supplementary Conditions: Duties of the Construction Manager.

C. Section 01 6000 - Product Requirements: General product requirements.

D. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.

1.03 REFERENCE STANDARDS

A. AIA G716 - Request for Information; 2004.

B. CSI/CSC Form 12.1A - Submittal Transmittal; Current Edition.

C. CSI/CSC Form 13.2A - Request for Information; Current Edition.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

B. Make the following types of submittals to Architect:
   1. Requests for Interpretation (RFI).
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Design data.
   6. Manufacturer's instructions and field reports.
   7. Applications for payment and change order requests.
   8. Progress schedules.
   9. Coordination drawings.
   10. Correction Punch List and Final Correction Punch List for Substantial Completion.
   11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

A. Schedule meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.

3. Distribution of Contract Documents.
4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
5. Submission of initial Submittal schedule.
6. Designation of personnel representing the parties to Contract, _____ and Architect.
7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
8. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.02 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum weekly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.

b. Do not forward requests which solely require internal coordination between subcontractors.
2. Prepare in a format and with content acceptable to Owner.
a. Use AIA G716 - Request for Information .
3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
a. Approval of submittals (use procedures specified elsewhere in this section).
b. Approval of substitutions (see Section - 01 6000 - Product Requirements)
c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
3. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.

E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.

F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.

H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.

I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.

3.04 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
1. Coordinate with Contractor's construction schedule and schedule of values.
2. Format schedule to allow tracking of status of submittals throughout duration of construction.
3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.05 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
1. Product data.
2. Shop drawings.

3. Samples for selection.
4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.06 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
1. Design data.
2. Certificates.
3. Test reports.
4. Inspection reports.
5. Manufacturer's instructions.
6. Manufacturer's field reports.
7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.07 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.08 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
1. After review, produce duplicates.
2. Retained samples will not be returned to Contractor unless specifically so stated.

3.09 SUBMITTAL PROCEDURES

A. General Requirements:
1. Use a single transmittal for related items.
2. Transmit using approved form.
a. Use Contractor's form, subject to prior approval by Architect.
3. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
4. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
a. Send submittals in electronic format via email to Architect.
5. Schedule submittals to expedite the Project, and coordinate submission of related items.

a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.

6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
7. Provide space for Contractor and Architect review stamps.
8. When revised for resubmission, identify all changes made since previous submission.
9. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
10. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
11. Submittals not requested will not be recognized or processed.
12. Submittals not requested will be recognized, and will be returned "Not Reviewed",

B. Product Data Procedures:
1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

3.10 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
a. "Approved", or language with same legal meaning.
b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
2. Not Authorizing fabrication, delivery, and installation:
a. "Revise and Resubmit".
1) Resubmit revised item, with review notations acknowledged and incorporated.
b. "Rejected".
1) Submit item complying with requirements of Contract Documents.

E. Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:

a. "Received" - to notify the Contractor that the submittal has been received for record only.

2. Items for which action was taken:
   a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Quality assurance.

C. Testing and inspection agencies and services.

D. Contractor's construction-related professional design services.

E. Contractor's design-related professional design services.

F. Control of installation.

G. Mock-ups.

H. Tolerances.

I. Manufacturers' field services.

J. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 01 2100 - Allowances: Allowance for payment of testing services.

B. Section 01 3000 - Administrative Requirements: Submittal procedures.

C. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).

B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2024.

C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2023.

D. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.

E. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.

F. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

1.04 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
   1. Design Services Types Required:
      a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.
      b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
   1. Temporary sheeting, shoring, or supports.
   2. Temporary scaffolding.
   3. Temporary bracing.
   4. Temporary stairs or steps required for construction access only.
   5. Investigation of soil conditions to support construction equipment.

1.06 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.

C. Scope of Contractor's Professional Design Services: Provide for the following items of work:

1.07 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

E. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
   1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

B. Contractor's Quality Control (CQC) Plan:
   1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
      a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
      b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
      c. Owner will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.

d. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.

1.09 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 01 2100; see Section 01 2100 and applicable sections for description of services included in allowance.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 3 EXECUTION

2.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

D. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

E. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

F. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

2.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

2.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

2.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment, and _____ as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

2.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering

B. Temporary sanitary facilities.

C. Temporary Controls: Barriers, enclosures, and fencing.

D. Security requirements.

E. Waste removal facilities and services.

F. Project identification sign.

1.02 RELATED REQUIREMENTS

A. Section 01 5100 - Temporary Utilities.

1.03 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls.

1.04 TEMPORARY UTILITIES - SEE SECTION 01 5100

A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

1.05 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 FENCING

A. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.08 SECURITY - SEE SECTION 01 3553

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.09 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.10 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated on drawings.

B. Erect on site at location established by Architect.

C. No other signs are allowed without Owner permission except those required by law.

1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Sustainable design-related product requirements.

C. Transportation, handling, storage and protection.

D. Product option requirements.

E. Substitution limitations.

1.02 RELATED REQUIREMENTS

A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 01 4000 - Quality Requirements: Product quality monitoring.

C. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

D. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 REFERENCE STANDARDS

A. 16 CFR 260.13 - Guides for the Use of Environmental Marketing Claims; Federal Trade Commission; Recycled Content; Current Edition.

B. ANSI A138.1 - Green Squared American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials; 2011 (Reaffirmed 2021).

C. ASTM D6866 - Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis; 2022.

D. CAN/CSA Z809 - Sustainable Forest Management; 2016 (Reaffirmed 2021).

E. EN 15804 - Sustainability of Construction Works - Environmental Product Declarations - Core Rules for the Product Category of Construction Products; 2022 (Corrigendum 2021).

F. ISO 14025 - Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures; 2006.

G. ISO 21930 - Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services; 2017.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NSF 332 - Sustainability Assessment for Resilient Floor Coverings; 2022.

J. NSF/ANSI 140 - Sustainability Assessment for Carpet; 2019.

K. NSF/ANSI 347 - Sustainability Assessment for Single Ply Roofing Membranes; 2018.

L. UL 100 - Standard for Sustainability for Gypsum Boards and Panels; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. Use of products having any of the following characteristics is not permitted:
   1. Made using or containing CFC's or HCFC's.
   2. Made of wood from newly cut old growth timber.
   3. Containing lead, cadmium, or asbestos.

C. Where other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 01 6116.
   2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
   3. Are extracted, harvested, and/or manufactured closer to the location of the project.
   4. Have longer documented life span under normal use.
   5. Result in less construction waste. See Section 01 7419
   6. Are made of recycled materials.
   7. If made of wood, are made of sustainably harvested wood, wood chips, or wood fiber.
   8. If bio-based, other than wood, are or are made of Sustainable Agriculture Network certified products.
   9. Are Cradle-to-Cradle Certified.
   10. Have a published Environmental Product Declaration (EPD).
   11. Have a published Health Product Declaration (HPD).
   12. Have a published GreenScreen Chemical Hazard Analysis.
   13. Have a published Manufacturer's Inventory of Chemical Content.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 2500 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.
   1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

I. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

J. Prevent contact with material that may cause corrosion, discoloration, or staining.

K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Cutting and patching.

C. Surveying for laying out the work.

D. Cleaning and protection.

E. Starting of systems and equipment.

F. Demonstration and instruction of Owner personnel.

G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

H. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Testing and inspection procedures.

B. Section 02 4100 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.

C. Section 07 8400 - Firestopping.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

1.05 QUALIFICATIONS

A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.06 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

C. Perform dewatering activities, as required, for the duration of the project.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.

F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means

acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations; and _____.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations, and _____.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

F. Restore work with new products in accordance with requirements of Contract Documents.

G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

I. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.06 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.07 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.08 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.09 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.10 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.11 FINAL CLEANING

A. Use cleaning materials that are nonhazardous.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Clean filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.12 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.13 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.

E. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.

F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. Section 01 5000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

C. Section 01 6000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

D. Section 01 7000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   4. Incinerator Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project delivered to incinerators.
      c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   5. Recycled and Salvaged Materials: Include the following information for each:
      a. Identification of material, including those retrieved by installer for use on other projects.
      b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
      c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
      e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
   6. Material Reused on Project: Include the following information for each:
      a. Identification of material and how it was used in the project.
      b. Amount, in tons or cubic yards (cubic meters).
      c. Include weight tickets as evidence of quantity.
   7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION

2.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 01 7000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Prebid meeting.
   2. Preconstruction meeting.
   3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. Provide containers as required.
   2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 7800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Materials transparency manual.

D. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Individual Product Sections: Specific requirements for operation and maintenance data.

C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   3. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Materials Transparency Manual:
   1. Compile and submit a digital and a printed version of information disclosing materials content for interior finishes, furnishings (including workstations), built-in furniture. Meet IWBI (BS) requirements for format and content.

D. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
   1. Include HVAC outdoor and exhaust air damper calibration strategy.
      a. Include provisions which ensure that full closure of dampers can be achieved.
   2. Include Carbon Monoxide Monitoring Protocol.

E. Include manufacturer's printed operation and maintenance instructions.

F. Include sequence of operation by controls manufacturer.

G. Include test and balancing reports.

H. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building demolition excluding removal of hazardous materials and toxic substances.

B. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 1000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.

C. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

D. Section 01 6000 - Product Requirements: Handling and storage of items removed for salvage and relocation.

E. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

F. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

G. Section 02 6500 - Underground Storage Tank Removal.

H. Section 31 2323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.03 DEFINITIONS

A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.

B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.

C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.

D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 REFERENCE STANDARDS

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Site Plan: Indicate:
   1. Areas for temporary construction and field offices.

C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
   1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.

D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.06 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of three years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill Material: See Section 31 2323.

PART 3 EXECUTION

3.01 DEMOLITION

A. Remove the entire building designated on Civil Drawings.

B. Remove paving and curbs required to accomplish new work.

C. Remove all other paving and curbs within site boundaries.

D. Within area of new construction, remove foundation walls and footings to minimum 4 feet (1200 mm) below finished grade.

E. Outside area of new construction, remove foundation walls and footings to minimum 2 feet (600 mm) below finished grade.

F. Remove concrete slabs on grade within site boundaries.

G. Remove underground tanks.

H. Remove manholes and manhole covers, curb inlets and catch basins.

I. Remove fences and gates.

J. Remove other items indicated, for salvage, relocation, recycling, and disposal.

K. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 2200.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.
   4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   6. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
   7. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
   8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements to remain in place and not removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

D. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

E. Hazardous Materials:
   1. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing

materials, lead, PCBs, and mercury.

F. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Comply with requirements of Section 01 7419 - Construction Waste Management and Disposal.
   2. Dismantle existing construction and separate materials.
   3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

G. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

H. Underground Storage Tanks: Remove and dispose of as specified in Section 02 6500.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove materials not to be reused on site; comply with requirements of Section 01 7419 - Waste Management.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 3000

CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the work of this Section.

1.2 SUMMARY

A. Section includes but is not limited to the following as shown on the drawings and as specified herein:

1. Foundation systems including footings, caissons, caisson caps, piles, walls, beams, piers, pilasters, pits and similar concrete.
2. Slabs on grade.
3. Structural slabs on grade.
4. Structural slabs on metal deck.
5. Topping slabs
6. Stair pan fills.
7. Furnishing and installing all required anchors and inserts.
8. Placing in the forms all inserts, anchors, anchor bolts, bearing plates and the like furnished by other trades for casting into the concrete and cleaning of same after stripping of forms.
9. Protection of all inserts, anchors, hangers, sleeves and supports furnished and set by others for the attachment of other work to the concrete, or required to permit the passage of other work through the concrete.
10. Supply, fabricate and place all required reinforcing bars, mesh and other reinforcement for concrete where shown, called for, and/or required complete with proper supporting devices.
11. Erection and removal of all formwork required to properly complete the work.
12. Finishing of all concrete work as hereinafter specified.
13. Curing and protection of all concrete work.
14. Site concrete consisting of curbs, walls, pads, boxes and the like as shown on the drawings.
15. Floor sealers and dust-proofing of all areas exposed and/or covered with carpet.
16. Cutting, patching, grouting, repairing and pointing up as required.
17. Vapor barrier system below slabs on grade.
18. Under slab drainage course.
19. Dewatering.
20. Waterproofing.
21. Grouting of all beam bearing plates and column base plates.
22. Embedded plates in all foundation walls.
23. Equipment pads as required.

24. All other work and materials as may be reasonably inferred and needed to make the work of this section complete.
25. Waste Management

B. Related Requirements:

1. Division 01 Section “Construction Waste Management and Disposal”
2. Division 04 Section “Unit Masonry”
3. Division 05 Section “Structural Steel”
4. Division 05 Section “Metal Deck”
5. Division 05 Section “Metal Fabrications”
6. Division 06 Section “Rough Carpentry”
7. Division 07 Section “Waterproofing”
8. Division 07 Section “Joint Sealants”
9. Division 07 Section “Expansion Joint Cover Assemblies”
10. Division 31 Section “Dewatering”

1.3 SUBMITTALS

A. Product Data: Submit data for proprietary materials and items, including the following:

1. Reinforcement
2. Supports for reinforcement
3. Forming accessories
4. Admixtures
5. Patching compounds
6. Waterstops
7. Joint systems
8. Curing compounds
9. Dry-shake finish materials
10. Others items as requested by Architect.

B. Shop Drawings; Reinforcement: Submit original shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Details and Detailing of Concrete Reinforcement" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures. The shop drawings shall be prepared only by competent detailers, checked by the contractor prior to submission.

1. The shop drawings shall show construction, contraction and isolation joint locations and the added reinforcement required at same.
2. Obtain and coordinate information for sleeves and openings in concrete, which are required for the work of other trades. Make coordinated drawings showing size and location of openings and sleeves and incorporate this information on the reinforcing drawings.
3. Only those splices indicated on the approved shop drawings will be permitted.
4. Provide elevations of all foundation walls and other structural elements to a minimum 1/4" scale.

C. Shop Drawings Formwork: Submit shop drawings for fabrication and erection of specific finished concrete surfaces. Show form construction including jointing, special form joint or reveals, location and pattern of form tie placement, and other items which affect exposed concrete visually. Architect's review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility, prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

E. Contraction Joint Layout: Indicate proposed contraction joints required per applicable codes and drawings.

1. Location of contraction joints is subject to approval of the Architect.

F. The use of the Architect's or Engineer of Record's electronic drawing files as a base for the reinforcement, formwork, and joint layout shop drawings will be permitted at the request of the detailer/designer upon completion and return of the waiver form. The use of the Architect's or Engineer of Record's electronic drawing files as a base for shop drawing details will not be permitted. The detailer/designer will be responsible for compatibility of the files with his hardware or software. The electronic files are not to be considered the contract documents, the design team makes no representation regarding the accuracy or completeness of the electronic files given to detailer/designer and their use will be at the detailer/designer's sole risk and without liability to the design team. The detailer/designer shall remove the project title box and all references to the structural drawings including drawing numbers and structural drawing sections and details. The detailer/designer shall also remove all reference to work not included in the concrete contract.

G. Scaling of the Architect's or Engineer of Record's drawings is not permitted. This applies to hard paper, electronic, and all other versions.

H. Samples: Submit samples of materials as requested by Architect, including names, sources and descriptions.

I. Laboratory Test Reports: Submit laboratory test reports for concrete materials, mix design test and microwave test.

J. Material Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements shall sign material certificates. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

K. Cold Weather and Hot Weather Concreting Procedures: Submit written descriptions of contractor's proposed cold weather and hot weather concreting procedures, when applicable.

L. Certification that pozzolanic materials conforms to ASTM C 618-01 (noting class C or class F), ASTM C 989 or ASTM C1240.

M. Certified recycled steel content. Provide cut sheets clearly indicating whether the rebar used meets the minimums for post-consumer OR post-industrial recycled contents. Or, if cut sheets are not available, obtain a written affidavit from the manufacturer stating the recycled content percentage and if the recycled content is post-consumer or post-industrial.

N. Formwork: Specify whether reusable, permanent, salvaged or new wood forms are to be used.

O. Recycled Aggregate: Provide laboratory reports indicating that aggregate conforms to ASTM C33 for structural concrete or ASTM D1241-00 for sub-base material. Provide cut sheets clearly indicating the source, total weight and volume of the recycled aggregate. If aggregate provided is a mix of virgin and recycled aggregates obtain a written affidavit from the manufacturer stating the recycled content percentage

P. VOC content for curing compounds, sealants and release agents: Provide a cut sheet and a Material Safety Data Sheet (MSDS) for each curing compound, sealant, hardener and release agent used highlighting VOC contents. VOC content must be less than or equal to limits stated under "PRODUCTS".

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

D. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. State of Michigan Building Code, Latest Edition
2. ACI 117 "Standard Specifications for Tolerances for Concrete Construction and Materials and Commentary."
3. ACI 211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight and mass concrete."

4. ACI 211.2, “Standard Practice for Selecting Proportions for Structural Lightweight Concrete.”
5. ACI 214R, “Evaluation of Strength Test Results of Concrete.”
6. ACI 232.2R, “Use of Fly Ash in Concrete.”
7. ACI 233R, “Guide to Use of Slag Cement in Concrete and Mortar.”
8. ACI 234, “Guide for the Use of Silica Fume in Concrete.”
9. ACI 301 “Specifications for Structural Concrete.”
10. ACI 302.1R “Guide for Concrete Floor and Slab Construction.”
11. ACI 304R, “Guide for Measuring, Mixing, Transporting and Placing Concrete.”
12. ACI 305R “Hot Weather Concreting.”
13. ACI 306R-10 “Guide to Cold Weather Concreting.”
14. ACI 308.1 “Standard Specification for Curing Concrete.”
15. ACI 309R, “Guide for Consolidation of Concrete.”
16. ACI 311.4R, “Guide for Concrete Inspections.”
17. ACI 315, “Details and Detailing of Concrete Reinforcement.”
18. ACI 318 “Building Code Requirements for Structural Concrete and Commentary.”
19. ACI 347 “Guide to Formwork of Concrete.”
20. Concrete Reinforcing Steel Institute, (CRSI) “Manual of Standard Practice.”
21. CRSI-WCRSI, “Placing Reinforcing Bars.”
22. AWS D1.4, “Structural Welding Code Reinforcing Steel.”
23. The ACI Field Reference Manual, SP-15 shall be kept at the job site, and the practices set forth therein shall be strictly adhered to.
24. ASTM Standards as applicable in the building code of the local jurisdiction and as noted in this specification.
25. AASHTO T 318, “Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.”

E. Concrete Testing Service: Owner will engage a testing laboratory acceptable to Architect and Engineer of Record to perform material evaluation tests and to design concrete mixes.

F. Materials and installed work may require testing and retesting at anytime during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

G. Preconstruction Meeting:

1. At least 35 days prior to the start of the concrete construction schedule, the Contractor shall conduct a meeting to review the proposed mix designs and to discuss the required methods and procedures to achieve the required concrete construction. The Contractor shall send a pre-concrete conference agenda to all attendees 20 days prior to the scheduled date of the conference.
2. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

    a. Contractor's superintendent
    b. Laboratory responsible for the concrete design mix
    c. Laboratory responsible for field quality control
    d. Concrete subcontractor

e. Ready-mix concrete producer
f. Admixture manufacturer(s)
g. Concrete pumping equipment manufacturer.

3. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed by the contractor to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: Owner or owner's representative, Architect, and Engineer of Record.
4. The minutes shall include a statement by the concrete contractor indicating that the proposed mix design and placing can produce the concrete quality required by these specifications.
5. A minimum of a 4 cubic yard trial mixture containing all required admixtures shall be placed at the job site using the accepted methods of placing, finishing and curing. All applicable tests including slump, strength, water content, air content, permeability, and air content will be performed. This shall occur at least four weeks before actual concreting operations with the proposed mix design begins. The admixture manufacturer(s) and inspectors shall be present. The same testing should be done in the laboratory at the same time for comparison. A test sample should be done for each condition that is to be placed.
6. The Engineer of Record will be present at the conference. The Contractor shall notify the Engineer of Record at least 10 days prior to the scheduled date of the conference.

1.5 PROJECT CONDITIONS

A. The Contractor, before commencing work, shall examine all adjoining work on which this work is in any way dependent for proper installation and workmanship according to the intent of this specification, and shall report to the Architect or Engineer of Record any condition which prevents this contractor from performing first class work.

B. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

C. Protect adjacent finish materials against spatter during concrete placement.

D. Provide all barricades and safeguards at all pits, holes, shaft and stairway openings, etc., to prevent injury to workmen and others within and about the premises. Also provide all safeguards as required by the Building Code, OSHA, or any other departments having jurisdiction. Take full responsibility for all safety precautions and methods.

E. Procedure of Work: The contractor shall keep themself constantly informed as to the progress of the work in the field, materials and workers ready to start work immediately when conditions of preceding work are available or ready, wholly or in part, so as not to delay the progress of building work or to interfere with the progress of work of other contractors, and in any event the contractor shall, within 24 hours after notice from the Owner, proceed with such work as directed to maintain the uninterrupted progress of the work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Preference shall go to salvaged or re-used Dimensional Lumber. Provide lumber dressed on at least 2 edges and one side for tight fit.

B. Form Coatings: Provide VOC compliant commercial formulation form- coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces. Use biodegradable form release agent listed below or equivalent made from soy or rapeseed oil.

1.	“Clean Strip J1EF”	Dayton Superior
2.	“Soy Form Away”	Cure & Seal by Natural Soy Products
3.	“Bio-Form”	Leahy-Wolf Company
4.	“Duogard II”	W. R. Meadows, Inc.
5.	“Atlas Bio-Guard”	Atlas Construction Supply, Inc.

C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

D. Form Ties: Form ties and spreaders: prefabricated assemblies by Richmond; Superior, Dayton or approved equal. Wire ties shall not be used. Ties for foundation work shall be of snap design with removal cones and water seal washer.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615 M, Grade 60.

B. Weldable Reinforcing Bars: ASTM A 706/A 706M, Grade 60.

C. Non-magnetic Stainless Steel Reinforcing Bars: ASTM A 955/A 955M, Grade 60 (bars shall meet requirements of ASTM A 276, Type 316LN.

D. Galvanized Reinforcing Bars: ASTM A 767, Class II (2.0 oz. zinc psf) Class I (3.0 oz. zinc psf) hot-dip galvanized, after fabrication and bending.

E. Epoxy-Coated Reinforcing Bars: ASTM A 775 (as noted on plan and/or in section).

F. Steel Wire and Welded Wire Reinforcement: ASTM A 1064. Galvanized at exterior locations, conditions permanently exposed to weather and/or water, and where noted on drawings (plan and/or sections).

G. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

H. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 , plain-steel bars, ASTM A 775/A 775M epoxy coated.

I. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

J. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

K. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire reinforcement in place. Use wire bar type supports complying with CRSI specifications.

1. For epoxy coated reinforcement provide plastic protected chairs and plastic ties. All imperfections in the epoxy coating are to be repaired prior to placement of concrete.

    a. Use recycled plastic rebar supports (give preference to local supplier if available). Subject to compliance with requirements, provide one of the following:

        1) International Plastics Group
        2) Eclipse Plastic

2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I) or stainless steel protected (CRSI, Class 2), at a spacing not to exceed 4'-0" on center in either direction.

2.3 CONCRETE MATERIALS

A. Portland cement: ASTM C 150, Types I, II, or I/II. Total percentage of Portland Cement is NOT to exceed 75% of the cementitious content of each mix. Use one brand of cement

throughout project, unless otherwise acceptable to Architect. Provide either fly ash or GGBF in mix per sections below.

a. Fly Ash: Cast-in-place concrete shall incorporate fly ash as a replacement for at least 25% (by weight) of the Portland cement. All design mixes must be reviewed and approved by the Engineer of Record. Fly Ash shall not be used in conjunction with Ground Granulated Blast Furnace Slag.
b. Ground Granulated Blast Furnace Slag (GGBF): Cast-in-place concrete shall incorporate GGBF as a replacement for at least 40% (by weight) of the Portland cement. All design mixes must be reviewed and approved by the Engineer of Record. GGBF shall not be used in conjunction with Fly Ash.
c. Pozzolans and Slags: These must be completely accounted for in the design mix. Mix design must meet minimum design requirements set in the contract documents. Additional admixtures may be required to meet early strength requirements and alternative cementitious material goals. If a "blended cement" is used which already contains a certain percentage of Pozzolans or Slags this content may offset or entirely satisfy the minimum percentage required.

    1) Coal Fly Ash: ASTM C 618 (Class C or Class F): ASTM C 618 (Note: Class F fly Ash will require higher amounts or air entraining admixtures than class C).
    2) Blast Furnace Slag: ASTM C989
    3) Silica Fume: ASTM C 1240
    4) Rice Hull (or “husk”) Ash: ASTM C 618 Blended hydraulic cement, as defined by ASTM C 595 or ASTM C 1157

B. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.

1. Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Architect.
2. Normal weight Fine Aggregate: washed, inert, natural or manufactured or combination thereof, sand conforming ASTM C33 gradation.
3. Normal weight Coarse Aggregate: well graded crushed stone or washed gravel conforming to ASTM C33, sizes 57 for foundations and 67 for slabs and structure.

    a. Recycled crushed concrete aggregate in concrete mixes is only to be used with approval of Engineer of Record. Recycled aggregate shall be used only as a substitute for coarse aggregate and must also be washed and well-graded, conforming to ASTM C33.
    b. For sub-base, slabs on grade and non-structural applications and Recycled Aggregate Materials are NOT required to meet the ASTM C 33 standard. In addition to concrete rubble, glass, porcelain, and tire chips can be used as filler material. Any inert material conforming to ASTM D1241 is acceptable for the applications described in this paragraph.

C. Lightweight Aggregates: Well-graded crushed expanded shale produced by rotary kiln method. Solite or equal, conforming to ASTM C330.

D. Water: Free from oils, acids, alkali, organic matter and other deleterious material to conform to ASTM C94. ASTM C94 for gray water use in the production of ready mixed concrete per approval by the Engineer of Record.

E. Air Entraining Admixture: ASTM C 260.

1. Liquid air entrainment: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	“Air Mix”	Euclid Chemical
b.	“AEA-92”	Euclid Chemical
c.	“Darex AEA”	W. R. Grace
d.	“MasterAir VR 10”	Master Builders

F. Water-Reducing Admixture: ASTM C 494.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	“MasterPolyheed 997”	Master Builders
b.	“Euclid MR”	Euclid Chemical
c.	“WRDA 64”	W. R. Grace.

G. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or Type G and containing not more than 0.05 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	"Eucon 37, 1037 or Plastol 5000"	Euclid Chemical Co.
b.	"Rheobuild 1000"	Master Builders
c.	"MasterGlenium 7500"	Master Builders
d.	"Daracem-100"	W. R. Grace

H. Water Reducing, Non-Corrosive Accelerating Admixture: The admixture shall conform to ASTM C 494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Accelerating admixtures are not to be used as antifreeze agents. Accelerating admixtures are permitted only upon review by Engineer of Record.

1. Products: Subject to compliance with requirements, provide the following or equal approved by Engineer of Record:

a.	"Accelguard 80"	Euclid Chemical Co.
b.	"Daraset”	W. R. Grace
c.	“Pozzutec 20”	Master Builders.

I. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and contain not more than 0.05 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	"Eucon Retarder 75"	Euclid Chemical Co.
b.	"Pozzolith 100XR"	Master Builders.
c.	"Plastiment"	Sika Chemical Co.
d.	"Daratard"	W.R. Grace.

J. Microsilica Admixture shall be dry densified or slurry formed. Microsilica shall come from the same source throughout the project. If a single source cannot be maintained, laboratory testing of each new source shall be required before acceptance by the Engineer of Record at no cost to the owner.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	"Emsac F 100"	Elkem Chemical, Inc.
b.	"Eucon MSA"	Euclid Chemical Co.
c.	"Force 10,000"	W. R. Grace

K. Prohibited Admixtures: Calcium chloride, thyocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.

L. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of admixtures will be required from the admixture manufacturer prior to mix design review by the Engineer of Record.

M. Corrosion Inhibitor: 30% calcium nitrite (where called for in the specifications or on the drawings). Subject to compliance with requirements, provide the following at 3 gal/cy:

1.	“Eucon CIA	Euclid Chemical
2.	“DCI”	W. R. Grace
3.	“Rheocrete CNI”	Master Builders.

N. Contractor will be required to provide information demonstrating successful use in prior placement involving all admixtures.

2.4 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513 for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal approved by Engineer of Record:

a. Greenstreak
b. Williams Products, Inc.

2. Profile: Flat, dumbbell with center bulb.
3. Dimensions: 4 inches by 3/16 inch thick; nontapered.

B. Flexible PVC Waterstops: CE CRD-C 572 with factory-installed metal eyelets for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal approved by Engineer of Record:

a. BoMetals, Inc.
b. Greenstreak
c. Paul Murphy Plastics Company
d. Vinylex Corp.

2. Profile: Flat, dumbbell with center bulb.
3. Dimensions: 4 inches by 3/16 inch thick; nontapered.

C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	“MiraSTOP”	Carlisle Coatings & Waterproofing, Inc.
b.	“Waterstop-RX”	CETCO
c.	“Conseal CS-231”	Concrete Sealants Inc.
d.	“Swellstop”	Greenstreak
e.	“Hydro-Flex”	Henry Company, Sealants Division
f.	“Earth Shield Type 20”	JP Specialties, Inc.

2.5 GROUT

A. Non-Shrink, Non-Metallic Grout: The non-shrink grout shall be a factory pre-mixed grout and shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under a 4' x 4' base plate.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	"Euco-NS"	Euclid Chemical Co.
b.	"Five Star Grout"	U.S. Grout Corp.
c.	"Masterflow 713 Plus"	BASF

B. High Flow Grout: Where high fluidity and/or increased placing time is required, use high flow grout. The factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packages Dry, Hydraulic-Cement Grout (Non-shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under a 18" x 36" base plate.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	"Euco Hi-Flow Grout"	Euclid Chemical Co.
b.	"Masterflow 928"	BASF
c.	“Five Star Fluid Grout 100”	Five Star

2.6 RELATED MATERIALS

A. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 1241, Size 57, with 100 percent passing a 1-1/2 inch sieve and 0 to 5 percent passing a No. 8 sieve.

B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 1241, Size 10, with 100 percent passing a 3/8 inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

C. Non-slip Aggregate Finish: Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40% aluminum oxide and not less than 25% ferric oxide. Use material that is factory-graded, packaged, rustproof and non-glazing, and is unaffected by freezing, moisture, and cleaning materials.

D. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

E. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Waterproof paper
b. Polyethylene film
c. Polyethylene-coated burlap

F. Curing Compounds: The compound shall conform to ASTM C 309. Limit VOC content to 130 g/L. Use water-based curing compound. For surfaces receiving both a curing compound and additional flooring, verify that the curing compound and additional flooring are compatible.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	“SealTight 1100”	W.R. Meadows
b.	“Kurez W VOX”	Euclid Chemical Co.
c.	“Everclear VOX”	Euclid Chemical Co.
d.	‘VOCOMP-25”	W.R. Meadows

G. Curing & Sealing Compounds: Only specify for slabs that will remain exposed, i.e. will not receive additional flooring. The compound shall conform to ASTM C1315. Limit VOC content to 130 g/L. Use water-based curing compound.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	“Everclear VOX”	Euclid Chemical Co.
b.	“VOCOMP-25”	W.R. Meadows

H. Sealers/Hardeners: For use on concrete surfaces that will remain exposed. Slabs that will receive additional flooring do not require sealing or hardening. Sealers and hardeners must not yellow under ultra violet light after 500 hours of test in accordance with and have a maximum moisture loss of 0.039 grams per sq. cm. when applied at a coverage rate of 250 sq. ft. per gallon. Limit VOC content to 130 g/L. Use water- or vegetable-based product.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	“Kure-N-Harden”	BASF

I. For concrete floors subjected to heavy vehicular traffic use a Liquid Sealer/Densifier: The product must be a high performance, deeply penetrating concrete densifier conforming to ASTMC836; odorless, colorless, VOC - compliant, non-yellowing siliconate based solution designed to harden, dustproof and protect and to resist black rubber tire marks on concrete surfaces. The compound must contain a minimum of 20% solids content of which 50% is siliconate

J. Evaporation Retardant:

1. Products Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	"Eucobar"	Euclid Chemical Co.
b.	"MasterKure ER 50"	BASF

K. Certify that all curing compounds, sealers and hardeners are compatible with all adhesive products intended for attaching co-lateral floor material. In conformance with ASTM F 710, coordination with flooring manufacturer is required to insure concrete coatings will not obstruct the bond between the concrete and the adhesive. Insure coatings and

adhesives are “benignly compatible” -- in other words, do not combine substances whose constituents are reactive. Reactivity releases VOCs and /or other toxic fumes.

L. Crack Sealer: Elastomeric liquid crack sealer resistant to water, gasoline, oil and salts.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a. "Eucolastic 1NS" Euclid Chemical Co.
Maximum allowable depth of this product is ½”.

M. Underlayment Compound: Free flowing, self-leveling, pumpable cementitious base compound.

1. Products: Subject to compliance with requirements, provide the following or equal approved by Engineer of Record:

a. "Flo-Top 90 or Super Flo-Top" Euclid Chemical Co.
b. "Ardex" Ardex Co.
c. "Underlayment 110" Master Builders

N. Bonding Admixture: The compound shall be a latex, non-rewettable type.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a. "Flex-Con" Euclid Chemical Co.
b. "SBR Latex" Euclid Chemical Co.

O. High Strength Polymer Repair Mortar: For form and pouring or large horizontal repairs, provide the flowable on-part, high strength repair mortar.

1. Products: subject to compliance with requirements, provide the following or equal approved by Engineer of Record:

a. "Eucocrete" The Euclid Chemical Co.
b. "Euco Speed MP" (Cold Weather) The Euclid Chemical Co.
c. “Emaco R” Master Builders.

P. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

a. “Daraweld C” W.R. Grace

Q. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Type IV for bonding hardened concrete to hardened concrete, and Type V for bonding freshly mixed concrete to hardened concrete.

R. Reglets: Fabricate reglets of not less than 0.022 inch thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

S. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

T. Vapor Barrier: Provide vapor barrier which conforms to ASTM E 1745, Class A or B. The membrane shall have a water-vapor permeance rate no greater than 0.012 perms when tested in accordance with ASTM E 154, Section 7. The vapor barrier shall be placed over prepared base material where indicated below slabs on grade. Vapor barrier shall be no less than 10 mil thick in accordance with ACI 302.1R. Preferred vapor barriers will be manufactured from post-consumer recycled polymers.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	“Stego Wrap (15 mil) Vapor Barrier”	Stego Industries LLC
b.	“Griffolyn Vaporguard”	Reef Industries
c.	“Premoulded Membrane with Plastmatic Core”	W.R. Meadows.

U. Expansion Joint Filler: ASTM D 1751.

1. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:

a.	“Homex 300”	Homasote Company
b.	“Standard Cork Expansion Joint Filler”	APS Cork
c.	“Fibre Expansion Joint”	W.R. Meadows

V. Water: Potable.

2.7 PROPORTIONING AND DESIGN OF MIXES

A. Preparation of Design Mixes

1. All mix designs shall be proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and prepared by a licensed testing laboratory approved by the owner, but paid for by the contractor. Submit mix designs on each class of concrete for review.
2. If previously used mixes are submitted, all materials shall be from the same sources and with the same brand names as the previously utilized mix.
3. If trial batches are used, the mix design shall be prepared by an independent testing laboratory and shall achieve an average compressive strength 1200 psi higher than the specified strength. This over-design shall be increased to 1.10f’c+700 psi when concrete strengths greater than 5000 psi are used.
4. The proposed mix designs shall be accompanied by complete standard deviation analysis or trial mixture test data.

B. Submit each proposed mix to the Architect and Structural Engineer for review at least 5 days prior to the pre-concrete conference. Do not begin concrete production until Architect and Engineer of Record has reviewed and approved mixes.

1. Submit Test reports for any pozzolans or slags indicating compliance with ASTM C 618 or ASTM C 989, respectively.
2. Provide cut sheets clearly indicating the percentages of pozzolans or slags used in the mix design as replacement for Portland cement. Or, if cut sheets are not available, obtain a written affidavit from the manufacturer stating the percentage.
3. Test reports for recycled aggregate indicating compliance with ASTM C 33. Provide cut sheets clearly indicating the percentage of aggregates used that are recycled. Or, if cut sheets are not available, obtain a written affidavit from the manufacturer stating the recycled content percentage and source or sources of the material.
4. Provide cut sheets clearly indicating the percentage of sub-base and filler aggregate materials that are recycled. Or, if cut sheets are not available, obtain a written affidavit from the manufacturer stating the recycled content percentage and source or sources of the material.

C. Design mixes to provide concrete with strength as indicated on drawings and schedules.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect and Engineer of Record. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect and Engineer of Record before using in work.

E. Admixtures:

1. Use water-reducing admixture or high range water-reducing admixture (superplasticizer) in all concrete as required for placement and workability.
2. Use non-corrosive, non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50^{o}F (10^{o}C).
3. Use high-range water-reducing admixture in pumped concrete, architectural concrete, parking structure slabs, fiber concrete, concrete required to be watertight, concrete with ultimate strength of 5,000 psi or more, and concrete with water/cement ratios below 0.50.
4. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Exposure category for exterior concrete is F1. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus-or-minus 1-1/2 percent within following limits:

    a. Concrete structures and slabs exposed to freezing and thawing or deicer chemicals.
        1) 1-1/2” maximum aggregate: 4.5 percent (exposure class F1, moderate exposure); 5.5 percent (exposure class F2 and F3, severe exposure)
        2) 1” maximum aggregate: 4.5 percent (exposure class F1, moderate exposure); 6 percent (exposure class F2 and F3, severe exposure)

3) ¾” maximum aggregate: 5 percent (exposure class F1, moderate exposure); 6 percent (exposure class F2 and F3, severe exposure)
4) ½” maximum aggregate: 5.5 percent (exposure class F1, moderate exposure); 7 percent (exposure class F2 and F3, severe exposure)
5) 3/8” maximum aggregate: 6 percent (exposure class F1, moderate exposure); 7.5 percent (exposure class F2 and F3, severe exposure)

b. Other Concrete: (not exposed to freezing, thawing, or hydraulic pressure): 2 percent to 4 percent air.
c. Interior concrete to receive hard troweling shall not be air entrained unless specifically approved by the Engineer.

5. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

F. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:

1. Concrete for precast slabs, precast beams, structural topping slab, caisson caps, caissons, poured in place slabs and grade beams, columns and walls, over water, on ground or exposed to weather: W/C 0.40.
2. Concrete on metal deck:

a. With specified minimum compressive strength not greater than 5,000 psi: 0.40.
b. With specified minimum compressive strength not greater than 7,000 psi: 0.35.

3. “Quick Dry” Concrete: 0.40.
4. Subjected to freezing and thawing; W/C 0.45.
5. Subjected to deicers/watertight: W/C 0.45.
6. Reinforced concrete subjected to brackish water, salt spray or deicers; W/C 0.40.

G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramp slabs and sloping surfaces: Not more than 3".
2. Reinforced foundation systems, including mud slabs below hydrostatic slabs: Not less than 1" and not more than 3".
3. Concrete containing HRWR admixture (superplasticizer): Not more than 9" unless otherwise approved by the architect. The concrete shall arrive at the job site at a slump of 2" to 3" (3" to 4" for concrete receiving a "shake-on" hardener or lightweight concrete), be verified, then the high-range water-reducing admixture added to increase the slump to the approved level.
4. Other Concrete: Not less than 1" or more than 4".

H. Chloride Ion Level: Chloride ion content of aggregate shall be tested by the laboratory making the trial mixes. The total chloride ion content of the mix including all constituents shall not exceed the limitations set forth in Table 4.4.1 of ACI 318 for concrete subjected to deicers or exposed to chloride in service (0.15% chloride ions by weight of cement).

2.8 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

B. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

C. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. When air temperature is between 85°F (30°C) and 90°F (32°C), reduce maximum mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce maximum mixing and delivery time to 60 minutes.

D. No water shall be added after mixing to concrete containing HRWR (Superplasticizer). If loss of slump occurs, the concrete treated with HRWR may be redosed as long as a "flash set" has not occurred. Redosage procedures must be discussed and approved by the Engineer of Record and the manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 INSPECTION

A. Examine all work prepared by others to receive work of this section and report any defects affecting installation to the Contractor for correction. Commencement of work will be construed as complete acceptance of preparatory work by others.

3.3 CONCRETE

A. Concrete shall develop the minimum compressive strengths shown on drawings at 28 days when sampled and tested in accordance with ASTM C 31 and C 39 with the maximum slump in accordance with the approved mix design.

B. Concrete shall be in accordance with the requirements and specifications of "Building Code Requirements for Structural Concrete" as modified by the building code noted above.

C. Fly Ash Concrete & Slag Concrete: Concrete mixes containing high volumes of fly ash or Slag have slower set times and may take up to 56 days to reach full strength. The Engineer of Record, agency responsible for concrete mix design, the architect and the concrete subcontractor must coordinate to ensure that the form stripping schedule is

consistent with the ability of the structure to support itself and all imposed construction loads.

3.4 FORMS

A. Design formwork to maximize its reusability, reduce resources devoted to formwork construction and minimize waste generated. Where appropriate choose alternative formwork systems (refer to sections listed above).

B. Design, erect, support, brace and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shapes, alignment, elevation and position. Maintain formwork construction tolerances complying with ACI 347. Provide Class A tolerances for concrete exposed to view. Provide Class C tolerances for other concrete surfaces.

C. Design formwork to be readily removable without impact, shocks or damage to cast-in-place concrete surfaces and adjacent materials.

D. Construct forms to size shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back- up at joints to prevent leakage of cement paste.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, recesses, and the like, to prevent swelling and for easy removal.

F. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

G. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

3.5 VAPOR BARRIER INSTALLATION

A. Examine the condition of porous fill and remedy any unsatisfactory portions prior to installing vapor barriers.

B. Sub-base material to be per above sections.

C. Following leveling and tamping of sub-base for slabs on grade, place vapor barrier sheeting with longest dimension parallel with direction of pour.

D. Lap joints 6" and seal with appropriate tape.

E. After placement of moisture barrier, cover with granular material and compact to depth as shown on drawings.

F. Avoid cutting or puncturing vapor barrier during reinforcement placement and concreting operations.

3.6 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials, which reduce or destroy bond with concrete.

C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain at least minimum coverage's for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

F. Micro-Fibers: All concrete where indicated on the drawings shall contain the specified micro-fibers. Length shall be per the manufacturer’s specification. The dosage rate shall be 1.0 – 1.6 lbs per cubic yard per the manufacturer’s specification. Submit proposed dosage rate to Engineer of Record for review prior to concrete placement.

G. Macro-Fibers: All concrete where indicated on the drawings shall contain the specified macro-fibers. Length shall be per the manufacturer’s specification. The dosage rate shall be 3.0 – 5.0 lbs per cubic yard per the manufacturer’s specification. Submit proposed dosage rate to Engineer of Record for review prior to concrete placement.

H. Epoxy-coated reinforcing bars supported from formwork shall rest on coated wire bar supports. Reinforcing bars used as support bars shall be epoxy-coated. In walls having epoxy-coated reinforcing bars, spreader bars where specified by the Architect or Engineer of Record, shall be epoxy-coated. Proprietary combination bar clips and spreaders used in walls with epoxy-coated reinforcing bars shall be made of corrosion-resistant material.

I. Epoxy-coated reinforcing bars shall be fastened with nylon- , epoxy- , or plastic-coated tie wire, or other acceptable materials.

J. Repair of damaged epoxy-coating: When required, damaged epoxy-coating shall be repaired with patching material conforming to ASTM A775. Repair shall be done in accordance with the patching material manufacturer's recommendations.

K. Unless permitted by the Engineer of Record, epoxy-coated reinforcing bars shall not be cut in the field. When epoxy-coated reinforcing bars are cut in the field, the ends of the bars shall be coated with the same material used for repair of coating damage.

3.7 JOINTS

A. Construction Joints: Locate and install construction joints as indicated, or if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.

B. Provide keyways at least 1-1/2" deep in construction joints in walls, slabs and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

D. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions, using manufacturer's specified welding irons.

E. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals and elsewhere as indicated.

1. Joint filler and sealant materials are specified in the section for "Related Materials"

F. Contraction (Control) Joints in Slabs-on-Ground: Maximum joint spacing shall be 36 times the slab thickness unless otherwise noted on the drawings. The dry cut saw shall be used immediately after final finishing and to a depth of 1-1/2". A conventional saw shall be used as soon as possible without dislodging aggregate and to a depth of 1/4 slab thickness.

1. Joint sealant material is specified in the section for "Related Materials".

3.8 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

C. Embedded Plates at Foundation Walls: Install plate at top of forms so that exterior face of steel plate is level and plumb. Use construction documents for locations, sizes and elevations.

3.9 PREPARATION OF FORM SURFACES

A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.

B. If form-release compound is required, coat contact surfaces of forms with a form-coating compound *before* reinforcement is placed.

C. Thin form-coating compounds only with thinning agent of type, and amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in- place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.10 CONCRETE PLACEMENT

A. Ready-mix concrete shall comply with the requirements of ASTM C 94 and ACI 304. All plant and transporting equipment shall comply with the concrete plant standards and truck mixer and agitator standards of the National Ready Mix Concrete Association.

B. Cold weather mixing procedures shall be submitted to the architect for approval.

C. Notify Architect and Owner’s Inspector at least 36 hours (1 1/2 regular working days) before each pour so that forms and reinforcing may be examined. Do not place concrete until inspection has been made or waived.

D. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to

permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

E. General: Comply with ACI 304 “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete,” and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

F. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 18" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints. Use internal vibrators penetrating both the top and preceding layers.

G. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.

H. Use and type of vibrators shall conform to ACI 309 “Recommended Practice for Consolidation of Concrete.” Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

I. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

J. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

K. Slabs: Bring slab surfaces to correct level with straightedge and strikeoff. Use highway straightedge, bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations. See also "MONOLITHIC SLAB FINISHES" below.

L. Maintain reinforcing in proper position during concrete placement operations.

M. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

1. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Use only a non-corrosive, non-chloride accelerator. Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are NOT permitted.
4. Care must be taken to store water-based curing and sealing compounds where they will not freeze. In most cases, they cannot be reconstituted after thawing.

N. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32°C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog spray forms, reinforcing steel and subgrade just before concrete is placed.

3.11 FINISH OF FORMED SURFACES

A. Concrete mixes containing pozzolans or slags do not set at the same rate or with the same bleed water characteristic as plain Portland cement. Therefore attention must be directed to the proper procedures. Refer to ACI 232.2R and ACI 301.

B. Rough Form Finish: For formed concrete surface not exposed-to- view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

C. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp-proofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed. Follow all requirements in ACI 301, Chapter 10 for smooth form finish. Surface preparation for surfaces receiving waterproofing must be approved by the waterproofing manufacturer prior to construction.

3.12 FLOOR FLATNESS/LEVELNESS TOLERANCES

A. FF defines the maximum floor curvature allowed over 24 in. Computed on the basis of successive 12 in. (300 mm) elevation differentials, FF is commonly referred to as the "Flatness F-Number".

B. FL defines the relative conformity of the floor surface to a horizontal plane as measured over a 10 ft. (3.05 m) distance commonly referred to as the "Levelness F-Number".

C. All floors shall be measured within 72 hours of being poured and in accordance with ASTM E 1155 "Standard Test Method for Determining Floor Flatness and Levelness Using the "F Number" System (Inch-Pound Units).

D. All slabs shall achieve the specified overall tolerance. The minimum local tolerance (1/2 bay or as designated by the architect) shall be 2/3 of the specified tolerances.

E. All elevated slabs shall achieve the specified FL tolerance before the removal of the forms.

F. All slabs on metal deck shall achieve the specified FF.

3.13 MONOLITHIC SLAB FINISHES

A. Float Finish: Apply float finish to slabs at crawl spaces, unless otherwise noted. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture. Surface shall achieve an FF 20 - FL 17 tolerance.

B. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system, unless otherwise noted. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance and with a surface leveled to an FF 25/ FL 20 tolerance (FL17 for elevated slabs). Grind smooth surface defects, which would telegraph through applied floor covering system.

C. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, and slab surfaces which are to be covered with membrane or elastic waterproofing, or sand-bed terrazzo, and as otherwise indicated, apply single trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming. Surface preparation for surfaces receiving waterproofing must be approved by the waterproofing manufacturer prior to construction

D. Sealers, Hardeners and Liquid Densifiers: Apply a coat of the specified compound to all EXPOSED interior concrete floors where indicated on the drawings. This surface must

be continuously moist cured by a method satisfactory to the Architect. Apply and mechanically scrub compound into the floor in strict accordance with the manufacturer's printed instructions.

3.14 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
3. In order to avoid plastic or drying shrinkage cracks during warm, dry or windy weather, ACI 302 and ACI 308 shall be followed using wind breaks and sun shades when recommended. Evaporation retardant shall be as specified in Section 2.04.
4. Care must be taken to store water based curing and sealing compounds where they will not freeze. In most cases, they cannot be reconstituted after thawing.

B. Curing Methods: Perform curing of concrete by moisture curing, moisture-retaining cover curing, curing and sealing compound, and by combinations thereof, as herein specified.

1. Provide moisture curing by following methods.

    a. Keep concrete surface continuously wet by covering with water.
    b. Continuous water-fog spray.
    c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

2. Provide moisture-retaining cover curing as follows:

    a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Provide curing and sealing compound to exposed interior slabs not receiving additional flooring. A clear curing and sealing compound shall be used on exterior slabs, sidewalks and curbs not receiving a penetrating sealer.
4. Use the specified curing compound on surfaces to be covered with finish or coating material applied directly to concrete, such as liquid densifier/sealer, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials. Apply compound in accordance with manufacturer’s direction.

C. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of the specified curing compound or a continuous moist curing method approved by the architect.

E. Certify that all curing compounds, sealers and hardeners are compatible with all adhesive products intended for attaching co-lateral floor material. In conformance with ASTM F710, coordination with flooring manufacturer is required to insure concrete coatings will not obstruct the bond between the concrete and the adhesive. In addition, insure coatings and adhesives are “benignly compatible” -- in other words, do not combine substances whose constituents are reactive.

F. Sealer and Dustproofer: Apply a second coat of the specified curing and sealing compound to exposed interior slabs not subjected to vehicular traffic, noted on the drawings. These slabs must have received an initial coat of the curing and sealing compound.

3.15 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50^{o}F (10^{o}C) for 12 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28-days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.16 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

B. When forms are intended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to

avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.17 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in- place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

D. Grout base plates and foundations as indicated using specified free-flowing non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated.

E. Where high fluidity and/or increased placing time is required use the specified high flow grout. This grout shall be used for all base plates larger than 10 square feet.

F. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screeds, tamp, and finish concrete surfaces as scheduled.

G. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

3.18 CONCRETE SURFACE REPAIRS

A. Prior to all repairs, an as-built condition sketch and method of repair must be submitted to the Architect and Engineer of Record for review and approval.

B. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.

C. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with a bonding grout containing the specified bonding admixture. Place patching mortar after while bonding grout is still tacky.

D. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

E. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discoloration's that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or pre-cast cement cone plugs secured in place with bonding agent.

F. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

G. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for tureens of slope, in addition to smoothness, using a template having required slope.

H. Repair finished unformed surfaces that contain defects, which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

I. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days, except at hydrostatic slabs.

J. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. The specified underlayment compound or repair toping may be used when acceptable to Architect.

K. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

L. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cutout holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry-pack after bonding compound has dried. Compact dry-pack mixture

in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

M. Structural Repair: All structural repairs shall be made with prior approval of the Engineer of Record as to method and procedure, using the specified polymer repair mortar and/or specified epoxy adhesive. Where epoxy injection procedures must be used, an approved low viscosity epoxy made by the manufacturers previously specified shall be used. In addition, all cracks shall be filled with the specified crack sealer or other method as approved by the Engineer of Record. All garage slabs shall be repaired prior to the slab being treated with the specified penetrating anti-spalling sealer.

N. Underlayment Application: Leveling of floors for subsequent finishes may be achieved by use of specified underlayment material. Underlayment application shall achieve the tolerances specified in "MONOLITHIC SLAB FINISHES" above.

O. Specified Polymer Horizontal Repair Mortar: All exposed floors shall be leveled, where required, with the specified self-leveling repair topping.

P. Repair Methods not specified above may be used, subject to acceptance of Architect.

3.19 FOUNDATION WALLS

A. The contractor shall form and leave openings in walls as shown on drawings and approved shop drawings for work of other contractors. These openings shall be temporarily closed and when so directed, the contractor shall point up in solid and neat manner with waterproofed cement.

3.20 WORK IN CONNECTION WITH OTHER TRADES AND CONTRACTS

A. Sleeves, pockets, openings, etc., shall be set in the concrete walls and arches as required for the mechanical trades as shown on approved shop drawings; these shall be encased or built into the concrete work and shall be properly placed and secured in position in the forms before concrete is placed.

B. Provide all chases, pipe slots, etc., required for the mechanical trades (see mechanical drawings), constructed as shown on the approved shop drawings.

C. Leave temporary access panels where required to install mechanical equipment as required by trade affected. Panels shall be formed with construction joints as specified. Details for such panels shall be submitted to Architect for approval.

D. Coordinate all penetrations, cutting, and patching with waterproofing contractor.

3.21 CUTTING AND PATCHING

A. Contractor for concrete work shall be responsible for all cutting, removing and patching work where concrete surfaces are not installed within the limits shown on the drawings

or specified herein. All such work shall meet with the approval of the Architect or Engineer of Record.

B. Where cutting and patching is required to accommodate the work of other subcontractors, such cutting shall be done at the expense of said subcontractors but shall be performed by the contractor for concrete work.

C. The location and extent of cutting in completed concrete work and the patching thereof shall meet with the approval of the Architect or Engineer of Record.

3.22 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Owner will employ a testing laboratory to perform tests and to submit test reports.

B. Provide special inspections per the applicable Building Code and the requirements of all applicable ACI standards.

C. At locations previously indicated in this specification and on the contract drawings, verify the use of non-magnetic materials. No magnetic materials are permitted in locations where prohibited by this specification or the contract drawings.

D. Sampling and testing for quality control during placement of concrete may include the following, as directed by Architect.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
2. Slump: ASTM C 143; one test at point of discharge for each truck; additional tests when concrete consistency seems to have changed.
3. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each truck of air-entrained concrete.
4. Concrete Temperature: Test hourly when air temperature is 40^{o}F (4^{o}C) and below, and when 80^{o}F (27^{o}C) and above; and each time a set of compression test specimens made.
5. Compression Test Specimen: ASTM C 31; one set of 5 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
6. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 25 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimens tested at 7 days, three specimens tested at 28 days, and one specimens retained in reserve for later testing if required.

    a. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

b. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
c. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

7. Water Cementitious Ratio Test: Check water content of concrete in accordance with AASHTO T 318 “Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying”. Frequency of this test shall be the same as that of compressive strength tests, noted above.
8. Floor Preparation to Receive Resilient Flooring: For any concrete that receives resilient flooring, test concrete in accordance with ASTM F 710 prior to acceptance by owner.
9. Test results will be reported in writing to Architect, Engineer of Record, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

    a. Non Compliance: All test reports indicating non-compliance shall be faxed immediately to all parties on the test report distribution list and the hard copies submitted on different colored paper.
    b. Nondestructive Testing: Windsor probes, sonoscope, or other non-destructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

10. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 2 PRODUCTS

END OF SECTION

SECTION 03 3511
CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High-gloss sealer.

B. Polished concrete.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

B. Section 03 3000 - Cast-in-Place Concrete: Curing compounds that also function as sealers.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

C. Manufacturer's qualification statement.

D. Installer's qualification statement.

E. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

F. Specimen warranty.

G. Executed warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 3 years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least 3 years of documented experience.

1.06 MOCK-UPS

A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.

B. Locate where directed.

C. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.08 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.

B. Do not finish floors until interior heating system is operational.

C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide five-year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Polished Finish:
   1. Use at the following locations: As indicated on drawings.

2.02 COATINGS

A. High-Gloss Clear Coating: Transparent, nonyellowing, acrylic-polymer-based coating.
   1. Composition: Water-based.
      a. Nonvolatile Content: 15 percent, minimum, when measured by volume.
      b. Products:
         1) LATICRETE L&M; Petrotex: www.lmcc.com/#sle.
         2) Substitutions: See Section 01 6000 - Product Requirements.

2.03 POLISHED CONCRETE SYSTEM

A. Description: Materials, equipment, and procedures designed and furnished by single manufacturer to produce densely polished concrete of specified sheen.
   1. Products:
      a. LATICRETE L&M; FGS Permashine Concrete Polishing System: www.lmcc.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.03 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.

C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

3.04 CONCRETE POLISHING

A. Execute using materials, equipment, and procedures specified by manufacturer, using manufacturer approved installer.
   1. Final Polished Sheen: Satin finish; other sheens are included as comparison to illustrate required sheen; final sheen is before addition of any sealer or coating, regardless of whether that is also specified or not.
   2. Satin Finish: Reflecting images from side lighting.

3.05 PROTECTION

A. Protect installed coatings from subsequent construction operations.

B. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 05 1200

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes but is not limited to the following as shown on the drawings and as specified herein:

1. Furnish and deliver for installation by others, anchor bolts, bearing plates and loose lintels with complete instructions and templates to facilitate installation.
2. Furnish and erect all struts, columns, bearing plates, beams, steel trusses, girders, bracing, hangers and all related connections (bolted and welded).
3. Openings (unreinforced and reinforced) in structural steel to accommodate mechanical and electrical work.
4. Shop painting and field touch-up painting.
5. Erection bracing and supports, including steel wedges, shims or nuts required for leveling base plates.
6. Lintels and angles attached to structural steel as shown on drawings.
7. Unless specifically excluded, furnish and install all other items for structural steel work indicated on the drawings, specified, or obviously needed to make the work of this Section complete.
8. Waste Management

B. Related Requirements:

1. Division 01 Section “Construction Waste Management and Disposal”
2. Division 03 Section “Cast in Place Concrete”
3. Division 04 Section “Unit Masonry”
4. Division 05 Section “Metal Deck.”
5. Division 05 Section “Metal Fabrications.”
6. Division 06 Section “Rough Carpentry.”
7. Division 07 Section “Waterproofing.”
8. Division 07 Section “Joint Sealants.”
9. Division 07 Section “Expansion Joint Cover Assemblies.”
10. Division 31 Section “Dewatering.”

C. Related Work Specified Elsewhere

1. Installation of anchor bolts furnished under this section.
2. Grout under base and bearing plates.
3. Installation of loose lintels furnished under this section.
4. Miscellaneous metal work
5. Light gage metal roof trusses.
6. Stair framing and hangers.
7. Field painting of structural steel, except as specified herein.
8. Fireproofing systems.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches .
2. Welded built-up members with plates thicker than 2 inches .
3. Column base plates thicker than 2 inches .

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of all connections required by the drawings to be completed by structural steel fabricator (including comprehensive engineering analysis by a qualified professional engineer) to withstand loads indicated and comply with other information and restrictions indicated, unless noted otherwise.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use design method indicated on structural drawings.
3. Moment Connections: Fully restrained unless otherwise noted on drawings.

B. Lateral Force Resisting System: Type used is indicated on structural drawings.

1.5 SUBMITTALS

A. Product Data: Submit data for each type of product indicated in the contract documents.

B. Shop Drawings: Submit shop drawings in accordance with the specifications as follows:

1. Show clearly all work, including relationship of structural steel to the adjacent work of other trades and to significant lines of finishes of other trades.
2. Do not fabricate or deliver work to the site before drawings reviewed by the Architect and Engineer of Record have been returned.
3. Before preparing steel shop drawings, submit proposed submittal schedule for review by Architect and Engineer of Record.
4. Before preparing steel shop drawings, submit for review a set of job standards showing all necessary joint details with full particulars of connection pieces, shop and field welds, and holes for erection bolts and permanent bolts. These shall include any moment and shear connections. Appropriate marks for designating all types and sizes of joint details shall be included. After approval of these job standards, the erection plans are to be submitted and shall be marked to indicate unmistakably the type and size of joint to be used for every beam connection. Do not order steel in advance of approval of the job standards and the erection plans with joint marks, except at own risk
5. Submit calculations for design of connections on job standards and all other connections such as moment and brace frames. Calculations shall be signed and sealed by a Professional Engineer licensed in the state in which the project is located.
6. Prepare remainder of steel shop drawings after approval of job standards and erection plans. Drawings submitted prior to approval of job standards will be returned without review.
7. Prepare shop drawings in conformance with the applicable procedures shown in "*Detailing for Steel Construction*," latest edition, published by AISC. Prepare shop drawings under the supervision of competent engineering personnel, licensed by the state in which the construction is to take place. During the preparation of shop drawings, and prior to submittal, coordinate and cross check all shop drawings, including those prepared by subcontractors, for compliance with the Contract Documents.
8. Indicate clearly the size and grade of steel for each component. Identify rolled shapes, tubes and plates by using the standard designations used in "Steel Construction Manual" Latest Edition, by AISC.
9. Indicate welds and nondestructive tests by using the symbols conforming to AWS A2.4 "Symbols for Welding and Nondestructive Testing." Where necessary for clarity, indicate welding procedure designations or other data in the tail of the welding symbol.
10. Show explicitly the type of connection used in each location, including the grade, size, and number of bolts; the type, number, position, designation and orientation of each washer; and the size of each hole, whether slotted or round. Ensure that adequate wrench clearance for correct bolt tightening is provided and note special bolt tightening sequences where applicable and necessary.
11. Show all camber dimensions in the shop drawings. Where specific camber is not shown in the drawings, note on each affected shop drawing that such members

are to be fabricated with the natural camber up.

12. Show holes required for securing work specified in other sections to structural steelwork, as well as all holes required for passage through structural steelwork of work of other trades. Provide field work drawings for all such holes not shown in shop or erection drawings. Addition of, or change in size or location of openings will not be permitted without prior approval.
13. Use bolted connections wherever possible; avoid field welding unless otherwise noted on drawings.
14. Make details in such a way as to avoid having steel, connections, bracing, bolts, etc., interfere with architectural details or in any way reduce the areas of shafts, openings, clearances, etc.
15. Detail and schedule cleaning and painting data and requirements, including specific indication of "no-paint" areas.
16. The use of the Architect’s or Engineer of Record's electronic drawing files as a base for the erection shop drawings will be permitted at the request of the structural steel detailer upon completion and return of the waiver form. The use of the Architect’s or Engineer of Record's electronic drawing files as a base for shop drawing details will not be permitted. The structural steel detailer will be responsible for compatibility of the files with his hardware or software. The electronic files are not to be considered the contract documents, the design team makes no representation regarding the accuracy or completeness of the electronic files given to the structural steel detailer and their use will be at the structural steel detailer’s sole risk and without liability to the design team. The structural steel detailer shall remove the project title box and all references to the structural drawings including drawing numbers and structural drawing sections and details. The structural steel detailer shall also remove all reference to work not included in the steel contract.
17. Scaling of the Architect’s or Engineer of Record’s drawings is not permitted. This applies to hard paper, electronic, and all other versions.
18. Show clearly the size and location of each member and the erection mark assigned to each member. Show each field connection with all data and details necessary for assembling the structure. Direct special attention to the possible need for special guying, bracing, or shoring to prevent deformation of existing or new structure due to stresses caused by erection procedures and equipment, by construction loadings, and by forces of natural phenomena.
19. Prepare, keep up-to-date, and submit a complete drawing index cross-referencing each assigned piece mark with the drawing number in which the piece is detailed. Detail drawings submitted without an up-to-date index and the applicable erection drawing(s) showing the location of each piece will be deemed an incomplete submission and will not be accepted as subject to any agreed shop drawing review schedule.
20. Prepare anchor bolt and base plate erection drawings containing complete location and placing details, including details of all templates. Provide anchor bolt erection drawings to the concrete trade in advance of applicable concrete work and in coordination with concrete construction sequence.
21. Submit, in writing, any proposed deviations from the Contract Documents, prior to the submission of shop drawings showing the proposed deviation. Submit requests for deviations on the steelwork subcontractor's letterhead. Deviations not

identified, or identified only in letters of transmittal or in shop drawings or both, without the required written request, may not be accepted, and shall be sufficient cause for the architect to return each shop drawing containing such deviations without further action. Acceptance of shop drawings containing deviations not detected by the architect during shop drawing review shall not relieve the steelwork subcontractor from responsibility to conform strictly to the Contract Documents.

22. Prior to resubmission of shop drawings with additions or corrections, circle or bubble and identify all changes. Drawings submitted without each change being clearly identified are subject to return for resubmission.
23. Prior to making shop drawings for any portion of the work involving alterations to an existing structure, make all necessary field observations, measurements and surveys of existing conditions. If probes are required to accomplish such measurements, give timely notice where probes will be required.

C. Submit certified copies of each survey conducted by a surveyor licensed by the state in which the construction is to take place and employed by the structural steel subcontractor. Survey shall show elevations and locations of base plates and anchor bolts to receive structural steel, and final elevations and locations for major members. Indicate discrepancies between actual installation and Contract Documents.

D. Reports:

1. Submit certified copies of mill test reports for all steel furnished. Perform mechanical and chemical tests for all material regardless of thickness or use.
2. Submit certification of recycled steel content. Certification shall clearly indicate post-consumer AND post-industrial recycled steel content for the particular member or members used.
3. Submit anchor bolt checking certification as required.
4. Submit qualification certificates of all welders who will perform work on the project.
5. Submit survey of erected steelwork as required.

E. Submit verification of bio-degradable or low VOC, and low Hazardous Air Pollutants (HAPS) cleaning solutions. Provide a cut sheet for all cleaning solutions used in the surface preparation of steel components. Highlight VOC limits and chemical component limits.

1.6 QUALITY ASSURANCE

A. Except as modified by this specification, comply with the applicable provisions and recommendations of the following codes and standards:

1. Michigan Building Code, Latest Edition
2. AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings".
3. AISC "Code of Standard Practice for Steel Buildings and Bridges" latest edition.
4. AISC “Seismic Provisions for Structural Steel Buildings”, latest edition.
5. Industrial Fasteners Institute "Handbook of Bolt and Bolted Joints" latest edition.
6. RCSC "Specifications for Structural Joints Using High-Strength Bolts."

7. ASTM Standards as applicable in the building code of the local jurisdiction and as noted in this specification.
8. AWS D1.1, "Structural Welding Code."
9. AWS A5.18 & A5.28, Structural Welding Code for GMAW
10. SSPC "Painting Manual, Volume 2, Systems and Specifications.", Latest edition.

B. Qualifications for welding work shall be as follows:

1. Qualify welding procedures and welding operators in accordance with the AWS "Standard Qualification Procedure."

    a. Include amended requirements of the building code as noted above.

2. Submit certification that all welders to be employed in work are AWS qualified. If re-certification of welders is required, retesting will be responsibility of structural steel subcontractor.

    a. Include licensing requirements as per the building code noted above and local jurisdiction.

1.7 TESTING AND INSPECTION

A. Special Inspection as required by the applicable Building Code of all structural steelwork in the shop and field will be performed by an inspection agency retained by the Owner at no expense to the Contractor. The inspection agency shall work under the direction of the Owner. Contractor shall provide the inspection agency with the following:

1. Schedule of all work in both shop and field with at least ten days' written notice before commencement of either activity.
2. A complete set of approved shop and erection drawings.
3. Cutting lists, order sheets, material bills, shipping bills and mill test reports.
4. Information as to time and place of all rollings and shipment of material to shops.
5. Representative sample pieces as requested by the testing agency.
6. Full and ample means and assistance for testing all material.
7. Proper facilities, including scaffolding, temporary work platforms, etc., for inspection of the work in the mills, shop and field.

B. Each person installing connections shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that the inspector can refer back to the person making the connection.

C. The following minimum criteria shall be adhered to in testing of welds and bolts:

1. All welds and bolts shall be examined by visual means.
2. 25% of all welds, selected randomly, shall be measured.
3. Bolted joints shall be verified per the RCSC “Specification for Structural Joints Using High-Strength Bolts,” Section 9, based on installation method.
4. All welds subject to tensile stress shall be examined by the Ultrasonic Method for

100% of their length.

5. 10% of all manual fillet welds shall be tested by the magnetic particle method.
6. 1'-0" at each end of automatic fillet welds shall be tested by the magnetic particle method.
7. 100% of groove welds shall be tested by the ultrasonic method.

D. Shop inspection will include examination of steel for straightness and alignment, fissures, mill scale, and other defects and deformities, as described in ASTM A6, examination of fabricated pieces for conforming to approved shop drawings, testing of bolts and welds, and inspection of shop painting. All shop welds shall be visually inspected and spot tested using Ultrasonic Method ASTM E 114 and AWS, Chapter 6, Part C. All inspected welds shall be identified by the inspector.

E. Field inspection will include examination of erected steel for welding, proper fitting and tensioning of bolts, alignment, trueness and plumbness, touching-up of shop coat, level of billets and base plates.

F. Inspection of welding will be such as to assure that the work is within the quality requirements specified below and elsewhere in this section of the specifications and will include:

1. Ascertainment that the electrodes and flux used for the SAW, GMAW and FCAW welding processes conform to the requirements of this section of the specifications.
2. Ascertainment that the approved welding procedures and sequence are followed without deviation, unless specific approval for change is obtained from the Engineer of Record.
3. The testing agency shall be prepared to utilize the following approved methods of testing:

    a. Liquid penetrant inspection: ASTM E 165.
    b. Magnetic particle: ASTM E 1444.
    c. Radiographic inspection: ASTM E 94 and E 1032.
    d. Ultrasonic inspection: ASTM E 114 and AWS, Chapter 6, Section C.

G. When defects are revealed, additional inspection by whatever method is deemed necessary by the inspector, shall be performed to the extent necessary to assure that the full amount of defect has been located. No further work shall be done on the assembly or sub-assembly in question until all the necessary corrections have been made. Defects shall be repaired, using the same welding procedure that was used initially in making the weld, unless otherwise approved by the Engineer of Record. Inspection of the repaired weld shall be by the same method that was used to reveal the defect. A second repair of a defective area shall not be made without approval of the Engineer of Record.

H. Apparatus and procedures for measuring required tension in pretensioned and slip-critical high strength bolted connections shall be furnished and maintained by the steel contractor, in accordance with the RCSC “Specification for Structural Joints Using High-Strength Bolts,” and shall be approved by the inspection agency. The inspection agency shall observe the pre-installation verification testing required and shall ensure by routine

observation that the bolted installations conform to the approved pretensioning method being used. The steel contractor shall provide a laborer and scaffolding as required for the testing of connections by the inspection agency, and shall, at his own expense, furnish such facilities and provide such assistance as may be required for proper inspection.

I. A distinguishing mark will be placed on all work that has been inspected and approved. Material or work that is not acceptable will be designated by words such as "REJECT" or "REPAIR" marked directly on the material or work.

J. Inspection of Shop Painting:

1. Visually evaluate surface preparation by comparison with pictorial standards in accordance with SSPC-Vis 1.
2. Measure dry film thickness of each coat with a magnetic film thickness gauge in accordance with SSPC-PA 2.
3. Visually inspect dried film for runs, sags, dry spray, overspray and missed areas.
4. Repair defective or damaged areas in accordance with painting requirements specified. Architecturally exposed structural steel shall be free of runs and holidays. Make repairs to shop or field coat as directed.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work. Minimize the disturbances to site and soil conditions.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time not to delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members in a safe, dry, off ground location, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration, discoloration or staining.

D. Do not store materials on structure in a manner that might cause distortion or damage to members of supporting structures. Repair or replace damaged materials or structures as directed.

1.9 PROJECT CONDITIONS

A. The structural steel contractor shall coordinate the structural steel work with the work of other Contracts. Verify all dimensions and details of this Contract and those of other Contracts that affect the work before proceeding. Any discrepancies shall be immediately reported to the architect.

B. Be fully responsible for the accurate installation of the work. Any discrepancy which arises from his failure to execute the work in conformity to the drawings and

specifications shall be properly remedied at the contractor's own expense and in a manner acceptable to the architect.

C. Locate dimensionally on setting plans all anchor bolts, inserts, bearing and base plates, etc., and prepare and deliver all required templates and fully dimensioned setting plans in time for the proper execution of the work. Anchor bolts shall be set by another subcontractor. The structural steel contractor shall check all such settings for correctness after they have been cast in place, and before proceeding with erection work.

D. Report to the architect and certify compliance with the above checking requirements in writing and indicate any inaccuracies found in the location of anchor bolts or inserts, and corrections which must be made to their installation. Any inaccuracies not included in the report and found during or after steel erection shall be the responsibility of the structural steel contractor and the cost of corrective measures shall be borne by the structural steel contractor.

E. Use base lines, bench marks, or other standards for survey work that have been provided or verified by others. If permanent building bench marks have been established, these will be used for field checking.

F. Coordinate with all other trades to ensure that work of this section does not cause undue conflict. Ensure that location of erection devices such as cranes, derricks, booms or hoists, does not cause over-stresses to steel frame to work previously placed by other trades or to existing structures. When required, retain the services of a licensed professional engineer to ascertain that erection devices do not create unsafe conditions or cause overstresses.

G. Ensure full co-ordination with other related trades and professions.

1.10 SUBSTITUTION

A. Architect reserves the right to require substitute shapes of other sizes than those indicated on the drawings when it is apparent that the shapes specified cannot be furnished within the time required for the progress of construction. Make said substitutions without additional cost to the owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel shapes, including structural steel wide flange and structural tee rolled shapes, channels, angles, plates, pipe, and hollow structural sections: As noted on structural drawings.

B. High Strength Bolts: As noted on Structural Drawings.

C. Anchor Rods: As noted on structural drawings

D. Filler metal for welding electrodes. As noted on structural drawings.

E. Structural steel primer paint: rust inhibitive primer conforms to the following criteria

1. Coordinate all paint requirements with specification section 099000.
2. Demonstrate a minimum of adhesion as classified by 4B of ASTM D 3359 method A
3. Demonstrate a minimum opacity as determined by ASTM D 2805
4. Demonstrate corrosion resistance per standards ASTM B 117 & ASTM D 5894
5. “Slip Critical” compatible rating where applicable
6. The product shall not contain any of the prohibited compounds as listed in Green Seal *Standard for Paintings and Coatings*, GS-11, latest edition and in Master Painters Institute (MPI) *Green Performance Standard*, GPS-1-08.
7. The product shall meet the VOC limits as set forth in the MPI Green Performance Standard, GPS-1-08, with a maximum allowable VOC of 340 g/L for rust preventative coatings. Limits are expressed in THINNED state. Preference shall be given to products with the least crystalline silica content.
8. The product shall meet all the requirements of MPI Standards: 23, 26, 76, 79, 95, 107, 135, 173, 275. Products not listed with MPI are acceptable if and only if they meet the same environmental criteria for the same product category.

    a. Exterior exposed steel, normal conditions: Use alkyd or polyamide solvent based paints (MPI #’s 76, 79 & 101)
    b. Interior exposed steel: Use water based paint (MPI # 107)
    c. Special Applications, highly corrosive environments: Use zinc rich paints (MPI #’s 20 & 200)

F. Structural steel field paint for exposed members: rust inhibitive primer conforms to the following criteria

1. Coordinate all paint requirements with specification section 099000.
2. Demonstrate a minimum of adhesion as classified by 4B of ASTM D 3359 method A
3. Demonstrate a minimum opacity as determined by ASTM D 2805
4. Demonstrate corrosion resistance per standards ASTM B 117 & ASTM D 5894
5. “Slip Critical” compatible rating where applicable.
6. The product shall not contain any of the prohibited compounds as listed in Green Seal *Standard for Paintings and Coatings*, GS-11, latest edition and in the Master Painters Institute *Green Performance Standard*, GPS-1-08.
7. The product shall meet the VOC limits as set forth in the MPI Green Performance Standard, GPS-1-08, with a maximum allowable VOC of 400 g/L for rust preventative coatings. Limits are expressed in THINNED state. Preference shall be given to products with the least crystalline silica content.
8. The product shall meet all the requirements of MPI Standards: 23, 26, 76, 79, 95, 107, 135, 173, 275. Products not listed with MPI are acceptable if and only if they meet the same environmental criteria for the same product category. Products not listed with MPI are acceptable if and only if they meet the same environmental

criteria for the same product category.

a. Exterior exposed steel, normal conditions: Use alkyd or polyamide solvent based paints (MPI #'s 23, 79)
b. Interior exposed steel: Use water based paint (MPI # 107)

PART 3 - EXECUTION

3.1 FABRICATION

A. All shop connections shall be high strength bolted unless specifically shown otherwise. Fabricate work in shop in as large assemblies as practicable. Use welded connections ONLY where shown on drawings. If a bolted connection is not possible, obtain written approval from the Engineer of Record for the welded connection.

B. Camber: As indicated on drawings.

C. Mill column ends and bearing stiffeners to give full bearing over the cross section. Plane contact surfaces of bearing plates when required by the AISC Specifications. It is not necessary to plane bottom surfaces of plates on grout beds.

D. Drill or punch holes at right angles to the surface of the metal, not more than 1/16" larger than the connector diameter. Do not make or enlarge holes by burning. Drill material having a thickness in excess of the connector diameter and material thicker than 7/8". Holes shall be clean-cut without torn or ragged edges. Remove outside burrs resulting from drilling operations.

E. Provide holes in members to permit connection of the work of other trades. Use suitable templates for proper location of these holes. Steel requiring adjustment or accurate alignment shall be provided with slotted holes or full bearing shims as shown.

F. Provide holes, slots and openings required by other trades together with necessary reinforcing required. Use suitable templates for proper location of these openings. All such openings shall be shown on the shop drawings. No change in size or location will be permitted without prior approval.

G. Manual flame cutting shall be done only with a mechanically guided torch. An unguided torch may be used provided the cut is within 1/8" of the required line.

3.2 SHOP CONNECTIONS

A. Provide connections as shown on the drawing exactly as detailed. Where connections are not detailed, the minimum connections shall comply with appropriate tables headed, "Framed Beam Connections" shown in the AISC "Manual of Steel Construction" unless otherwise noted on the drawings. Use high strength bolts unless otherwise shown.

B. Do not use welded connections unless shown on details. Field welding is not allowed without written instruction from the Engineer of Record.

C. Proportion and detail all connections on shop drawings to resist forces shown on design drawings.

D. Bolting

1. Bolts shall be of a length that will extend not less than 1/4" beyond the nuts. Enter bolts into holes without damaging the thread.
2. Joint Type: As noted on the Structural Drawings.
3. Make high-strength bolted joints without the use of erection bolts. Bolt heads and nuts shall rest squarely against the metal. Where structural members have sloping surface, bolted connections shall be provided with beveled washers to afford square seating or framing for bolt heads or nuts.
4. All joints are to be compacted to the snug-tight condition in accordance with Section 8 of the RCSC “Specification for Structural Joints Using High-Strength Bolts.” Protect bolt heads and threads from damage during installation.
5. Pretensioned and slip-crtical joints are to be installed by one of the methods prescribed in Section 8.2 of the RCSC “Specification for Structural Joints Using High-Strength Bolts,” unless written approval is obtained from the Engineer of Record.
6. Bolts that have been completely tightened shall be marked for identification.

E. Welding

1. The following environmentally preferable welding processes shall be used as described for the related application without exception:

    a. Submerged Arc Welding (SAW): Plate girders, fillet and butt joints in pipes, cylinders, columns and beams, and welds where ‘downhand’ or horizontal positions are possible.
    b. Gas Metal Arc Welding (GMAW) shall be used where SAW is not applicable (such as for angled connections and anything irregular or short).
    c. Field welding shall be allowed only in special circumstances; in such cases Flux Core Arc welding (FCAW) shall be specified

2. Do not begin structural welding until joint elements are inspected for surface preparation, fit-up, and cleanliness of surface to be welded and are then bolted or tacked in intimate contact and adjusted to dimensions shown on drawings, or both, with allowance for any weld shrinkage that is expected. No members are to be spliced without prior approval by the Engineer of Record.

    a. Containment surface preparation debris must meet SSPC-Guide 6 guidelines.

3. Pre-heat and interpass temperature shall be in accordance with Table 4.2 (including footnotes) of the AWS Code for Welding in Building Construction. The temperature shall be measured from the side opposite to that which the pre-heat

is applied, where possible.

4. All groove welds shall be continuous and full penetration welds unless otherwise shown on the design drawings. Welds made without the aid of a back-up bar shall have their roots chipped, ground or roughened out to sound metal from the second side, before welding is done from the second side.
5. All welds shall be sound throughout. There shall be no crack in any weld or weld pass. Weld may be considered sound if it contains only slight porosity or fusion defects which are well dispersed.
6. The heat, input, length of weld and sequence of weld shall be controlled to prevent distortions. The surfaces to be welded and the filler metals to be used shall be subject to inspection before any welding is performed.

3.3 SHOP PAINTING AND CLEANING

A. Finishing, coating, plating

1. Shop painting and factory finishing shall be preferred to field painting whenever possible. Where applicable, finishes and surface preparations based on a physical process such as abrasive blasting, grinding, buffing and polishing are preferred to coatings and solvent based cleaning. Where coatings are necessary powder-coated fabrication is preferred to painting and plating. Avoid plated metals especially those using cadmium and chromium as plate material or cyanide or copper/formaldehyde based electroless copper as the plating solution.

B. Remove all rust, scale, grease and other detrimental foreign matter in accordance with SSPC-SP 3, Power Tool Cleaning, unless conditions/opportunities listed below apply.

1. Use surface preparation classification recommended by paint manufacturer, SSPC or Master Painters Institute (MPI) for paint product used.

a. SSPC-Guide 6, Guide for Containing Debris Generated During Paint Removal Operations, must be followed for all applicable surface preparation techniques.

C. Immediately after surface preparation, apply structural steel primer paint where specified, in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 2.0 mils. Use painting methods which result in full coverage of joints, corners, edges and exposed surfaces. Use type of primer paint as specified in "Materials" article above. Apply two coats to surfaces that will be inaccessible after erection

D. Paint all structural steel in accordance with the foregoing specification, except as follows:

1. Steel which is to receive spray-on fireproofing.
2. Within 2" of field welds or welds made after paint is applied.
3. Faying surfaces in bolted connections shall be prepared per Section 3.2 of the RCSC “Specification for Structural Joints Using High-Strength Bolts.”

4. Machined surfaces and threaded parts required for adjustment of the structure. Protect these with suitable rust inhibiting coating which may be removed after final installation of the work so that proper finished coatings may be applied.

3.4 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.

3.5 SOURCE QUALITY CONTROL

A. Refer to testing and inspection requirements specified above.

3.6 EXAMINATION

A. Verify field measurements prior to start of erection. Check the alignment and elevation of all column supports and location of all anchor bolts with transit and level instruments before starting erection. Notify architect of any errors. Obtain Architect's approval of methods proposed for correcting errors prior to proceeding with corrections and erection.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.7 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.8 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

C. Column billets and bearing plates shall be supported and aligned on steel wedges, shims, or leveling nuts. After the supported members have been plumbed and properly positioned by instrument and anchor nuts tightened, the entire bearing area under the

plate shall be packed solidly with grout specified in another Section. Wedges and shims shall be set back a minimum of 3/4" from the edges of plates and shall be left in place. Leveling plates are not permitted.

D. Plumbing, Leveling and Bracing

1. Structural steel shall be erected true and level, and temporary bracing shall be introduced wherever necessary to provide for all loads to which the structure may be subjected, including equipment and the operation thereof. Such bracing shall be left in place as long as may be required for safety. No welding shall be done or bolts drawn up tight until structural steel has been properly aligned. Obtain approval for guy locations to assure lack of interference with operations of other trades.

E. Drifting

1. Light drifting necessary to draw holes together will be permitted, but drifting of unfair holes will not be permitted. Twist drills shall be used to enlarge holes as necessary to the next larger size; use next larger size bolts as required. Reaming that weakens the members, or make it impossible to fill the holes properly or to adjust accurately after reaming, will not be allowed.

3.9 FIELD CONNECTIONS

A. In addition to the requirements for shop connections comply with the following:

1. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
2. Joint Type: As noted on structural drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

3.10 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to

comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 3, Power Tool Cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 9."

D. After erection, all damaged areas in shop coat, exposed surfaces of bolt heads, nuts and washers, and all field welds and unpainted areas adjacent to field welds and high strength bolts shall be painted with a "touch-up" application of same paint used in the shop coat and then painted with same paint used for shop coat tinted another color. Retouch in field, any scraped, abraded, and unpainted surfaces. Painting shall be as specified for shop coats.

E. Structural steel which is to support mechanical equipment and will be left exposed to the weather in the finished project shall be field painted with one coat of anti-corrosive paint as described in Part 2 for Paint Materials.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the work of this Section.

1.2 SUMMARY

A. Section includes but is not limited to the following as shown on the drawings and as specified herein:

1. Floor deck
2. Roof deck
3. Headed shear studs
4. All necessary deck supports and reinforcing other than principal framing members including diagonals at columns, angles, plates, etc.
5. Flashing, cell closures, closure plates and sheet metal work required to contain concrete.
6. Ceiling hanger tabs at new decking composite with concrete where new suspended ceilings are required.
7. Waste Management.

B. Related Requirements:

1. Concrete and reinforcement over decking
2. Structural steel
3. Shoring of metal deck where unsupported span exceeds the allowable
4. Ceiling systems
5. Mechanical and electrical where supported from deck
6. Fireproofing systems
7. Sheet metal work
8. Waste Management/Recycling Strategies

1.3 PERFORMANCE REQUIREMENTS

A. Metal deck unit sizes and gauges are indicated on the drawings. Gauges indicated on the drawings are a minimum. Thickness of deck may be required to be increased by deck manufacturer for loadings indicated on drawings.

B. Unit shall span over three or more supports except where steel layout does not permit.

C. Maximum allowable deflection under live load plus super imposed dead load shall not exceed (1/360) of the span or (1/4) inch whichever is less.

D. Deck shall be sized as unshored. Shoring of deck is not permitted unless specifically shown in areas on the drawings.

E. Use of piercing, non-piercing, and integral hanger tabs is not permitted at roof deck.

F. Units included in a fire rated assembly must be classified in appropriate UL design.

1.4 SUBMITTALS

A. Product Data: Product data, including manufacturer's specifications, load tables, section properties and installation instructions for each type of decking and accessories.

B. Shop Drawings: Shop drawings for all installations showing gauges, deck layout, type of deck, any shoring required, where located, welding details necessary for fabrication to fit in place, and all accessories. Do not use reproductions of the Design Drawings. In addition, include the following:

1. Ceiling tab, fillers, closures and similar items.
2. Show placement of headed shear studs connectors with respect to the flutes of the metal deck. Variation from the specified deck configuration may result in a decrease of the capacity of the studs, requiring more studs.

C. Product Certificates: Certification of specification compliance for each item specified.

D. Reports

1. Submit certification of recycled steel content. Certification shall clearly indicate post-consumer AND post-industrial recycled steel content for the particular member or members used.
2. Submit verification of finishing process:

    a. Provide a cut sheet and a Material Safety Data Sheet (MSDS) for all shop and field paints used highlighting VOC limits and chemical and mineral component limits.
    b. For heavy metals in used plating processes: Provide a cut sheet and a Material Safety Data Sheet (MSDS) for each plating material and related compounds highlighting chemical component limits.
    c. Certification of recycled zinc content for galvanized products: Provide cut sheets clearly indicating whether the galvanized products used meet the minimums for post-consumer OR post-industrial recycled contents. Or, if cut sheets are not available, obtain a written affidavit from the manufacturer stating the recycled content percentage and if the recycled content is post-consumer or post-industrial.

3. Submit verification of biodegradable or low VOC, and low Hazardous Air Pollutants (HAPS) cleaning solutions. Provide a cut sheet and a Material Safety Data Sheet

(MSDS) for all cleaning solutions used in the surface preparation of steel components. Highlight VOC limits and chemical component limits.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

F. Evaluation Reports: For steel deck.

1.5 QUALITY ASSURANCE

A. Except as modified by governing codes and by this specification, comply with the applicable provisions and recommendations of the following codes and standards:

1. Michigan Building Code, Latest Edition
2. American Iron and Steel Institute (AISI) "Specification for the Design of Cold-Formed Steel Structural Members".
3. American Welding Society (AWS), D1.1 "Structural Welding Code" and D1.3 "Structural Welding Code-Sheet Steel".
4. Steel Deck Institute (SDI) "Design Manual for Composite Decks, Form Decks, and Roof Decks".
5. American National Standards Institute (ANSI)/Steel Deck Institute (SDI) “Quality Control and Quality Assurance for Installation of Steel Deck”.
6. ASTM Standards as applicable in the building code of the local jurisdiction and as noted in this specification.

B. Fabricator Qualifications: The work under this section shall be performed by a fabricator and erector submitting conclusive evidence of having satisfactorily completed work of similar scope and of having the necessary skill, equipment, facilities and capacities to fabricate and perform the erection in accordance with the construction schedules and in full compliance with all requirements of the Contract Documents.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work. However, efforts should be made to minimize the disturbance to site and soil conditions for example, by not requiring excessive areas to be put aside for on-site storage.

B. Store materials to permit easy access for inspection and identification. Keep all materials in a safe, dry, off ground location, using pallets, platforms, or other supports. Protect all materials from corrosion and deterioration, discoloration or staining. Make efforts to minimize any wastage and ensure that as much waste as possible is recycled.

C. Do not store materials on structure in a manner that might cause distortion or damage to members of supporting structures. Repair or replace damaged materials or structures as directed.

1.7 PROJECT CONDITIONS

A. Examine all work prepared by others to receive work of this section and report any defects affecting installation to the contractor for correction. Commencement of work will be construed as complete acceptance of preparatory work by others.

B. If the supporting beams are not properly aligned or sufficiently level to permit proper bearing of the steel decking units, the steel decking contractor shall bring the matter to the attention of the contractor for corrective action. The steel decking units are not to be placed until the necessary corrections are made.

C. Installation of the deck and shear studs will be inspected by the Architect and/or Owner's agent.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 MANUFACTURERS

A. Supply manufactured deck units in accordance with the applicable requirements of the Steel Deck Institute's "Design Manual for Floor Decks and Roof Decks".

B. Deck shall be manufactured by one of the following (or other equivalent as approved by the architect and engineer of record):

1. United Steel Deck (manufactured by Canam)
2. New Millennium
3. Vulcraft

2.3 DECK MATERIALS

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, with the minimum section properties indicated on the drawings. Contractor shall provide heavier gauge if minimum gauge indicated is not adequate to support total loads as shown on the drawings.

B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, with the minimum section properties indicated on the drawings. Contractor shall provide heavier gauge if minimum gauge indicated is not adequate to support total loads

as shown on the drawings.

C. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated on the drawings. Contractor shall provide heavier gauge if the minimum gauge indicated is not sufficient to support construction loads as unshored forms and/or total load as indicated on the drawings based on the composite section. Deck shall have deformations specifically designed to produce composite action between the deck and the concrete slab by mechanical bond.

D. Non-composite Form Deck: Fabricate ribbed-steel sheet non-composite form-deck panels to comply with "SDI Specifications and Commentary for Non-composite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated on the drawings. Contractor shall provide heavier gauge if minimum gauge indicated is not adequate to support total loads as shown on the drawings.

2.4 ACCESSORIES

A. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

B. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

C. Anchor clips, vent clips, welding washers, flashing, saddle plates, sump pans, other accessories shall be those types, sizes, and configurations recommended by the decking manufacturer, and shall be of the same material and finish as the deck units. All accessories shall conform to ASTM A653/A63M.

D. Cell closure flexible strips, and fillers shall be of material in compliance with applicable building code governing class of construction.

E. Provide metal closure strips at edges of all slabs and openings that serve as pour stops for concrete. Gauge shall be sufficient to span or cantilever from steel beams.

F. Roof sump pans: Fabricate from a single piece of galvanized sheet steel of the same quality as the deck units; not less than nominal 0.0747" (14 gauge) thick before galvanizing; with bottoms level after erection and sloping sides to direct water flow to the drain, unless otherwise shown. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3" wide. Recess pans not less than 1-1/2" below the roof deck surface, unless otherwise shown or required by deck configuration. Weld to deck at maximum 12" on-center.

G. Headed studs for shear connectors shall be per drawings manufactured from cold drawn wire and conforming to ASTM A 108, Grades 1010 thru 1020.

1. Subject to compliance with requirements, studs shall be manufactured by one of the following:

a. Nelson
b. KSM

H. Paint: Where indicated on drawings, must be compatible with galvanized surfaces such that minimal preparation is required.

1. For decks exposed to exterior conditions or high humidity paint must

a. Demonstrate corrosion resistance per standards ASTM B 117 & ASTM D 5894

2. For all decks paint must

a. Demonstrate a minimum opacity as determined by ASTM D 2805
b. Demonstrate a minimum of adhesion as classified by 4B of ASTM D 3359 method A

3. The product shall not contain any of the prohibited compounds as listed in Green Seal *Standard for Paintings and Coatings*, GS-11, latest edition and in Master Painters Institute (MPI) *Green Performance Standard*, GPS-1-08.

4. The product shall meet the VOC limits as set forth in the MPI Green Performance Standard, GPS-1-08, with a maximum allowable VOC of 340 g/L for rust preventative coatings. Limits are expressed in THINNED state. Preference shall be given to products with the least crystalline silica content.

2.5 FABRICATION

A. Fabricate deck units in accordance with the AISI's "Specification for the Design of Cold-Formed Steel Structural Members" and accepted shop drawings. Fabricate deck units to the sizes and configurations indicated and cut to lengths which will span not fewer than three supporting members; use only full length units at overhang where indicated in a manner that laps fit tightly. Locate openings for penetrations where indicated and provide support framing and edge reinforcement for all openings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSPECTION

A. Inspection of the metal deck and shear stud installation will be performed by an inspection agency retained by the owner at no expense to the contractor. The inspection agency shall work under the direction of the owner. Contractor shall provide the inspection agency with the following:

1. Schedule of all work in both shop and field with at least ten days written notice before commencement of either activity.
2. A complete set of approved shop and erection drawings.

3.3 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section. Erection shall closely follow the erection of structural steel.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members as per load schedule provided on contract documents.

D. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

E. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work, per drawings and manufacturer’s specifications.

F. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

G. Headed shear studs shall be installed by welding through metal deck onto beam below. Automatic welding machinery of approved design, amperage, duration of current, etc., shall be used. Studs shall be tested by testing laboratory in accordance with AWS Procedures for Bend Test; replace all studs which do not pass test.

H. All welding shall be performed by competent experienced welding mechanics. Welding mechanics must have AWS D1.3 certification for welding sheet metal less than 1/8 inch thick. All welds shall be given a protective coat of paint as specified in painting article of section 051200.

I. All abraded or damaged protective surfaces of steel decking work shall be touched up with a protective coat of paint by this contractor as erected.

3.4 ROOF DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members per drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports per drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing per manufacturer’s specification but not less than 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.

D. All unframed openings in roof deck shall be reinforced per the drawings.

E. Roof sump pans: Fabricate from a single piece of galvanized sheet steel of the same quality as the deck units; not less than nominal 0.0747" (14 gauge) thick before galvanizing; with bottoms level after erection and sloping sides to direct water flow to the drain, unless otherwise shown. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3" wide. Recess pans not less than 1-1/2" below the roof deck surface, unless otherwise shown or required by deck configuration. Weld to deck at maximum 12" on-center.

F. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.5 FLOOR DECK INSTALLATION

Fasten floor-deck panels to steel supporting members per the drawings.Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports per the drawings.

A. End Bearing: Install deck ends over supporting frame with a minimum end bearing per manufacturer’s specification but not less than 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2” minimum or butted at Contractor's option.

B. All unframed deck openings in composite deck with concrete larger than 6" shall be reinforced per the drawings.

C. At composite deck with concrete, metal hanger tabs shall be installed at all panel sidelaps 24 inches on-center, longitudinally 24 inches on-center to create a grid nominally 24 inches by 24 inches. Tabs shall be 18 gauge minimum, capable of supporting the specified ceiling, tabs shall be a minimum of 18 gauge capable of supporting ceiling and all other suspended loads or 200 pounds, whichever is greater.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Sealing cellular deck openings, butt joints, and junctions with trench headers with tape

is not included in this Section. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. The steel decking units shall be placed on the supporting steel framework and adjusted to final position before being permanently fastened. Each unit shall be brought to proper bearing on the supporting beams.

G. Deck shall, where possible, span 3 or more supports.

H. The side laps of adjacent units shall be fastened by approved method (to be shown on shop drawings) between supports at intervals as noted on the drawings.

I. All welding shall be performed by competent experienced welding mechanics. Welding mechanics must have AWS D1.3 certification for welding sheet metal less than 1/8 inch thick. All welds, shall be given a protective coat of paint as specified in painting article of Section 051200.

J. All abraded or damaged protective surfaces of steel decking work shall be touched up with a protective coat of paint by this contractor as erected.

K. Headed shear studs shall be installed by welding through metal deck onto beam below. Automatic welding machinery of approved design, amperage, duration of current, etc., shall be used. Studs shall be tested by testing laboratory in accordance with AWS Procedures for Bend Test; replace all studs which do not pass test.

L. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.6 FIELD QUALITY CONTROL

A. Special Inspection as required by the applicable Building Code of all metal decking will be performed by an inspection agency retained by the Owner at no expense to the Contractor. The inspection agency shall work under the direction of the owner. Contractor shall provide the inspection agency with the following:

1. Schedule of all work in field with at least ten days' written notice before commencement of either activity.
2. A complete set of approved shop and erection drawings.
3. Order sheets, material bills, shipping bills and mill test reports.
4. Representative sample pieces as requested by the testing agency.
5. Full and ample means and assistance for testing all material.
6. Proper facilities, including scaffolding, temporary work platforms, etc., for inspection of the work in the mills, shop and field.

B. Each person installing connections shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that the inspector can refer back to the person making the connection.

C. The following minimum criteria shall be adhered to in testing of welds:

1. All welds shall be examined by visual means.
2. 25% of all welds, selected randomly, shall be measured.
3. In addition, all welds subject to tensile stress shall be examined by the Ultrasonic Method for 100% of their length.
4. 10% of all manual fillet welds shall be tested by the magnetic particle method.
5. 1'-0" at each end of automatic fillet welds shall be tested by the magnetic particle method.
6. 100% of groove welds shall be tested by the ultrasonic method.

D. Field inspection will include examination of decking for welding and touching-up of shop coat.

E. Inspection of welding will be such as to assure that the work is within the quality requirements specified below and elsewhere in this section of the specifications and will include:

1. Ascertainment that the electrodes and flux used for the SAW, GMAW and FCAW welding processes conform to the requirements of this section of the specifications.
2. Ascertainment that the approved welding procedures and sequence are followed without deviation, unless specific approval for change is obtained from the architect.
3. The testing agency shall be prepared to utilize the following approved methods of testing:

    a. Liquid penetrant inspection: ASTM E 165.
    b. Magnetic particle: ASTM A 709.
    c. Radiographic inspection: ASTM E 94 and E 1032.
    d. Ultrasonic inspection: ASTM E 114 and AWS, Chapter 6, Section C.

F. When defects are revealed, additional inspection by whatever method is deemed necessary by the inspector, shall be performed to the extent necessary to assure that the full amount of defect has been located. No further work shall be done on the assembly or sub-assembly in question until all the necessary corrections have been made. Defects shall be repaired, using the same welding procedure that was used initially in making the weld, unless otherwise approved by the architect. Inspection of the repaired weld shall be by the same method that was used to reveal the defect. A second repair of a defective area shall not be made without approval of the Architect.

G. A distinguishing mark will be placed on all work that has been inspected and approved. Material or work that is not acceptable will be designated by words such as "REJECT" or "REPAIR" marked directly on the material or work.

H. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

I. Remove and replace work that does not comply with specified requirements.

J. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.7 CLEANING UP

A. Remove all equipment, unused materials and debris from the site immediately upon the completion of this work.

END OF SECTION

SECTION 05 5133
METAL LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop-fabricated metal ladders.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

E. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

G. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

H. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED LADDERS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
   1. Side Rails: 3/8 by 2 inches (9 by 50 mm) members spaced at 20 inches (500 mm).
   2. Rungs: One inch (25 mm) diameter solid round bar spaced 12 inches (300 mm) on center.
   3. Space rungs 7 inches (175 mm) from wall surface.

2.04 FINISHES - STEEL

A. Prepare surfaces to be primed in accordance with SSPC-SP2.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Prime Painting: One coat.

2.05 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).

C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).

D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).

E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

SECTION 05 7311
DECORATIVE METAL AND GLAZED METAL RAILINGS - VIVA

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Railing and handrail assemblies.

1.02 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

C. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

F. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.

G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

H. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.

I. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

J. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

L. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

M. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

N. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.

O. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.

P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

Q. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).

R. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
   1. Contractor.
   2. Manufacturer's representative.
   3. Architect.
   4. Owner's representative.
   5. Other subcontractors of adjacent work.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's product data, including description of materials, components, and finishes.

C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, transitions, and terminations.

D. Samples: Submit one (1) of each item below for each type and condition shown.
   1. Glass: 12 inches by 12 inches (305 mm by 305 mm), showing color, thickness and edge condition.
   2. Railing: 12-inch (305 mm) long section of handrail showing color, finish and connection detail.

E. Manufacturer's qualification statement.

F. Single-source qualification statement.

G. Installer's qualification statement.

H. Maintenance Data: Manufacturer's instructions for care and cleaning.

I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging.

B. Protect materials against damage during transit, delivery, storage, and installation at site.

C. Inspect materials upon delivery for damage. Replace damaged items.

D. Prior to installation, store materials and components under cover in a dry location.

1.06 FIELD CONDITIONS

A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C).

B. Maintain ambient temperature of space at minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C) for 24 hours before, during, and after railing installation.

1.07 WARRANTY

A. Warranty: Manufacturer's standard one-year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Viva Railings, LLC: 151 W. Vista Ridge Mall Drive, Lewisville, TX 75067. 972-353-8482. www.vivarailings.com/#sle.

B. Substitutions: Not permitted.

2.02 RAILING SYSTEMS, GENERAL

A. Factory- or shop-fabricate to suit project conditions, for proper connection to building structure, and in largest practical sizes for delivery to site.

B. Handrails: Comply with applicable accessibility requirements of ADA Standards.

C. Joints: Tightly fitted and secured, machined smooth with hairline seams.

D. Field Connections: Provide sleeves, anchors, and other devices required for site assembly and installation.

E. Welded Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.

2.03 METAL RAILINGS

A. Metal Railing: Engineered, post-supported railing system with metal or glass infill.
   1. Product:

a. Viva Railings, LLC; CIRCA: www.vivarailings.com/#sle.
2. End and Intermediate Posts: Stainless steel; configuration shown on drawings.
3. Top Rail and Grip Rail: Round, stainless steel, 1-1/2-inch (38 mm) diameter.
4. Handrail Brackets: Same metal as railing.
5. Infill: Glass; as specified in this section at interior areas.
6. Glass Mounts: Pressure clamps/infill mounts, same metal as railing.
7. Fasteners: Concealed.

B. Metal Railing: Engineered, post-supported railing system with metal or glass infill.
1. Product:
a. Viva Railings, LLC; BEACON: www.vivarailings.com/#sle.
1) Basis-of-Design Product: Subject to compliance with requirements, provide VIVA Railings, LLC; iRAIL Railing System.
2. End and Intermediate Posts: Stainless steel; configuration shown on drawings.
3. Top Rail: Round, stainless steel, 2-inch (51 mm) diameter.
4. Grip Rail: Round, stainless steel, 1-1/2-inch (38 mm) diameter.
5. Handrail Brackets: Same metal as railing.
6. Infill: Manufacturer's cable.
7. Glass Mounts: Pressure clamps/infill mounts, same metal as railing.
8. Fasteners: Concealed.

C. Wall-Mounted Handrail: Engineered, bracket-supported railing.
1. Product:
a. Viva Railings, LLC; WALL RAIL: www.vivarailings.com/#sle.
2. Handrail: 1-1/2-inch (38 mm) diameter stainless steel; No.4 bright finish.
3. Handrail Brackets: Manufacturer's standard stainless steel brackets.
a. Mounting: Wall.
b. Finish: No.4 bright finish.

2.04 MATERIALS AND FINISHES

A. Aluminum Components: ASTM B221 or ASTM B221M.
1. Clear Anodized Finish: Class I, AAMA 611 AA-M12C22A41, clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils (0.007 inch) (0.018 mm) thick.

B. Steel Components:
1. Sections, Shapes, Plates, and Bars: ASTM A36/A36M.
2. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
3. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

C. Stainless Steel Components:
1. ASTM A666, Type 304 or Type 316.
2. Stainless Steel Tubing: ASTM A554, Type 304 or Type 316.
3. Stainless Steel Bars, Shapes, and Moldings: ASTM A276/A276M, Type 304 or Type 316.
4. Stainless Steel Finish: No.6 Satin.

D. Glass:
1. Laminated Safety Glass: ASTM C1172, unless otherwise indicated.
a. Impact Strength: Category II, tested in accordance with 16 CFR 1201.
b. Thickness: 3/4 inch (19 mm).
c. Configuration: As indicated on drawings.
d. Edges: Ground smooth and polished.
e. Finish: Plain, no finish.
f. Color: As selected by Architect.

2.05 ACCESSORIES

A. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed

fasteners are unavoidable, provide flush countersunk fasteners.

1. For anchorage to concrete, provide inserts to cast into concrete for bolt anchors.
2. For anchorage to masonry, provide brackets to embed in masonry for bolt anchors.
3. For anchorage to stud walls, provide backing plates for bolt anchors.
4. Exposed Fasteners: No exposed bolts or screws.

B. Carbon Steel Bolts and Nuts: ASTM A307.

C. Hydraulic Expansion Cement: ASTM C1107/C1107M.

D. Concrete Adhesive Type Anchors: Comply with ICC-ES AC308.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

3.02 PREPARATION

A. Protect existing work.

B. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.

C. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

A. Use manufacturer's approved installer.

B. Installation by manufacturer.

C. Comply with manufacturer's drawings and written instructions.

D. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.

E. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

F. Anchor securely to structure.

G. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

H. Weld connections that cannot be shop welded due to size limitations.

1. Weld in accordance with AWS D1.1/D1.1M.
2. Weld stainless steel in accordance with AWS D1.6/D1.6M.
3. Match shop welding and bolting.
4. Clean welds, bolted connections, and abraded areas.
5. Touch up shop primer and factory-applied finishes.
6. Repair galvanizing with galvanizing repair paint in accordance with ASTM A780/A780M.

I. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, noncumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.05 FIELD QUALITY CONTROL

A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.06 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

C. Glass and Glazing: Clean glazing surfaces; remove excess glazing sealant compounds, dirt, and other substances.

3.07 PROTECTION

A. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
   1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough opening framing for doors, windows, and roof openings.

B. Roof-mounted curbs.

C. Roofing nailers.

D. Roofing cant strips.

E. Preservative treated wood materials.

F. Communications and electrical room mounting boards.

G. Concealed wood blocking, nailers, and supports.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

B. AWPA U1 - Use Category System: User Specification for Treated Wood; 2023.

C. PS 1 - Structural Plywood; 2019.

D. PS 20 - American Softwood Lumber Standard; 2021.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

B. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
   3. Other Locations: PS 1, C-D Plugged or better.

2.04 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber exposed to weather.
      c. Treat lumber in contact with roofing, flashing, or waterproofing.
      d. Treat lumber in contact with masonry or concrete.
      e. Treat lumber less than 18 inches (450 mm) above grade.
   2. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
      a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
   3. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
      a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Chalkboards and marker boards.
   8. Wall paneling and trim.
   9. Joints of rigid wall coverings that occur between studs.

3.03 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at each roof opening except where specifically indicated otherwise; form corners by alternating lapping side members.

3.04 INSTALLATION OF CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

END OF SECTION

SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Hardware.

C. Preparation for site finishing.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 12 3600 - Countertops.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

D. BHMA A156.9 - Cabinet Hardware; 2020.

E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Quality Certification:
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
   5. Replace, repair, or rework all work for which certification is refused.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

B. Provide sustainably harvested wood, certified or labeled; see Section 01 6000.

C. Provide wood harvested within a 500 mile (805 km) radius of the project site.

D. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide

lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.

2.03 PANEL CORE MATERIALS

A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.
   1. Grade: M-2; moisture resistance: MR10.
   2. Panel Thickness: 3/4 inch (19.1 mm).

2.04 LAMINATE MATERIALS

A. Manufacturers:
   1. Arborite; ColorEdge: www.arborite.com/#sle.
   2. Formica Corporation: www.formica.com/#sle.
   3. Wilsonart LLC: www.wilsonart.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.05 COUNTERTOPS

A. Countertops: See Section 12 3600.

2.06 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's standard range.
   2. Use at all exposed shelf edges.

C. Vinyl Countertop Edge: PVC anchor type tee-molding edging in width to match thickness of countertop, color as indicated, used at locations as indicated.

D. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.07 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Metal Z-Shaped Wall Cabinet Support Clips: Paired, cleated, structural anchorage components applied to back of cabinets and walls for wall cabinet mounting.
   1. Material: Extruded Aluminum.

C. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch (25 mm) spacing adjustments.

D. Countertop Support Brackets: Fixed, L-shaped, face-of-stud mounting.
   1. Materials: Steel; T-shape cross-section.
      a. Finish: Manufacturer's standard, factory-applied, powder coat.
      b. Color: Black.
      c. Height: 9 inches (230 mm).
      d. Width: 1 inch (25 mm).

E. Vanity Brackets: Fixed, ADA-compliant, face-of-stud mounting.
   1. Material and Shape: Steel; formed compound shapes.
      a. Finish: Manufacturer's standard, factory-applied, textured powder coat.
      b. Color: Black.
   2. Height: 18 inches (460 mm).
   3. Support Length: 21-1/2 inches (546 mm).

F. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers ("U" shaped wire pull, steel with chrome finish, 100 mm centers).

G. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.

H. Drawer Slides:

1. Type: Extension types as indicated.
2. Static Load Capacity: Commercial grade.
3. Mounting: Side mounted.
4. Stops: Integral type.
5. Features: Provide self closing/stay closed type.

I. Soft-Close, Door and Drawer Adjustable Dampers:

J. Hinges: European style concealed self-closing type, steel with satin finish.

K. Television and Monitor Support Slides:
1. Manufacturers:
   a. Accuride International, Inc; CBLIFT-0019: www.accuride.com/#sle.
   b. Substitutions: See Section 01 6000 - Product Requirements.

2.08 FABRICATION

A. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)
1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

B. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches (400 mm) on center.

C. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

3.03 ADJUSTING

A. Test installed work for rigidity and ability to support loads.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 1713
BENTONITE PANEL WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bentonite clay panel waterproofing and accessories.

1.02 REFERENCE STANDARDS

A. ASTM D5993 - Standard Test Method for Measuring Mass per Unit Area of Geosynthetic Clay Liners; 2018.

B. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

C. Store and handle materials in accordance with manufacturer's written instructions.

D. Maintain minimum ambient storage temperature of 40 degrees F (5 degrees C) for bentonite panel products.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for at least 24 hours before and during application.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are resulting from structural failures of building; hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure. Complete forms in Owner's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bentonite Panel Waterproofing:
   1. CETCO, a division of Minerals Technologies Inc: www.mineralstech.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Bentonite: Pure bentonite clay, granulated, dry, and comprised of at least 50 percent sodium montmorillonite with at least 90 percent passing No.20 (850 micro m) mesh sieve, and maximum of 10 percent passing No.200 (75 micro m) mesh sieve.

B. Three-Ply Bentonite Panels: Triple corrugated core, smooth-faced kraft paper panels, center core filled with self-expanding bentonite clay granules, outer layers placed at right angles to core layer.
   1. Panel Size: 48 by 48 by 5/8 inches (1220 by 1220 by 15.9 mm), nominal.
   2. Bentonite Fill: 1.0 lb/sq ft (4.8 kg/sq m), minimum, in accordance with ASTM D5993.

C. Joint Packing: Water-soluble plastic filled with bentonite clay granules; 2-inch (51 mm) diameter by 24 inches (610 mm) long.

D. Joint Seal: Moist and hydrated bentonite clay gel using water and glycol for below-freezing application and water for above-freezing application.

2.03 ACCESSORIES

A. Fasteners: Galvanized, washerhead concrete or masonry screws.

B. Termination Bar: Metal, fastened at 12 inches (305 mm) on center; manufacturer's recommended type.

C. Adhesive: Manufacturer's recommended type.

D. Flashing: Provide UV-resistant flashing material, 12 inches (305 mm) wide, over top edge of panels at grade; manufacturer's recommended type.

E. Polyethylene Sheet: 3 mil, 0.003 inch (0.076 mm) thick.
   1. Color: White.
   2. Products:
      a. Rubber Polymer Company; Rufco Poly-Sheeting: www.rpcinfo.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

F. Drainage Panel: Formed plastic, 1/4 inch (6.4 mm) thick, and hollowed sandwich.

G. Protection Board: Biodegradable hardboard, 1/8 inch (3.2 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify substrate surfaces are smooth, durable, and free of matter detrimental to application of waterproofing system.

C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

A. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's installation instructions.

B. Remove concrete fins, projections, and form ties.

C. Fill holes, cracks, honeycombs, and voids with joint sealant at least 1/8 inch (3.2 mm) thick, and extend at least 3 inches (76 mm) beyond defect.

3.03 INSTALLATION

A. Install panels in accordance with manufacturer's installation instructions and applicable requirements of NRCA (WM).

B. Cut panels parallel to corrugations to prevent loss of bentonite.

C. Seal construction joints, control joints, through-wall projections and penetrations, and _____ with joint sealant, packing mastic, and _____.

D. Vertical Surfaces:
   1. Install triple-ply panels with concrete screws, starting at base of foundation.
   2. Fold panels around corners with corrugations vertical, and install unfolded panels with corrugations horizontal.
   3. Lap adjoining panels 1-1/2 inches (38 mm).
   4. Stagger vertical joints at mid-panel on succeeding courses.

5. Stagger vertical joints at least 16 inches (406 mm) on succeeding courses.
6. Install one extra layer of panels at external and internal corners.
7. Place joint packing continuously along junction of wall and footing; secure properly to prevent movement.

E. Drainage Panel:
1. Install drainage panel directly over waterproofing, butt joints, and position to ensure downward drainage.
2. Scribe and cut drainage panels around projections, penetrations, and interruptions.
3. Adhere drainage panel to substrate with mastic.

F. Protection Board:
1. Install protection board directly over waterproofing; butt joints.
2. Scribe and cut boards around projections, penetrations, and interruptions.
3. Adhere protection board to substrate with mastic.

3.04 PROTECTION

A. Do not permit traffic over unprotected or uncovered waterproofing.

B. Cover installed panel waterproofing with temporary polyethylene sheeting; remove sheeting just before backfilling begins.

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, and exterior wall behind metal or phenolic panel wall finish.

B. Batt insulation in exterior wall, ceiling, and roof construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.

B. Section 07 2600 - Vapor Retarders: Separate vapor retarder materials.

C. Section 07 2700 - Air Barriers: Separate air barrier materials.

D. Section 07 5400 - Thermoplastic Membrane Roofing: Installation requirements for board insulation over low slope roof deck.

1.03 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

E. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C; 2022.

F. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2018.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation Over Metal Stud Framed Walls, Continuous: Extruded polystyrene (XPS) carbon black board.

C. Insulation in Metal Framed Walls: Batt insulation with separate vapor retarder.

D. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

E. Insulation Over Roof Deck: Extruded polystyrene (XPS) board.

2.02 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
   1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   4. Type and Thermal Resistance, R-value (RSI-value): Type IV 6.0, minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
   5. Type and Water Absorption: Type XII, 0.3 percent by volume, maximum, by total immersion.

6. Products:
    a. DuPont de Nemours, Inc; Styrofoam Brand _____: building.dupont.com/#sle.
    b. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi: www.kingspan.com/#sle.
    c. Owens Corning Corporation; FOAMULAR Type ___ Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.
    d. Substitutions: See Section 01 6000 - Product Requirements.

B. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Comply with ASTM C578, and manufactured using carbon black technology.
1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
3. Type and Thermal Resistance, R-value (RSI-value): Type IV, 6.0, minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
4. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
5. Board Thickness: As shown on drawings.
6. Board Edges: Shiplap, at long edges.
7. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
8. Products:
    a. Substitutions: See Section 01 6000 - Product Requirements.

2.03 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
2. Formaldehyde Content: Zero.

B. Mineral Fiber Enclosure for Recessed Ceiling Fixtures: Insulated box enclosure with foil facing on exterior side for placement over recessed ceiling light fixture; flame spread index of 25 or less, and smoke development index of 450 or less when tested in accordance with ASTM E84.
1. Light Fixture Size: As indicated on drawings.

2.04 ACCESSORIES

A. Sheet Vapor Retarder: See Section 07 2600.

B. Self-Adhered Transition Flashing: Multipurpose, self-adhered flashing with modified butyl adhesive, polyester fiber top sheet, and polypropylene interlayer.
1. Application: Primerless adhesion for use as through-wall flashings and wall transitions to roof and below-grade systems.
2. Thickness: 45 mil, 0.045 inch (1.14 mm), nominal.
3. Size: 6 inches (152 mm) wide, in rolls 75 feet (23 m) long.
4. Tensile Strength: Greater than 1,300 psi (8963 kPa) complying with ASTM D412 test method.
5. Products:
    a. DuPont de Nemours, Inc; DuraGard CM Transition Flashing: building.dupont.com/#sle.
    b. Substitutions: See Section 01 6000 - Product Requirements.

C. Flashing Tape: Special reinforced film with high performance adhesive.
1. Application: Window and door opening flashing tape.
2. Width: As required for application.
3. Primer: Tape manufacturer's recommended product.
4. Products:
    a. Protecto Wrap Company; Protecto Super Stick Building Tape: www.protectowrap.com/#sle.
    b. Protecto Wrap Company; Protecto Seal 45 Butyl: www.protectowrap.com/#sle.

c. Protecto Wrap Company; Protecto Seal PW 100/40: www.protectowrap.com/#sle.
d. Protecto Wrap Company; Protecto BT20XL Butyl: www.protectowrap.com/#sle.
e. Protecto Wrap Company; Protecto BT25XL: www.protectowrap.com/#sle.
f. Rmax Inc; R-SEAL 6000: www.rmax.com/#sle.
g. Substitutions: See Section 01 6000 - Product Requirements.

D. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
1. Width: 3-1/2 inches (89 mm).
2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
3. Products:
a. Protecto Wrap Company; Triple Guard Energy Sill Sealer: www.protectowrap.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.

E. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch (50 mm) wide.
1. Products:
a. Rmax Inc; R-SEAL 3000: www.rmax.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.

F. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.

G. Air and Moisture Sealing Insulation Fasteners: Preassembled fastener units consisting of sealing washer, screw, and gasketing tube.
1. Length as required for thickness of insulation material and penetration of deck substrate.
2. Thread and tip types as required for substrate material.

H. Rigid Insulation Pronged Attachment Washers: Solid plastic cap washer with prongs and flexible perimeter seal attached with screws to substrate for attachment of rigid insulation and to help seal against air and moisture penetration through weather barrier assembly.
1. Products:
a. TruFast Walls, a Division of Altenloh, Brinck & Co. US, Inc; Thermal-Grip ci Prong Washer: www.trufastwalls.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.

I. Support for Cladding and Continuous Insulation: Thermal clips.
1. Thermally-broken clips that provide attachment support for girts, angles, channels, and other cladding support framing.
2. Fasteners: As recommended by clip manufacturer.
3. Products:
a. Advanced Architectural Products, LLC; SMARTci GREENGirt Clips - Thermal Spacer series: www.smartcisystems.com/#sle.
b. Cascadia Windows & Doors; Cascadia Clip: www.cascadiawindows.com/#sle.
c. Northern Facades; ISO Clip: www.northernfacades.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

J. Support for Cladding and Continuous Insulation: Continuous thermal Z-girts.
1. Fiberglass reinforced plastic (FRP) girts that provide cladding attachment support for exterior wall cladding, brick veneer, CMU veneer, metal wall panels, siding, and _____.
2. Fasteners: As recommended by clip manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards horizontally on foundation perimeter.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS

A. Adhere 6 inches (152 mm) wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.

B. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches (406 mm) on center with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inches (102 mm) wide sealant tape; comply with ASTM E2357.

C. Install boards horizontally on walls.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BOARD INSTALLATION USING CLADDING AND CONTINUOUS INSULATION SUPPORTS

A. Install supports in accordance with manufacturer's installation instructions.

B. Install supports in compliance with system orientation, sizes, and locations as indicated on drawings and in accordance with approved shop drawings.

C. Install supports to fill in exterior wall spaces without gaps or voids in insulation.

D. Trim insulation neatly to fit spaces and provide a continuous thermal layer.

3.05 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.06 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

A. Board Installation Over Roof Deck, General:
   1. See applicable roofing specification section for specific board installation requirements.
   2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
   3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
   4. Do not apply more insulation than can be covered with roofing on the same day.

3.07 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over face of member

F. Tape seal tears or cuts in vapor retarder.

G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane; tape seal in place.

3.08 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

3.09 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 2119
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foamed-in-place insulation.

B. Protective cementitious coating.

1.02 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).

E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.

C. Certificates: Certify that products of this section meet or exceed specified requirements.

D. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection as required by ABAA QAP.

E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience, and approved by manufacturer.

C. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
   1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.05 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

B. Do not apply foam when temperature is within 5 degrees F (2.78 degrees C) of dew point.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Foamed-In-Place Insulation:

1. Carlisle Spray Foam Insulation: www.carlislesfi.com/#sle.
2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Thermal Resistance: R-value (RSI-value) of 5.0 (0.88), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature when tested in accordance with ASTM C518.
   2. Water Vapor Permeance: Vapor retarder; 2 perms (115 ng/(Pa s sq m)), maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
   3. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
   4. Air Permeance: 0.04 cfm per square foot (0.2 L/(s/sq m)), maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf (75 Pa).
   5. Closed Cell Content: At least 90 percent.
   6. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
   7. Basis of Design:
      a. Carlisle Spray Foam Insulation; SealTite PRO Closed Cell: www.carlislesfi.com/#sle.
   8. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES

A. Primer: As required by insulation manufacturer.

B. Protective Coating: Cementitious type, spray applied; flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete before insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

3.02 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.

B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

B. Apply insulation by spray method, to a uniform monolithic density without voids.

C. Patch damaged areas.

D. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

E. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Field inspections and tests will be performed by an independent testing agency.

C. Inspection will include verification of insulation and protective coating thickness and density.

D. Coordination of ABAA Tests and Inspections:
   1. Provide testing and inspection required by ABAA QAP.
   2. Notify in ABAA writing of schedule for air barrier work. Allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.

5. Do not cover air barrier work until tested, inspected, and accepted.

3.05 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

SECTION 07 2500
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water-resistive barriers.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Water-resistive barrier under exterior cladding.

1.03 DEFINITIONS

A. Weather Barriers: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Water-Resistive Barrier: A material behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.

1.04 REFERENCE STANDARDS

A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).

PART 2 PRODUCTS

2.01 WATER-RESISTIVE BARRIER MATERIALS

A. Drainable Barrier Sheet: Nonwoven and nonperforated polypropylene material with 1/16 inch (1.5 mm) gap created by spacers providing drainage space.
   1. Width: 5 feet (1.52 m), minimum.
   2. Water Vapor Permeance: 19 perms (1,087 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F (23 degrees C).
   3. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 120 days of weather exposure.
   4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
   5. Seam and Perimeter Tape: As recommended by sheet manufacturer.
   6. Products:
      a. Tamlyn; TamlynWrap Drainable Wrap: www.tamlyn.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACCESSORIES

A. Sealants, Tapes, and Accessories Used for Sealing Water-Resistive Barrier and Adjacent Substrates: As indicated or complying with water-resistive barrier manufacturer's installation instructions.

B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
   1. Width: 6 inches (152 mm).
   2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.
   3. Products:
      a. DuPont de Nemours, Inc; FlexWrap: www.dupont.com/building/#sle.
      b. DuPont de Nemours, Inc; StraightFlash: www.dupont.com/building/#sle.
      c. DuPont de Nemours, Inc; VersaFlange: www.dupont.com/building/#sle.

d. Henry Company; FortiFlash: www.henry.com/#sle.
e. Henry Company; FortiFlex Butyl: www.henry.com/#sle.
f. Henry Company; FortiFlash Butyl: www.henry.com/#sle.
g. SIGA Cover Inc; SIGA-Wigluv: www.siga.swiss/global_en/#sle.
h. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions comply with requirements of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Water-Resistive Barriers: Install continuous water-resistive barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.

C. Mechanically Fastened Exterior Sheets:
1. Install sheets shingle-fashion to shed water, with seams aligned horizontal.
2. Overlap seams as recommended by manufacturer, 6 inches (152 mm), minimum.
3. Overlap at outside and inside corners as recommended by manufacturer, 12 inches (305 mm), minimum.
4. Attach to framed construction with fasteners extending through sheathing into framing, and space fasteners at 12 to 18 inches (305 to 460 mm) on center along each framing member supporting sheathing.
5. Attach to masonry construction using mechanical fasteners spaced at 12 to 18 inches (305 to 460 mm) vertically on center, and at 24 inches (610 mm), maximum, horizontally on center.
6. For applications indicated to be airtight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners as recommended by manufacturer.
7. Where stud framing rests on concrete or masonry substrate, extend lower edge of barrier sheets at least 4 inches (102 mm) below bottom of framing and seal to substrate with sealant or approved mounting tape.
8. Install water-resistive barrier over jamb flashings.
9. Install head flashings under water-resistive barrier.
10. At framed openings with frames having nailing flanges, extend sheet into opening and over flanges; at head of opening, seal sheet over flange and flashing.

D. Openings and Penetrations in Exterior Water-Resistive Barriers:
1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches (127 mm) onto water-resistive barrier and at least 6 inches (152 mm) up jambs; mechanically fasten stretched edges.
2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.
3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches (230 mm) wide, and covering entire depth of framing.
4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches (50 mm) beyond face of jambs; seal water-resistive barrier to flashing.
5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.

6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

3.04 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 2600
VAPOR RETARDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vapor retarders.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.

B. Section 06 1000 - Rough Carpentry: Vapor retarders on exterior wall sheathing.

C. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with vapor retarders.

1.03 DEFINITIONS

A. Vapor Retarder: Airtight barrier made of material that is relatively water vapor impermeable, to degree specified, with seams and joints sealed to adjacent surfaces.

B. Vapor Retarder Class: A measure of a material or assembly's ability to limit the amount of moisture that passes through that material or assembly. Vapor retarder class is defined using Procedure A, Desiccant Method at 73 degrees F (23 degrees C) and 50 percent Relative Humidity (RH), in accordance with ASTM E96/E96M and ICC (IBC)-2018, as follows:
   1. Class I: 0.1 perm or less.
   2. Class II: Greater than 0.1 perm to 1.0 perm.
   3. Class III: Greater than 1.0 perm to 10 perms.

1.04 REFERENCE STANDARDS

A. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016.

B. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).

C. ICC (IBC)-2018 - International Building Code; 2018.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Provide drawings of special joint conditions.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.01 VAPOR RETARDERS

A. Underslab Vapor Retarders: See Section 03 3000.

B. Vapor Retarder, Self-Adhering Membranes:
   1. Thickness: 40 mil, 0.04 inch (1.0 mm), nominal.
   2. Width: 36 inches (914 mm).
   3. Vapor Retarder Class I: 0.1 perm (5.72 ng/(Pa s sq m)) or less, when tested in accordance with ASTM E96/E96M, Procedure A.
   4. System Accessory Products: As recommended by membrane manufacturer.
   5. Products:
      a. Carlisle Coatings and Waterproofing; Fire Resist 705FR-A: www.carlisleccw.com/#sle.

b. Carlisle Coatings and Waterproofing; CCW-705 Air and Vapor Barrier Sheet: www.carlisleccw.com/#sle.
c. Henry Company; Blueskin SA: www.henry.com/#sle.
d. Henry Company; Blueskin SA LT (Low Temp): www.henry.com/#sle.
e. Hohmann & Barnard, Inc; X-Barrier: www.h-b.com/#sle.
f. Siplast; WALLcontrol Adhered Air and Water Barrier System: www.siplast.com/#sle.
g. Substitutions: See Section 01 6000 - Product Requirements.

C. Vapor Retarder Sheet: Polyethylene sheeting complying with ASTM D4397, clear colored.
1. Thickness: 10 mil, 0.010 inch (0.254 mm), nominal.
2. Seam and Perimeter Tape: Polyethylene self-adhering type, mesh reinforced, 2 inches (50 mm) wide; compatible with sheet material.
3. Products:
a. Tex-Trude; _____: www.tex-trude.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Vapor Retarder and Adjacent Substrates: As indicated, complying with vapor retarder manufacturer's installation instructions.

B. Sealant for Cracks and Joints in Substrates: Resilient elastomeric joint sealant compatible with substrates and vapor retarder materials.
1. Application: Apply at 30 to 40 mil, 0.030 to 0.040 inch (0.76 to 1.02 mm), nominal thickness.
2. Color: Green.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions comply with requirements of this section.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Vapor Retarders: Install continuous airtight barrier over surfaces indicated, with sealed seams and sealed joints to adjacent surfaces.

C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.

D. Self-Adhered Sheets:
1. Prepare substrate in accordance with sheet manufacturer's installation instructions; fill and tape joints in substrate and between dissimilar materials.
2. Lap sheets shingle fashion to shed water and seal laps airtight.
3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
4. Use same material, or other material approved by sheet manufacturer, to seal sheets to adjacent substrates, and as flashing.
5. At expansion joints, provide transition to joint assemblies approved by sheet manufacturer.

E. Openings and Penetrations in Exterior Vapor Retarders:
1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches (127 mm) onto vapor retarder and at least 6 inches (152 mm) up jambs; mechanically fasten stretched edges.
2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.
3. At openings with nonflanged frames, seal vapor retarder to each side of framing at opening using flashing at least 9 inches (230 mm) wide, and covering entire depth of framing.

4. At head of openings, install flashing under vapor retarder extending at least 2 inches (50 mm) beyond face of jambs; seal vapor retarder to flashing.
5. At interior face of openings, seal gaps between window/door frame and rough framing using appropriate joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of vapor retarder.

3.03 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 4213
METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels and subgirt framing assembly, with insulation, related flashings, and accessory components.

B. Solar air heating wall panels.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Wall panel substrate.

B. Section 07 2500 - Weather Barriers: Weather barrier under wall panels.

C. Section 07 9200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 93 - Methods of Testing to Determine the Thermal Performance of Solar Collectors; 2010, with Errata (2014).

B. ICC 901/SRCC 100 - Solar Thermal Collector Standard; 2015.

C. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Test Reports: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in installing products specified in this section with minimum three years of documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

C. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

D. Prevent contact with materials that may cause discoloration or staining of products.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

C. Special Warranty: Provide 2-year warranty covering water tightness and integrity of seals of metal wall panels. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Wall Panels - Concealed Fasteners:
   1. AEP Span, a Division of ASC Profiles, LLC.; Flex Series.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 METAL WALL PANEL SYSTEM

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
   1. Provide exterior wall panels and subgirt framing assembly.
   2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
   3. Design Pressure: In accordance with applicable codes.
   4. Fire Performance: Tested in accordance with, and complying with acceptance criteria of NFPA 285.
   5. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
   6. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
   7. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   8. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
   9. Corners: Factory-fabricated in one continuous piece with minimum 2-inch (51 mm) returns.
   10. Provide continuity of weather barrier seal at building enclosure elements in accordance with requirements; see Section 07 2500.

B. Exterior Wall Panels:
   1. Profile: Vertical; style as indicated.
   2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
   3. Material: Precoated steel sheet, 22 gauge, 0.0299 inch (0.76 mm) minimum thickness.
   4. Panel Width: ___ inches (___ mm).
   5. Color: As selected by Architect from manufacturer's Cool Dura Tech MX line.

C. Subgirt Framing Assembly:
   1. Profile as indicated; to attach panel system to building.

D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

E. Expansion Joints: Same material, thickness and finish as exterior sheets; ___ gauge, ___ inch (___ mm) thick; manufacturer's standard brake formed type, of profile to suit system.

F. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

G. Anchors: Galvanized steel.

2.03 SOLAR AIR HEATING WALL PANELS

A. Products:
   1. Conserval Systems Inc. 10 John James Audubon Pkwy #110, Amherst, NY 14228 .
   2. Telephone: (716) 835-4903 Fax: (716) 835-4904; E-mail: info@solarwall.com; website: www.solarwall.com.

3. Substitutions: See Section 01 6000 - Product Requirements.

B. System:
   1. SolarWall® single stage: Comprised of vent-slit-perforated, unglazed, transpired solar collector with metal standoffs and a special internal framing system to balance air flow

C. Performance Requirements:
   1. Solar collector cladding to balance air flow passing through and duct air to nearest intake fan.
   2. Test Method/Criteria: ASHRAE Std 93 and ICC 901/SRCC 100.
   3. Mode Of Operation: Outside air heating, single stage.

D. Construction: Unit consisting of manufacturer's standard assembly of frame, cover, back cover with insulation, absorber plate assembly, and accessories.

E. Frame:

F. Plate Assembly: Aluminum sheet with with corrugations.
   1. Sheet Width: 41-1/4 inches (1050 mm).
   2. Sheet Length: 36 inches (915 mm).
   3. Perforation Density: 240 per sq ft (2500 per sq m).

2.04 ACCESSORIES

A. Support for Cladding and Continuous Insulation: Thermal clips.
   1. Thermally-broken clips that provide attachment support for girts, angles, channels, and other cladding support framing.
   2. Fasteners: As recommended by clip manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing members are ready to receive panels.

B. Verify weather barrier, see Section 07 2500, has been installed over wall panel substrate; see Section 05 4000.

3.02 PREPARATION

A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at intervals indicated.

B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.03 INSTALLATION

A. Install panels on walls in accordance with manufacturer's instructions.

3.04 TOLERANCES

A. Offset From True Alignment Between Adjacent Members Abutting or In Line: 1/16 inch (1.6 mm), maximum.

3.05 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove site cuttings from finish surfaces.

C. Remove protective material from wall panel surfaces.

3.06 PROTECTION

A. Protect metal wall panels until completion of project.

B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 07 4243
COMPOSITE WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Composite wall panel system and accessories with drainable and back-ventilated rainscreen assembly.

1.02 RELATED REQUIREMENTS

A. Section 07 2500 - Weather Barriers: Water-resistive barrier.

B. Section 07 6200 - Sheet Metal Flashing and Trim.

1.03 REFERENCE STANDARDS

A. AAMA 509 - Voluntary Test and Classification Method for Drained and Back Ventilated Rainscreen Wall Cladding Systems; 2022.

B. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets; 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's data sheets on each product to be used including, but not limited to, materials, dimensions, accessories, and fasteners.

C. Shop Drawings: Indicate layout, panel locations, and configuration.
   1. Indicate size, spacing, and location of support and attachment components, connections, types and locations of fasteners.
   2. Indicate necessary provisions for structural and thermal movement between wall panel system and adjacent materials.
   3. Indicate locations and sizes of penetrations through wall panel system for Architect's approval.

D. Samples: Submit two samples of each style and color panel, 12 by 12 inches (305 mm by 305 mm) in size and showing finish color, sheen, and texture.
   1. Submit 6 by 6 inches (152 mm by 152 mm), mounted sample of each four-way joint having equal sized panels on each corner.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum three years of documented experience and approved by manufacturer.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Locate where directed.

C. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver and store materials with labels intact in manufacturer's unopened packaging until ready for installation.

C. Store products under waterproof cover, well ventilated, and elevated above grade on a flat surface.

1.08 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. At project closeout, provide manufacturer's limited ten year warranty covering defects in materials. Warranty only available when material installed by an installation contractor trained and approved by the manufacturer's representative.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Phenolic Wall Panels:
   1. Trespa International B.V.; P.O. Box 110, 6000 AC Weert Wetering 20, 6002 SM Weert The Netherlands; www.trespa.com.
   2. Manufacturer's Representative: Trespa North America, Ltd.; 12267 Crosthwaite Cir., Poway, CA 92064. ASD. Toll Free Tel: (800) 4-TRESPA. Tel: (858) 679-2090. Fax: (858) 679-9568. Email: info.northamerica@trespa.com. Web: http://www.trespa.com/na.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PHENOLIC WALL PANELS

A. A. Solid Phenolic Wall Panels: Trespa Pura NFC Trespa International as represented by Trespa North America, LTD.

B. Material: Solid panel manufactured using a combination of high pressure and temperature to create a flat panel created from thermosetting resins, homogenously reinforced with wood-based fibers and an integrated decorative surface or printed décor.
   1. Color and Finish: As selected by the Architect from manufacturer's full range color palette.
   2. Panel Core: Fire retardant (FR) black core.
   3. Panel Thickness: Panel Thickness: 1/2 inch (13 mm).

C. Physical Properties:
   1. Modulus of Elasticity: 1,300,000 psi (9000 N/mm2) minimum, ISO 178.
   2. Tensile Strength: 10,100 psi (70 N/mm2) minimum, ISO 527-2.
   3. Flexural Strength: 14,500psi (120 N/mm2) minimum, ISO 178.
   4. Thermal Conductivity: 2.1 BTU/inch/ft2.hr.°F, EN 12524.

D. Structural Performance (ASTM E330):
   1. Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 15 pounds per square foot (psf). Wind load testing shall be done in accordance with this standard to obtain the following results:
      a. Normal to the plane of the wall, the maximum panel deflection shall not exceed L/175
      b. Normal to the plane of the wall between supports, deflection of the aluminum sub-framing members shall not exceed L/175 or 3/4 inch, whichever is less.
      c. At 1-1/2 times design pressure, permanent deflection of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion.
      d. If system tests are not available, mock ups shall be constructed and tests performed under the direction of an independent third party laboratory which show compliance to the minimum standards listed above.

E. Fire Performance:
   1. Flame Spread: Class A, ASTM E 84.
   2. Smoke Development: Less than 450, ASTM E 84.
   3. Ignition Temperature: Greater than 650 degree F (350 degree C) above ambient, ASTM D1929.
   4. Burning Classification: CC1 or CC2, ASTM D635.
   5. When required for compliance with local building codes, the wall cladding assembly shall show no degradation of the rating of Fire Resistant Assemblies, ASTM E119.
   6. When required for compliance with local building codes, the wall cladding assembly including cladding and non-cladding elements such as, but not limited to, specific weather resistive barriers and/or exterior insulation materials, shall meet the performance

requirements of NFPA 285. Performance shall be determined by actual testing in accordance with NFPA 285 or through an equivalency analysis provided by a recognized fire protection expert.

7. When required for compliance with local building codes, the wall cladding assembly shall not ignite when exposed to a radiant heat energy source, NFPA 268.

F. Finish Performance: Electron Beam Cure resin in conformance with the following general requirements:
   1. Color: As selected by the architect rom manufacturer's standard colors or a custom color to be matched by the panel supplier.
   2. Humidity Resistance: No formation of blisters when subjected to condensing water fog at 100% relative humidity and 100 degree F (38 degree C) for 3000 hours, ASTM D 2247.
   3. Salt Spray Resistance: Corrosion creepage from scribe line (1/16 inch (1.6 mm) max.) and minimum blister rating of 8 within the test specimen field, ASTM B117.
   4. Weather Exposure: Accelerated - 3000 hours in Atlas Type Weatherometer using cycle of 90 minutes light and 30 minutes diminished light and demineralized water with a maximum color change of 5 Delta E units from the original color according to ASTM D-2244, with the exception of Uni-Colors A12.3.7 / A18.3.5 / A04.1.7, which will not deviate more than 10 Delta E units from original color according ASTM D-2244.
   5. Color Stability: The decorative surface comply with, classification, 4 - 5 measured with the grey scale according to ISO 105 A02-93 according to test method EN 438-2:29.
   6. Microbial Characteristics: Will not support micro-organic growth (ISO 846).

G. Mounting System:
   1. Concealed fastening over fixed depth sub-framing.
   2. Aluminum Sub Structure: Aluminum sub-structure designed to withstand structural loading due to wind load and the dead load of the panel, painted as required to conceal behind the open joinery of the attachment system.
      a. Extrusions, including corner closures, joint closures and vent screens, formed members, sheet, and plate shall conform with the recommendations of the manufacturer.
      b. Fasteners (Concealed/Exposed): Fasteners shall be non-corrosive and as recommended by panel manufacturer. Exposed fasteners shall be colored to match panels where required by the architect.
   3. Panel Corner Profile:
      a. Dimensions: 143.70 inches by 11.81 inches by 11.81 inches (3650 by 300 by 300 mm) with a 5/16 inch (8 mm) thick by 3/4 inch (19 mm) radius.
      b. Dimensions: 143.70 inches by 11.81 inches by 11.81 inches (3650 by 300 by 300 mm) with a 3/8 inch (10 mm) thick by 3/4 inch (19 mm) radius.

H. FABRICATION
   1. Panels: Solid phenolic impregnated kraft paper wall panels with no voids, air spaces or foamed insulation in the core material.
   2. Accessory items in accordance with manufacturer's recommendations and approved submittals
   3. Panel Weight: 8 mm (2.4 lb/ft2), 10 mm (3 lb/ ft2), 13 mm (3.8 lb/ ft2).
   4. Panel Bow: = 2 mm / m (= 0.079 inch/39.38 inches).
   5. Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.
   6. Appearance: Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.

I. Rainscreen Assembly: Ventilated cavity formed by back of panels and water-resistive barrier; provide positive drainage to exterior from moisture entering or condensation occurring within panel system.
   1. Drained and Back-Ventilated Rainscreen System Classification: V1/W1 when tested in accordance with AAMA 509.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.

B. Verify that water-resistive barrier has been properly installed; see Section 07 2500.

C. Inspect products thoroughly prior to installation. Do not install any product which may have been damaged in shipment or appears to have a damaged or irregular finish.

D. Do not begin until unacceptable conditions have been corrected.

E. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Touch-up field cut edges before installing.

B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.03 INSTALLATION

A. Wall Panels:

1. Install solid phenolic wall panels and sub-frame system in accordance with manufacturer's instructions.
2. Install wall panels with manufacturer's recommended concealed attachment system.
3. Install solid phenolic wall panels plumb and level and accurately spaced in accordance with manufacturer's recommendations and approved submittals and drawings.
4. Anchor panels and sub-framing securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary movement and structural support.
5. Fasten solid phenolic wall panels with fasteners approved for use with supporting substrate.
6. Do not install panels or component parts which are observed to be defective or damaged including, but not limited to: warped, bowed, abraded, scratched, and broken members.
7. Do not cut or trim component parts during installation in a manner that would damage the finish, decrease the strength, or result in visual imperfection or a failure in performance. Return component parts with require alteration to the shop for re-fabrication or replacement.
8. Install corner profiles and trim with fasteners appropriate for use with adjoining construction as indicated on the Contract Drawings and as recommended by manufacturer.

3.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean exposed work upon completion of installation; remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to finish.

C. Remove masking or panel protection as soon as possible after installation. Any masking intentionally left in place after panel installation on an elevation, shall become the responsibility of the General Contractor to remove.

D. Adjust final panel installation so that all joints are true and even throughout the installation. Panels out of plane shall be adjusted with the surrounding panels to minimize any imperfection.

E. Repair panels with minor damage. Remove and replace panels damaged beyond repair as a direct result of the panel installation. After installation, panel repair and replacement shall become the responsibility of the General Contractor.

F.

3.05 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 5400
THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.

B. Insulation, flat and tapered.

C. Vapor retarder.

D. Deck sheathing.

E. Flashings.

F. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 05 3100 - Steel Decking: Placement of acoustical insulation for deck flutes.

B. Section 06 1000 - Rough Carpentry: Wood cant strips.

1.03 REFERENCE STANDARDS

A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.

C. ASTM C728 - Standard Specification for Perlite Thermal Insulation Board; 2017a (Reapproved 2022).

D. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

E. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.

F. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011 (Reapproved 2019).

G. NRCA (RM) - The NRCA Roofing Manual; 2024.

H. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

C. Manufacturer's qualification statement.

D. Installer's qualification statement.

E. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this section with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.

C. Store materials in weather protected environment, clear of ground and moisture.

D. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

E. Protect foam insulation from direct exposure to sunlight.

1.07 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F (5 degrees C) or above ____ degrees F (____ degrees C).

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within five years after installation.

C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 20 years.
   2. For repair and replacement include costs of both material and labor in warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
   1. Carlisle SynTec Systems; Sure-Weld TPO: www.carlisle-syntec.com/#sle.
   2. GAF; EverGuard TPO 45 mil: www.gaf.com/#sle.
   3. Johns Manville; JM TPO - 45 mil: www.jm.com/#sle.
   4. Versico Roofing Systems; VersiFleece RL TPO RapidLock Membrane: www.versico.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Thermoplastic Polyvinyl Chloride (PVC) Membrane Roofing Materials:
   1. Carlisle SynTec Systems; Sure-Flex PVC KEE HP FleeceBACK: www.carlisle-syntec.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

C. Insulation:
   1. Carlisle SynTec Systems; SecurShield Insulation: www.carlisle-syntec.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING - UNBALLASTED APPLICATIONS

A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.

B. Roofing Assembly Requirements:
   1. Solar Reflectance Index (SRI): Minimum of 64 based on three-year aged value; if three-year aged data is not available, minimum of 82 initial value.
      a. Calculate SRI in accordance with ASTM E1980.
      b. Field applied coating may not be used to achieve specified SRI.

C. Acceptable Insulation Types - Constant Thickness Application: Any type that meets requirements and is approved by membrane manufacturer for application.
   1. Minimum 2 layers of extruded polystyrene board.

D. Acceptable Insulation Types - Tapered Application: Any of types specified.
   1. Tapered extruded polystyrene board.
   2. Tapered extruded polystyrene board covered with uniform thickness extruded polystyrene board.
   3. Uniform thickness extruded polystyrene board covered with tapered polyisocyanurate, extruded polystyrene, or perlite board.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:
   1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
      a. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
   2. Sheet Width:
      a. Adhered Application: Limit width to 120 inches (3,048 mm), maximum, when ambient temperatures are less than 40 degrees F (4.4 degress C) for extended period of time during installation.
   3. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Vapor Retarder: Material approved by roof manufacturer complying with requirements of fire rating classification; compatible with roofing and insulation materials.
   1. Fire-retardant adhesive.

D. Flexible Flashing Material: Same material as membrane.

E. Through-Wall Flashing with Termination Bar: At least 40 mil, 0.040 inch (1.0 mm) thick poly-reinforced membrane with extruded termination bar and drip-edge.
   1. Width: 18 inches (457 mm), minimum.

2.04 DECK SHEATHING

A. Deck Sheathing: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
   1. Thickness: 5/8 inch (15.9 mm), Type X, fire-resistant.
   2. Products:
      a. Georgia-Pacific; DensDeck: www.densdeck.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.05 INSULATION

A. Perlite Board Insulation: Expanded perlite mineral aggregate, complying with ASTM C728.
   1. Board Size: 24 by 48 inches (619 by 1220 mm).
   2. Board Thickness: 1/2 inch (12.7 mm).
   3. Tapered Board: Slope as indicated; minimum thickness ____ inch (____ mm); fabricate of fewest layers possible.

B. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578, with natural skin surface and drainage channels on one face.
   1. Board Size: 48 by 96 inches (1220 by 2440 mm).
   2. Board Thickness: 1-1/2 inches (38 mm).
   3. Tapered Board: Slope as indicated; minimum thickness 1/2 inch (12.7 mm); fabricate of fewest layers possible.
   4. Board Edges: Tongue-and-groove.
   5. Products:
      a. DuPont de Nemours, Inc; _____: building.dupont.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.06 ACCESSORIES

A. Cant Strips: Wood, pressure preservative treated; see Section 06 1000.

B. Sheathing Joint Tape: Paper type, ____ inches (____ mm) wide, self adhering.

C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches (152 mm) wide; self adhering.

D. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

E. Membrane Adhesive: As recommended by membrane manufacturer.

F. Insulation Adhesive: As recommended by insulation manufacturer.

G. Insulation Perimeter Restraint: Stainless steel edge device configured to restrain insulation boards in position and provide top flashing over ballast.

H. Sealants: As recommended by membrane manufacturer.

I. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
   1. Composition: Roofing membrane manufacturer's standard.
   2. Surface Color: White.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION - METAL DECK

A. Install preformed acoustical glass fiber insulation strips in roof deck flutes in accordance with manufacturer's instructions; see Section 05 3100.

B. Install deck sheathing on metal deck:
   1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
   2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
   3. Tape joints.
   4. Mechanically fasten sheathing to roof deck, in accordance with roofing manufacturer's instructions.

3.03 INSTALLATION, GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.

B. Do not apply roofing membrane during cold or wet weather conditions.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.04 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
   1. Extend vapor retarder under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Attachment of Insulation:
   1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions.
   2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.

C. Lay subsequent layers of insulation with joints staggered minimum 6 inches (152 mm) from joints of preceding layer.

D. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

E. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

F. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

G. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

H. Do not install more insulation than can be covered with membrane in same day.

3.05 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Apply adhesive to substrate at rate of ___ gallons per square foot (___ L/sq m). Fully embed membrane in adhesive except in areas directly over or within 3 inches (76 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (76 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 6 inches (154 mm) onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.

F. Around roof penetrations, seal flanges and flashings with flexible flashing.

G. Coordinate installation of roof drains and sumps and related flashings.

3.06 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing in accordance with requirements.

C. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

3.07 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove bituminous markings from finished surfaces.

C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, and exterior penetrations.

B. Sealants for joints within sheet metal fabrications.

1.02 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).

D. CDA A4050 - Copper in Architecture - Handbook; current edition.

E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.04 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sheet Metal Flashing and Trim:
   1. ALUCOBOND by 3A Composites USA; ALUCOBOND AXCENT: www.alucobondusa.com/#sle.
   2. Fairview Architectural LLC; VitraEdge _____: www.fairview-na.com/#sle.
   3. Petersen Aluminum Corporation; _____: www.pac-clad.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Exterior Penetration Flashing Panel:
   1. Quickflash Weatherproofing Products, Inc; _____: www.quickflashproducts.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SHEET MATERIALS

A. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gauge, 0.0156 inch (0.40 mm) thick; smooth No. 4 - Brushed finish.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.04 EXTERIOR PENETRATION FLASHING PANELS

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.05 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer Type: Zinc chromate.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
   1. Products:
      a. Franklin International, Inc; Titebond WeatherMaster Metal Roof Sealant: www.titebond.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

E. Fenestration Perimeter Flashing Attachments: Two-piece flashing receiver and clip of extruded aluminum, at least 0.045 inch (1.14 mm) thick, for attaching flashing at perimeter of exterior wall fenestration openings.
   1. Provide flashing receiver profile appropriate for flashing applications.

F. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.03 INSTALLATION

A. Comply with drawing details.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Exterior Flashing Receivers: Install in accordance with manufacturer's recommendations, and in proper relationship with adjacent construction, and as follows:

F. Seal metal joints watertight.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 7200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof curbs.

B. Equipment rails.

C. Roof penetrations mounting curbs.

D. Rooftop mounted guardrails.

E. Roof hatches, manual and automatic operation, including smoke vents.

F. Roof hatches with access ladders.

1.02 REFERENCE STANDARDS

A. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.

B. 29 CFR 1926.502 - Fall protection systems criteria and practices; Current Edition.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

PART 2 PRODUCTS

2.01 ROOF CURBS

A. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
   1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings.
   2. Roof Curb Mounting Substrate: Curb substrate consists of flat roof deck sheathing with insulation.
   3. Sheet Metal Material:
      a. Aluminum: 0.080 inch (2.03 mm) minimum thickness, with 3003 alloy, and H14 temper.
         1) Finish: Mill finish.
         2) Color: As selected by Architect from manufacturer's standard line of colors.
   4. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches (102 mm).
   5. Provide layouts and configurations indicated on drawings.

B. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
   1. Provide preservative treated wood nailers along top of curb.
   2. Insulate inside curbs with 1-1/2 inch (38 mm) thick fiberglass insulation.
   3. Height Above Finished Roof Surface: 8 inches (203 mm), minimum.

C. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.

D. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches (400 mm) square unless otherwise indicated.

2.02 ROOFTOP MOUNTED GUARDRAILS

A. Non-Penetrating Rooftop Mounted Guardrails:
   1. Provide top and mid railings that comply with 29 CFR 1910.29.

2. Structural Load: 200 lb (90.7 kg), minimum, in any direction with components in compliance with 29 CFR 1926.502.
3. Height: 42 inches (1067 mm), minimum.
4. Railings: 1-5/8 inches (41.3 mm) minimum outside diameter, hot-rolled, welded tubing, free of sharp edges and snag points.
5. Mounting Bases: 104 lb (47.2 kg), Class 30, gray iron material cast to hold four receiver posts, with rubber pads on underside.
6. Receiver Posts: Provide with positive locking system for placement in receiver holes of mounting bases that allow rails to be mounted in any direction; provide drain holes in receiver posts.
7. Fixed Ladder Guard System: 36-inch (914 mm) wide passage that extends 7.5 feet (2.3 m) onto roof from top of ladder; adjustable spanner bars extend distance another 40 inches (1016 mm) from ladder.
8. Steel Surface Finish: Hot-dip zinc galvanized, with color as selected by Architect.

2.03 ROOF HATCHES AND VENTS, MANUAL AND AUTOMATIC OPERATION

A. Roof Hatch Manufacturers:
1. A. Basis-of-Design Manufacturer: Type E-50TB Roof Hatch by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-535-1582, Web: www.BILCO.com..
2. Substitutions: See Section 01 6000 - Product Requirements.

B. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
1. Style: Provide flat metal covers unless otherwise indicated.
2. Mounting Substrate: Provide frames and curbs suitable for mounting on standing seam metal roof panel system.
3. For Ladder Access: Single leaf; 30 by 36 inches (762 by 914 mm).
4. For Ships Ladder Access: Single leaf; 30 by 54 inches (762 by 1372 mm).
5. For Stair Access: Single leaf; 30 by 96 inches (762 by 2438 mm).

C. Flat Roof Access Hatches with Ladder: Factory-assembled roof hatch with PVC frame and flat cover and folding metal access ladder, complete with operating and release hardware.
1. Mounting Substrate: Provide frames and curbs suitable for mounting on flat roof deck sheathing with insulation.
2. Thermally Broken Hatches: Provide insulation within hatch frame and cover.
3. Folding Ladder Access: Triple section ladder, upper roof hatch door with PVC frame and lower insulated door with wood box to enclose and support ladder; 23-1/2 by 47 inches (597 by 1194 mm) rough opening.

D. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch (2.3 mm) thick.
2. Insulation: Manufacturer's standard; 1 inch (25 mm) rigid glass fiber, located on outside face of curb.
3. Curb Height: 12 inches (305 mm) from finished surface of roof, minimum.

E. Metal Covers: Flush, insulated, hollow metal construction.
1. Capable of supporting 40 psf (1.92 kPa) live load.
2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch (2.3 mm) thick, liner 0.04 inch (1.0 mm) thick.
3. Insulation: Manufacturer's standard 1 inch (25 mm) rigid glass fiber.
4. Gasket: Neoprene, continuous around cover perimeter.

2.04 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
1. Design Loadings and Configurations: As required by applicable codes.

2. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
4. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean installed work to like-new condition.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 9200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

B. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

G. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).

H. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

I. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Backing material recommended by sealant manufacturer.
   4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   5. Substrates the product should not be used on.

C. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

D. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

E. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

C. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

D. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
   4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   6. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
   7. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

E. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inches (457 mm) long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25.4 mm) by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.
   3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nonsag Sealants:
   1. Dow: www.dow.com/#sle.
   2. Pecora Corporation: www.pecora.com/#sle.
   3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   4. Sika Corporation: www.usa.sika.com/#sle.
   5. Tremco Commercial Sealants & Waterproofing; ____: www.tremcosealants.com/#sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

B. Self-Leveling Sealants:
   1. Dow: www.dow.com/#sle.

2. Pecora Corporation: www.pecora.com/#sle.
3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
4. Sika Corporation: www.usa.sika.com/#sle.
5. Tremco Commercial Sealants & Waterproofing; ____: www.tremcosealants.com/#sle.
6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints:
      a. Seal open joints except open joints indicated on drawings as not sealed.
   2. Interior Joints:
      a. Seal open joints except specific open joints indicated on drawings as not sealed.
   3. Do Not Seal:
      a. Intentional weep holes in masonry.
      b. Joints indicated to be covered with expansion joint cover assemblies.
      c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
      d. Joints where sealant installation is specified in other sections.
      e. Joints between suspended ceilings and walls.

B. Exterior Joints: Use nonsag nonstaining silicone sealant, unless otherwise indicated.
   1. Lap Joints between Manufactured Metal Panels: Butyl rubber, noncuring.
   2. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane traffic-grade sealant.

C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
   1. Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.
   2. Wall and Ceiling Joints in Wet Areas: Nonsag polyurethane sealant for continuous liquid immersion.
   3. Floor Joints in Wet Areas: Nonsag polyurethane non-traffic-grade sealant suitable for continuous liquid immersion.
   4. Joints between Tile in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
   5. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
   6. Other Floor Joints: Self-leveling polyurethane traffic-grade sealant.

D. Interior Wet Areas: Bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.04 NONSAG JOINT SEALANTS

A. Type ___ - Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus ____ percent, minimum.
   2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Color: Match adjacent finished surfaces.
   5. Products:
      a. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
      b. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): www.pecora.com/#sle.
      c. Sika Corporation; Sikasil 728NS: www.usa.sika.com/#sle.
      d. Tremco Commercial Sealants & Waterproofing; Tremsil 600: www.tremcosealants.com/#sle.

e. Substitutions: See Section 01 6000 - Product Requirements.

B. Type ___ - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
   1. Color: White.

C. Polymer Sealant: ASTM C920; single component, cured sealant is paintable and mold/mildew resistant, low odor and VOC, and ultraviolet (UV) resistant.
   1. Color: White.

D. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.

E. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multicomponent; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
   1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.

F. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
   1. Color: Standard colors matching finished surfaces, Type OP (opaque).

G. Type ___ - Noncuring Butyl Sealant: Solvent-based, single component, nonsag, nonskinning, nonhardening, nonbleeding; nonvapor permeable; intended for fully concealed applications.

2.05 SELF-LEVELING JOINT SEALANTS

A. Type ___ - Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Color: To be selected by Architect from manufacturer's standard range.

B. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
   1. Movement Capability: Plus and minus 25 percent, minimum.

C. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Composition: Multicomponent, 100 percent solids by weight.
   2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
   3. Joint Width, Minimum: 1/8 inch (3 mm).
   4. Joint Width, Maximum: 1/4 inch (6 mm).

2.06 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.

2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
3. Record each test on Preinstallation Adhesion Test Log as indicated.
4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

G. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

END OF SECTION

SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Fire-rated hollow metal doors and frames.

D. Thermally insulated hollow metal doors with frames.

E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

C. Section 09 9113 - Exterior Painting: Field painting.

D. Section 09 9123 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.

B. ASCE: American Society of Civil Engineers.

C. HMMA: Hollow Metal Manufacturers Association.

D. NFPA: National Fire Protection Association.

E. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2022.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

I. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

K. ITS (DIR) - Directory of Listed Products; Current Edition.

L. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

M. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

N. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.

O. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

R. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

S. UL (DIR) - Online Certifications Directory; Current Edition.

T. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: https://steeldoor.org/sdi-certified/#sle.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   3. Mesker, dormakaba Group; FDJ Series Drywall Frames: www.meskeropeningsgroup.com/#sle.
   4. Steelcraft, an Allegion brand; ____: www.allegion.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
   4. Door Edge Profile: Manufacturers standard for application indicated.
   5. Typical Door Face Sheets: Flush.
   6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
   7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
   8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 1 - Standard-duty.
   b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.
   e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
   a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
3. Door Thermal Resistance: R-Value of 8.7, minimum, for installed thickness of polyurethane.
4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

C. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 2 - Heavy-duty.
   b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

D. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 2 - Heavy-duty.
   b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
   a. Attach fire rating label to each fire rated unit.
4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Face welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

3. Weatherstripping: Separate, see Section 08 7100.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.
   2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

E. Door Frames, Fire-Rated: Slip-on type at gypsum board walls, and knock-down type at masonry walls.
   1. Fire Rating: Same as door, labeled.
   2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.
   3. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

A. Glazing: As specified in Section 08 8000, factory installed.

B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

C. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.
   1. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
   2. Astragal Type: Split, two parts, and with automatic locking, cutouts for other door hardware, and sealing gasket.
   3. Edge Type: Beveled edge
   4. Material: Aluminum.
   5. Metal Finish: Gray powder coating.
   6. Provide non-corroding fasteners at exterior locations.

D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Install door hardware as specified in Section 08 7100.

E. Comply with glazing installation requirements of Section 08 8000.

F. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.06 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 1416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.

B. Section 08 7100 - Door Hardware.

C. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

F. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

D. Samples: Submit two samples of door veneer, ___ by ___ inches (___ by ___ mm) in size illustrating wood grain, stain color, and sheen.

E. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.

1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Haley Brothers; ____: www.haleybros.com/#sle.
   2. Horton Automatics, a division of Overhead Door Corporation; FlexBarn: www.overheaddoor.com/#sle.
   3. Krieger Specialty Products; _____: www.kriegerproducts.com/#sle.
   4. Masonite Architectural; Aspiro Select Wood Veneer Doors: www.architectural.masonite.com/#sle.
   5. Oregon Door; _____: www.oregondoor.com/#sle.
   6. VT Industries, Inc; ____: www.vtindustries.com/#sle.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
   3. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft (0.01524 cu m/s/sq m) of door opening at 0.10 inch wg (24.9 Pa) pressure at both ambient and elevated temperatures for "S" label; if necessary, provide additional gasketing or edge sealing.
   4. Hardboard facing with factory opaque finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Hardboard Facing for Opaque Finish: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides) hardboard, 1/8 inch (3.2 mm) thick.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
   1. Exception: Doors to be field finished.

F. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

B. Factory finish doors in accordance with approved sample.

2.07 ACCESSORIES

A. Hollow Metal Door Frames: See Section 08 1113.

B. Glazing: See Section 08 8000.

C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

SECTION 08 3100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ceiling-mounted access units.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
   1. Material: Steel.
   2. Style: Exposed frame with door surface flush with frame surface.
   3. Door Style: Single thickness with rolled or turned in edges.
   4. Heavy-Duty Single Steel Sheet Door Panels: 14-gauge, 0.0747-inch (1.89 mm) minimum thickness.
   5. Steel Finish: Primed.
   6. Primed and Factory Finish: Polyester powder coat; color _____.
   7. Hardware:
      a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
      b. Latch/Lock: Screw driver slot for quarter turn cam latch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 3513.13
ACCORDION FOLDING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Four-Fold Doors

B. Operating hardware.

C. Folding Glass Storefront.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood supports and blocking for track support.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data for each type of product specified consisting of manufacturer's technical Product Data and installation instructions for each type of door required, including data substantiating that products comply with requirements.

C. Submittal Drawings showing fabrication and installation of Four-Fold metal doors including plans, elevations, sections, details of components, hardware, operating mechanism, and attachments to the other units of Work. Include wiring diagrams for coordination with electrical trade.

D. Product Data: Submit manufacturer's printed product literature for each Folding Glass Storefront system to be incorporated into the Work. Show performance test results and details of construction relative to materials, dimensions of individual components, profiles, and colors.

E. Product Drawings: Indicate Folding Glass Storefront system component sizes, dimensions and framing R.O., configuration, swing panels, direction of swing and stacking, typical head jamb, side jambs and sill details, type of glazing material, handle height.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store delivered materials and equipment in dry locations with adequate ventilation, free from dust and water, and so as to permit access for inspection and handling.

B. Handle materials carefully to prevent damage.

1.05 WARRANTY

A. The door manufacturer shall provide a written standard limited warranty for material and workmanship.

1.06 FIELD CONDITIONS

A. Field Measurements: Contractor to field verify dimensions of rough openings (R.O.) [and threshold depressions to receive sill.] Mark field measurements on product drawing submittal.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Doors shall be designed to withstand external or internal horizontal wind loads of 120mph (3 second gust) per ASCE 7-16. The maximum allowable deflection shall not exceed 1/120 of the span. Fiber stresses in main members shall be limited to 27,000 pounds per square inch. Steel frames shall be designed in accordance with the AISC "Steel Construction Manual".

D. Single Source Responsibility: Furnish Folding Glass Storefront system materials from one manufacturer for entire Project.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - Folding Glass Storefront: NANA WALL SYSTEMS, INC. (www.nanawall.com).
   1. NanaWall Generation 4 Folding Glass Walls

B. Basis of Design - Four-Fold industrial metal doors manufactured by Door Engineering and Manufacturing, 101 Power Dr, Mankato, MN 56001, (800)-959-1352.
   1. **FF300 Series: Glazed**

C. Manufacturers:
   1. Substitutions: Not permitted.

2.02 FOLDING GLASS STOREFRONT

A. Performance Criteria (Lab Tested):
   1. Air Infiltration (ASTM E283) - 0.27 cfm/ft2 (1.38 L/s/m2) at a static air pressure difference: of 1.57 psf (75 Pa).
   2. Water Penetration (ASTM E331, ASTM E547) - with weep holes by others: No uncontrolled water leakage at a static test pressure of 1.56 psf (75 Pa).
   3. Load Structure: At 1.5 times design wind pressure with no glass breakage or permanent damage to fasteners or storefront components.
   4. Design Pressure: Positive and Negative at 35 psf (1675 Pa)
   5. Forced Entry (AAMA 1303.5 and AAMA CAWM 300): Meets requirements.
   6. Swing Panel - Operation / Cycling Performance (AAMA 920): 500,000 cycles
   7. Acoustical Performance (DIN 52210-3,4): With 40 dB glass, unit STC (Rw) of 36
      a. System STC (Rw) 35 (35) and OITC 30 with 5/16-inch (8 mm) STC 37 laminated glass]
   8. Thermal Performance U-factor: NFRC 100 rated, certified, and labeled.
   9. Solar Heat Gain Coefficient (SHGC) + Visible Light Transmission (VT): NFRC 200 rated, certified, and labeled.

B. Design Criteria
   1. Sizes and Configurations: As indicated by the Drawings for selected number and size of panels, location of swing panels, location of track and stacking.
   2. Unit Operation: Sliding and folding hardware with top and bottom tracks.
   3. Panel Configuration:
      a. Straight
   4. Stack Storage Configuration:
      a. Inswing type.
   5. Mounting Type: Top-hung
   6. Panel type:Hinged.
      a. Primary swing panel of paired swing panels, looking from inside, to be on the left.
      b. Entry/Egress panel hinged to side jamb.

C. Materials
   1. Sliding-Folding Glass Storefront Description: Monumental top-hung system designed for straight runs, segmented angle changes, and center pivot. Manufacturer’s standard frame and panel profiles, with head and floor tracks, side jambs and panels with dimensions as shown on Drawings.
   2. Panels: Single Lite.
   3. Frame: Matching top track and side frame.
   4. Sill Type: Standard.
   5. Glazing: Safety Glazing: In compliance with ASTM C1036, ASTM C1048, ANSI Z97.1 and CPSC 16CFR 1201. Double insulated laminated units.
   6. Main Entry Panel(s) : Provide manufacturer’s Standard lever handles on the inside and outside and a lockset with a lockable latch and multi-point locking with a dead bolt and rods at the top and bottom on primary panel only.

7. Locking: standard cylinder.

D. Fabrication
   1. Extruded aluminum frame and panel profiles, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weather-stripping components needed to construct a folding glass wall.
   2. Each unit factory pre-assembled and shipped with all components and installation instructions.
   3. Exposed work to be carefully matched to produce continuity of line and design with all joints.
   4. No raw edges visible at joints.

2.03 FOUR-FOLD DOORS

A. Materials
   1. Steel Tube: ASTM A513 and ASTM A500/A500M
   2. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A1008 cold-rolled steel sheet.
   3. Hardware: Manufacturer's standard components.
   4. Fasteners: Zinc-coated steel.

B. Four-Fold Doors
   1. Construction: Door framing shall be minimum 11-gauge structural steel tube with 16-gauge steel sheet on the exterior and interior faces. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces. All frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening by more than 1/8 inch in 20 feet. Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.
   2. Surface Mounted Tube Frame: Supply pre-hung tube frame system constructed of minimum TS6x4x3/16", designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports and operator supports shall be factory attached.
   3. Factory finish: Door Panels and Tube Frames shall be finished with manufacturer's standard PPG Spectracron epoxy primer and polyurethane top coat. Customer to select from Manufacturer's standard color chart or furnish sample to match.
      a. Operator and operating hardware shall be powder-coated manufacturer's standard gray.
   4. Hardware: Hardware shall include guide tracks and brackets, trolleys, center guides, not less than three pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation.
      a. All hardware, including hinges and trolleys, shall be bolted to the panel for easy removal for service or panel replacement..
      b. Doors up to 16' wide and under 30psf windload shall require no floor mounted supports, guides or tracks.
      c. Top tracks shall be adjustable on the end track hangers to allow for adjustment of the door panels in the open position and easily replaceable without removal of the door framing or operators.
   5. Hinges: Jamb hinges shall be dual shear and have two thrust bearings and two needle bearings. Fold hinges shall be stainless steel and be dual shear with two thrust bearings. All bearings shall be completely concealed within the hinge barrel and include grease zerks. All hinge pins shall be minimum ¾" diameter hardened steel.
   6. Hinge Guards: Provide plastic guards at jamb hinges to prevent access through hinge space.
   7. Weatherstripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weatherstripping at center shall be 1/16" EPDM and include no exposed fasteners on the exterior side of the panel. Weatherstripping at sill shall include two 1/16" EPDM sweeps with an aluminum retainer. The retainer shall be attached to the door with adhesive.
   8. Perimeter Weatherstripping: Provide full perimeter jamb and head weatherstripping.

9. Vision Panels: Provide 1” insulated, tempered, vision panels of the size, shape and location as noted on the drawings.

C. Operator
   1. Each Four-Fold door shall be operated by an overhead mounted electro-mechanical drive unit designed for high cycle operation. Operator consists of an electric motor, gear reducer, and rotating drive arm. The door shall be operated with connecting rods attached to the rotating drive arm on the operator and to control arms attached to the jamb door section and to the door lintel. The connecting rods shall be positive drive, keeping the door under firm control at all times. The connecting rods shall be fitted with spherical bearings and control arms shall be equipped with oil impregnated bronze bearings on polished shafts.
   2. Operator shall be instantly reversible, open and close rapidly and start and stop gradually. Operator shall be adjustable to allow door to fully clear the opening. Operator shall automatically lock the door in the closed position. Operator shall be equipped with disengaging mechanism to convert to manual operation.
   3. Electric motor shall be of sufficient size to operate doors under normal operating conditions at no more than 75 percent of rated capacity. The motor shall be wound for three phase 208/230/480 VAC, 60 Hertz operation.
   4. Electric Controls: Controls shall be furnished by the door manufacturer and shall be complete for each door, and built in accordance with the latest NEMA standards.
      a. Control panel assemblies shall be UL listed as per NFPA70.
      b. Controls shall include a programmable logic controller with digital message display. Controller shall include programmable close timers and programmable inputs/outputs.
      c. Controls shall include a variable frequency drive with independent adjustment of the opening and closing speeds.
      d. Enclosures shall be NEMA 4 with disconnect switch.
      e. Pushbuttons (interior) for each door shall have one (1) momentary pressure three-button push-button station marked “OPEN”, “CLOSE” and “STOP”. Push button enclosure shall be NEMA 4.
      f. Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position.
      g. Safety edges: Provide monitored electric safety edges on leading edge of all doors to reverse door upon contact with obstruction.
      h. Photo eyes: Provide (1) exterior, jamb mounted, light Curtain type photo eyes, NEMA 4 rated. Photo eye shall cover from floor level to 72” above floor.
      i. Presence Sensor: Provide (1) interior, overhead mounted, presence sensor BEA IS40P or equal. Doors over 16’ tall shall include LZR-Widescan or equal.
      j. Radio controls: Provide one (1) radio receiver and (1) single button remotes per door. Remotes to open and close doors with single button.
      k. Wiring: Door manufacturer shall supply controls and components only. Electrical contractor shall install controls and furnish and install conduits and wiring for jobsite power and control wiring.
      l. Provide remote closure.

D. Track: Formed steel; 1-1/4 x 1-1/4 inches (32 x 32 mm) size; thickness and profile designed to support loads; steel sub-channel.

E. Carriers: Nylon wheels on trolley carrier at top center of every second fold, with threaded pendant bolt for vertical adjustment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that field measurements are as indicated.

C. Carefully examine rough openings with Installer present, for compliance with requirements affecting Work performance.

D. Verify the structural integrity of the header for deflection with live and dead loads limited to the lesser of L/720 of the span or 1/4 inch (6 mm). Provide structural support for lateral loads, and both wind load and eccentric load when the panels are stacked open.

3.02 INSTALLATION

A. Install door in accordance with manufacturer's instructions. Install in strict accordance with the approved drawings by qualified door erection crews. All door openings shall be completely prepared by the general contractor prior to the installation of the doors. Permanent or temporary electric wiring shall be brought to the door opening before installation is started and shall be completed so as not to delay the inspection test.

B. Doors shall be set plumb, level, and square, and with all parts properly fastened and mounted. All moving parts shall be tested and adjusted and left in good operating condition.

C. Lubricate moving components.

3.03 ADJUSTING

A.

B. Clean surfaces and repaint abraded or damaged finished surfaces to match factory-applied finish.

C. Visually inspect door in fully closed position for light leaks to identify a potential acoustical leak, and adjust to achieve light tight seal.

3.04 CLOSEOUT ACTIVITIES

A. Demonstrate operation of door and identify potential operational problems.

END OF SECTION

SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.

B. Section 08 8000 - Glazing: Glass and glazing accessories.

1.02 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

F. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

I. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

L. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

M. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

N. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

E. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefronts:
   1. Tubelite, Inc; TU24000 Series Storefront: www.tubeliteinc.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Center-Set Style, Thermally-Broken:
   1. Basis of Design: Tubelite Inc. TU24000 Series Storefront: 2” x 4-1/2” (dual thermal barrier).

2.03 BASIS OF DESIGN -- SWINGING DOORS

A. Narrow Stile, Insulating Glazing, Thermally-Broken:
   1. Basis of Design: Tubelite Inc. TU24000 Series Storefront: 2” x 4-1/2” (dual thermal barrier).
   2. Thickness: 1-3/4 inches (43 mm).

2.04 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
   2. Finish: Class I natural anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
   3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
a. Design Wind Loads: Comply with requirements of ASCE 7.
b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.
3. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.05 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Glazing Stops: Flush.
2. Cross-Section: As indicated on drawings.
3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: See Section 08 8000.

C. Swing Doors: Glazed aluminum.
1. Thickness: 1-3/4 inches (43 mm).
2. Top Rail: 4 inches (100 mm) wide.
3. Vertical Stiles: 4-1/2 inches (115 mm) wide.
4. Bottom Rail: 10 inches (254 mm) wide.
5. Glazing Stops: Square.
6. Finish: Same as storefront.

2.06 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

D. Fasteners: Stainless steel.

E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

F. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.07 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

B. Color: As indicated on drawings.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.08 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: See Section 08 7100.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

B. See Section 01 4000 - Quality Requirements for general testing and inspection requirements.

C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.

1. Perform a minimum of two tests in each designated area as indicated on drawings.
2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

D. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 4413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and infill panels.

1.02 RELATED REQUIREMENTS

A. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.

D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

K. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

L. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

M. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

N. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, _____, and infill.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

E. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.

F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with installer.

C. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

D. Extended Correction Period: Correct defective work within 5-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glazed Aluminum Curtain Walls Manufacturers:
   1. Tubelite, Inc; 400TU Series: www.tubeliteinc.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Outside glazed, with pressure plate and mullion cover, where indicated on drawings.
   2. Fabrication Method: Field fabricated stick system.
   3. Glazing Method: Field glazed system.
   4. Finish: Class I natural anodized.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   5. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the following:
      a. Positive Design Wind Load: ____ lbf/sq ft (___ Pa).
      b. Negative Design Wind Load: ____ lbf/sq ft (___ Pa).
      c. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
      d. Member Deflection: For spans less than 13 feet 6 inches (4115 mm), limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch (19 mm), whichever is less and with full recovery of glazing materials.
      e. Member Deflection: For spans over 13 feet 6 inches (4115 mm) and less than 40 feet (12.2 m), limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch (1/240 of span plus 6.4 mm), with full recovery of glazing materials.
   2. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
   3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F (82 degrees C) surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F (77 degrees C) over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 10 psf (480 Pa).
   2. Test Method: ASTM E331.

D. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.24 psf (300 Pa) pressure difference across assembly.

E. Thermal Performance Requirements:
   1. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

B. Glazing: See Section 08 8000.

C. Applied Muntins: Prefabricated simulated divided lite grid assembly with perimeter surround; designed to be adhered and fastened to curtain wall framing members and glazing.
   1. Material: Extruded aluminum.
   2. Profile: Manufacturer's standard, as detailed on drawings.
   3. Finish: Same as curtain wall.
   4. Mounting: Anchor pins at perimeter.
   5. Pin Hole Filler: Manufacturer's standard, matching color of muntin grid.

D. Beam Covers: Aluminum, 20-gauge, 0.032-inch (0.81 mm) minimum thickness, finish to match curtain wall framing members.

E. Applied Battens:
   1. Applications: Attachment to curtainwall mullions.
   2. Type: Aluminum extrusions co-extruded with wood composite finish.

3. Profile: As indicated on drawings.
4. Attachment: Manufacturer's standard clips and fasteners.
5. Battens: Manufacturer's standard.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Structural Steel Sections: ASTM A36/A36M; shop primed.

D. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.

E. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

F. Exposed Flashings: Aluminum sheet, 20-gauge, 0.032-inch (0.81 mm) minimum thickness; finish to match framing members.

G. Concealed Flashings: Sheet aluminum, 26-gauge, 0.017-inch (0.43 mm) minimum thickness.

H. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.

I. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material.

J. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

K. Glazing Accessories: See Section 08 8000.

2.05 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Install applied muntin grid assembly in accordance with manufacturer's instructions.

H. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm/m) noncumulative or 0.5 inches per 100 feet (12 mm/30 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 1/4 inch (6 mm).

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for general testing and inspection requirements.

B. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as directed by Architect.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

C. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

D. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 5113
ALUMINUM WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extruded aluminum windows with fixed sash.

B. Factory glazing.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Rough opening framing.

B. Section 07 2500 - Weather Barriers: Sealing frame to water-resistive barrier installed on adjacent construction.

C. Section 07 9200 - Joint Sealants: Sealing joints between window frames and adjacent construction.

D. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022.

B. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

C. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products; 2021.

D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

I. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

K. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

L. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

M. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, anchorage locations, _____, and installation requirements.

C. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
   1. Evidence of AAMA Certification.

2. Evidence of WDMA Certification.
3. Evidence of CSA Certification.
4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

D. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

E. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of AAMA CW-10.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).

B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Tubelite Inc. UniVent 1375AW Series Window.

B. Other Acceptable - Aluminum Windows Manufacturers:
1. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ALUMINUM WINDOWS

A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
1. Frame Depth: 3-1/2 inch (89 mm).
2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
3. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
4. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
6. Thermal Movement: Design to accommodate thermal movement caused by 180 degrees F (82.2 degrees C) surface temperature without buckling stress on glass, joint seal failure, damaging loads on structural elements, damaging loads on fasteners, reduction in

performance or other detrimental effects.

B. Fixed, Non-Operable Type:
   1. Construction: Thermally broken.
   2. Glazing: Single; clear; transparent.
   3. Exterior Finish: Class I natural anodized.
   4. Interior Finish: Class I natural anodized.

2.03 PERFORMANCE REQUIREMENTS

A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:
   1. Performance Class (PC): R.

B. Design Pressure (DP): In accordance with applicable codes.

C. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 12.11 psf (580 Pa).

D. Air Leakage: 0.1 cfm/sq ft (0.5 L/sec sq m) maximum leakage per unit area of outside window frame dimension when tested at 1.57 psf (75 Pa) pressure difference in accordance with ASTM E283/E283M.

E. Condensation Resistance Factor of Frame: 50, measured in accordance with AAMA 1503.

F. Overall Thermal Transmittance (U-value): 0.35, maximum, including glazing, measured on window sizes required for this project.

2.04 COMPONENTS

A. Frames: ____ inch (____ mm) wide by ____ inch (____ mm) deep profile, of ____ inch (____ mm) thick section; thermally broken with interior portion of frame insulated from exterior portion; flush glass stops of snap-on type.

B. Glazing: See Section 08 8000.

C. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.05 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

2.06 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41, clear anodic coating not less than 0.7 mil (0.018 mm) thick.

B. Finish Color: As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings and adjoining water-resistive barrier materials are ready to receive aluminum windows; see Section 07 2500.

3.02 PRIME WINDOW INSTALLATION

A. Install windows in accordance with manufacturer's instructions.

B. Install window assembly in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.

C. Install windows in accordance with ASTM E2112.

D. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

E. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

F. Install sill and sill end angles.

G. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

H. Install glass and infill panels in accordance with requirements; see Section 08 8000.

3.03 TOLERANCES

A. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft (1.5 mm/m) non-cumulative or 1/8 inches per 10 ft (3 mm/3 m), whichever is less.

3.04 FIELD QUALITY CONTROL

A. Provide services of aluminum window manufacturer's field representative to observe for proper installation of system and submit report.

B. See Section 01 4000 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

C. Provide field testing of installed aluminum windows by independent laboratory in accordance with AAMA 502 and AAMA/WDMA/CSA 101/I.S.2/A440 during construction process and before installation of interior finishes.
   1. Field test for water penetration in accordance with ASTM E1105 using Procedure B - cyclic static air pressure difference; test pressure shall not be less than 1.9 psf (91 Pa).
   2. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf (75 Pa).

D. Repair or replace fenestration components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust hardware for smooth operation and secure weathertight closure.

3.06 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.

B. Remove protective material from factory finished aluminum surfaces.

C. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.

D. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

E. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.
h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

D. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware

(including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
1. Five years for standard duty cylindrical (bored) locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual surface door closer bodies.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Acceptable Manufacturers:

a. Hager Companies.
b. McKinney Products; ASSA ABLOY Architectural Door Accessories.
c. Stanley.

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Acceptable Manufacturers:

a. Hager Companies.
b. Select Companies.

2.3 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.

3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Acceptable Manufacturers:

    a. Door Controls International.
    b. Rockwood Products; ASSA ABLOY Architectural Door Accessories.
    c. Trimco.

B. Coordinators: ANSI/BHMA A156.3 certified door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.

1. Acceptable Manufacturers:

    a. Rockwood Products; ASSA ABLOY Architectural Door Accessories.
    b. Trimco.

C. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Acceptable Manufacturers:

    a. Rockwood Products; ASSA ABLOY Architectural Door Accessories.
    b. Trimco.

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.

2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new master key system as directed by the Owner.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

F. Construction Cores: Provide construction cores for use during construction period.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

H. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Acceptable Manufacturers:

a. Lund Equipment.

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Bored Locks to be ANSI/BHMA A156.2, Series 4000, Grade 1 (except where mortise locks are shown in sets).

1. Locks are to be non-handed and fully field reversible.

2. Acceptable Manufacturers:

a. Schlage, ND series.
b. No alternate manufacturers are permitted without architect’s written approval prior to bidding.

2.6 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.7 ELECTRIC STRIKES

A. Standard Electric Strikes: Heavy duty, cylindrical and mortise lock electric strikes conforming to ANSI/BHMA A156.31, Grade 1, UL listed for both Burglary Resistance and for use on fire rated door assemblies. Stainless steel construction with dual interlocking plunger design tested to exceed 3000 lbs. of static strength and 350 ft-lbs. of dynamic strength. Strikes tested for a minimum 1 million operating cycles. Provide strikes with 12 or 24 VDC capability and supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Acceptable Manufacturers:

a. HES.
b. Von Duprin.

2.8 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the

proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.

9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

10. Rail Sizing: Provide exit device rails factory sized for proper door width application.

11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Acceptable Manufacturers:

    a. Von Duprin.
    b. No alternate manufacturers permitted without architects written approval prior to bidding.

2.9 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Acceptable Manufacturers:

a. LCN.
b. No alternate manufacturers permitted without architects written approval prior to bidding.

2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:

a. Hiawatha, Inc..
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories.
c. Trimco.

2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Acceptable Manufacturers:

1. National Guard Products.
2. Pemko Products; ASSA ABLOY Architectural Door Accessories.
3. Reese Enterprises, Inc.

2.12 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

SET 01

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	PRIVACY LOCK	L9040 x L283-722 x L583-363	626	SCHLAGE
1	EA	CLOSER	4040XP CUSH	689	LCN
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD
1	SET	SEALS	S88	BLK	PEMKO

SET 02

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	CLASSROOM LOCK	ND70R	626	SCHLAGE
1	EA	CLOSER W/H.O.	4040XP H x ST1630 x 18TJ	689	LCN
1	EA	OVERHEAD STOP	100 SERIES	630	GLYNN JOHNSON
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD

SET 03

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	CLASSROOM LOCK	ND70R	626	SCHLAGE
1	EA	OVERHEAD STOP	100 SERIES	630	GLYNN JOHNSON

SET 04

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	STOREROOM LOCK	ND80R	626	SCHLAGE
1	EA	CLOSER	4040XP	689	LCN
1	EA	WALL STOP	409	630	ROCKWOOD
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD

SET 05

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	OFFICE LOCK	ND53R	626	SCHLAGE
1	EA	WALL STOP	409	630	ROCKWOOD

SET 06

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	PRIVACY LOCK	L9040 x L283-722 x L583-363	626	SCHLAGE
1	EA	CLOSER	4040XP	689	LCN
1	EA	WALL STOP	409	630	ROCKWOOD
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD
1	SET	SEALS	S88	BLK	PEMKO

SET 07

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	RIM EXIT DEVICE	99 L-BE	626	VON DUPRIN
1	EA	CLOSER	4040XP CUSH	689	LCN
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD
1	EA	WEATHERSTRIP	160SA	AL	NGP
1	EA	SWEEP	200NA	AL	NGP
1	EA	THRESHOLD	8425	MIL	NGP

SET 08

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	CLASSROOM LOCK	ND70R	626	SCHLAGE
1	EA	WALL STOP	409	630	ROCKWOOD

SET 09

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	CLASSROOM LOCK	ND70R	626	SCHLAGE
1	EA	FLUSH BOLT	555	626	ROCKWOOD
2	EA	WALL STOP	409	630	ROCKWOOD

SET 10

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	PASSAGE LATCH	ND10	626	SCHLAGE
1	EA	CLOSER	4040XP	689	LCN
1	EA	WALL STOP	409	630	ROCKWOOD
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD

SET 11

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	PASSAGE LATCH	ND10	626	SCHLAGE
1	EA	CLOSER	4040XP	689	LCN
1	EA	WALL STOP	409	630	ROCKWOOD
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD
1	SET	SEALS	S88	BLK	PEMKO
1	EA	SWEEP	200NA	AL	NGP
1	EA	THRESHOLD	8425	MIL	NGP

SET 12

1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAGER
1	EA	RIM EXIT DEVICE	99 L-NL	626	VON DUPRIN
1	EA	CYLINDER	AS REQUIRED	626	SCHLAGE
1	EA	CLOSER	4040XP SCUSH	689	LCN
1	EA	WEATHERSTRIP	160SA	AL	NGP
1	EA	SWEEP	200NA	AL	NGP
1	EA	THRESHOLD	8425	MIL	NGP
1	EA	DOOR POS. SWITCH	BY SECURITY CONTRACTOR		

SET 13

1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAGER
1	EA	STOREROOM LOCK	ND80R	626	SCHLAGE
1	EA	CLOSER W/H.O.	4040XP HEDA	689	LCN
1	EA	OVERHEAD STOP	100 SERIES	630	GLYNN JOHNSON
1	EA	WEATHERSTRIP	160SA	AL	NGP
1	EA	SWEEP	200NA	AL	NGP
1	EA	THRESHOLD	8425	MIL	NGP
1	EA	DOOR POS. SWITCH	BY SECURITY CONTRACTOR		

SET 14

2	EA	CONTINUOUS HINGE	780-224HD	CLR	HAGER
1	EA	STOREROOM LOCK	ND80R	626	SCHLAGE
2	EA	FLUSH BOLT	555	626	ROCKWOOD
1	EA	CLOSER W/H.O.	4040XP HEDA	689	LCN
2	EA	OVERHEAD STOP	100 SERIES	630	GLYNN JOHNSON
1	EA	WEATHERSTRIP	160SA	AL	NGP
1	EA	ASTRAGAL	139SP	USP	NGP
2	EA	SWEEP	200NA	AL	NGP
1	EA	THRESHOLD	8425	MIL	NGP
2	EA	DOOR POS. SWITCH	BY SECURITY CONTRACTOR		

SET 15

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	STOREROOM LOCK	ND80R	626	SCHLAGE
1	EA	CLOSER	4040XP	689	LCN
1	EA	WALL STOP	409	630	ROCKWOOD
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD
1	SET	SEALS	S88	BLK	PEMKO
1	EA	AUTO DOOR BOTTOM	683	AL	NGP

SET 16

	EA	HINGES	AS SPECIFIED	630	HAGER
1	EA	PRIVACY LOCK	L9040 x L283-722 x L583-363	626	SCHLAGE
1	EA	CLOSER	4040XP	689	LCN
1	EA	WALL STOP	409	630	ROCKWOOD
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD
1	SET	SEALS	S88	BLK	PEMKO

SET 17

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	PRIVACY LOCK	L9040 x L283-722 x L583-363	626	SCHLAGE
1	EA	CLOSER	4040XP CUSH	689	LCN
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD
1	SET	SEALS	S88	BLK	PEMKO
1	EA	AUTO DOOR BOTTOM	683	AL	NGP

SET 18

	EA	HINGES	AS SPECIFIED	652	HAGER
1	EA	STOREROOM LOCK	ND80R	626	SCHLAGE
1	EA	ELECTRIC STRIKE	1500C	630	HES
1	EA	CLOSER	4040XP x ST-1630 x 18TJ	689	LCN
1	EA	OVERHEAD STOP	100 SERIES	630	GLYNN JOHNSON
1	EA	KICK PLATE	10” x 2” LDW	630	ROCKWOOD
1	EA	DOOR POS. SWITCH	BY SECURITY CONTRACTOR		
1	EA	CARD READER	BY SECURITY CONTRACTOR		

* OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL ALLOWS ENTRY. DOOR REMAINS LOCKED UPON LOSS OF POWER. INSIDE LEVER ALWAYS FREE FOR EGRESS.

SET AL1

1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAGER
1	EA	RIM EXIT DEVICE	33A-NL-OP	626	VON DUPRIN
1	EA	CYLINDER	AS REQUIRED	626	SCHLAGE
1	EA	OFFSET PULL	BF158	630	ROCKWOOD
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	CLOSER	4040XP EDA x 18 x 61	689	LCN
1	EA	OVERHEAD STOP	100 SERIES	630	GLYNN JOHNSON
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	8425	MIL	NGP
1	EA	DOOR POS. SWITCH	BY SECURITY CONTRACTOR		
1	EA	CARD READER	BY SECURITY CONTRACTOR		

* SEALS BY DOOR SUPPLIER.

* OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL ALLOWS ENTRY. DOOR REMAINS LOCKED UPON LOSS OF POWER. INSIDE PUSH PAD ALWAYS FREE FOR EGRESS.

SET AL2

1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAGER
1	EA	PUSH / PULL UNIT	BF15847	630	ROCKWOOD
1	EA	CLOSER	4040XP EDA x 18 x 61	689	LCN
1	EA	OVERHEAD STOP	100 SERIES	630	GLYNN JOHNSON

SET AL3

1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAGER
1	EA	RIM EXIT DEVICE	33A-NL-OP	626	VON DUPRIN
1	EA	CYLINDER	AS REQUIRED	626	SCHLAGE
1	EA	OFFSET PULL	BF158	630	ROCKWOOD
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	CLOSER	4040XP EDA x 18 x 61	689	LCN
1	EA	WALL STOP	409	630	ROCKWOOD
1	EA	DOOR POS. SWITCH	BY SECURITY CONTRACTOR		
1	EA	CARD READER	BY SECURITY CONTRACTOR		

* OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL ALLOWS ENTRY. DOOR REMAINS LOCKED UPON LOSS OF POWER. INSIDE PUSH PAD ALWAYS FREE FOR EGRESS.

SET AL4

1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAGER
1	EA	STOREROOM LOCK	ND80R	626	SCHLAGE
1	EA	ELECTRIC STRIKE	6211AL	630	VON DUPRIN
1	EA	CLOSER	4040XP	689	LCN
1	EA	WALL STOP	409	630	ROCKWOOD
1	EA	DOOR POS. SWITCH	BY SECURITY CONTRACTOR		
1	EA	CARD READER	BY SECURITY CONTRACTOR		

* OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL ALLOWS ENTRY. DOOR REMAINS LOCKED UPON LOSS OF POWER. INSIDE LEVER ALWAYS FREE FOR EGRESS.

SET AL5

1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAGER
1	EA	RIM EXIT DEVICE	33A-L-BE	626	VON DUPRIN
1	EA	CLOSER	4040XP EDA x 18 x 61	689	LCN
1	EA	WALL STOP	409	630	ROCKWOOD
1	EA	SWEEP	200NA	AL	NGP
1	EA	THRESHOLD	8425	MIL	NGP

* SEALS BY DOOR SUPPLIER.

SET AL6

1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAGER
1	EA	PUSH / PULL UNIT	BF15847	630	ROCKWOOD
1	EA	DEADBOLT	MS1850S	628	ADAMS RITE
1	EA	CYLINDER	AS REQUIRED	626	SCHLAGE
1	EA	THUMBTURN CYL.	09-904 x XB11-720	626	SCHLAGE
1	EA	CLOSER	4040XP EDA x 18 x 61	689	LCN
1	EA	OVERHEAD STOP	100 SERIES	630	GLYNN JOHNSON
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	8425	MIL	NGP
1	EA	DOOR POS. SWITCH	BY SECURITY CONTRACTOR		

* SEALS BY DOOR SUPPLIER.

END OF SECTION 087100

SECTION 08 8000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Plastic films.

D. Glazing compounds.

1.02 RELATED REQUIREMENTS

A. Section 07 2500 - Weather Barriers.

B. Section 07 9200 - Joint Sealants: Sealants for other than glazing purposes.

C. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

D. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.

E. Section 08 4313 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

F. Section 08 4413 - Glazed Aluminum Curtain Walls: Glazing provided as part of wall assembly.

G. Section 08 5113 - Aluminum Windows: Glazing provided by window manufacturer.

H. Section 08 8300 - Mirrors.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

F. ASTM C1036 - Standard Specification for Flat Glass; 2021.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.

I. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

J. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

M. GANA (SM) - GANA Sealant Manual; 2008.

N. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

O. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

P. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

C. Samples: Submit two samples () in size of glass units.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.06 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
   1. Pilkington North America Inc: www.pilkington.com/na/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Laminated Glass Manufacturers:
   1. Viracon, Architectural Glass segment of Apogee Enterprises, Inc; 1-5/16" (31.96mm) Laminated Insulating (Coating #4) Clear / VE1-2M: www.viracon.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

C. Plastic Films Manufacturers:
   1. 3M Window Film: solutions.3m.com/wps/portal/3M/en_US/Window_Film/Solutions/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.

4. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. In conjunction with weather barrier related materials described in other sections, as follows:
      a. Water-Resistive Barriers: See Section 07 2500.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   5. Wired Glass Type: ASTM C1036, Type II - Wired Flat Glass, Quality - Q6, with color and performance characteristics as indicated.
   6. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.04 INSULATING GLASS UNITS

A. Manufacturers:
   1. Viracon, Apogee Enterprises, Inc; 1-5/16" (31.96MM) LAMINATED INSULATING (COATING #4) CLEAR / VE1-2M: www.viracon.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Warm-Edge Spacers: Low-conductivity thermoplastic with desiccant warm-edge technology design.
      a. Spacer Width: As required for specified insulating glass unit.
      b. Spacer Height: Manufacturer's standard.
   4. Spacer Color: Black.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
      b. Color: Black.
   6. Purge interpane space with dry air, hermetically sealed.
   7. Capillary Tubes: Provide tubes from air space for insulating glass units without inert type gas that have a change of altitude greater than 2500 feet (762 m) between point of fabrication and point of installation to permit pressure equalization of air space.

a. Capillary Tubes: Tubes to remain open and be of length and material type in accordance with insulating glass fabricator's requirements.

C. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with argon.
3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
a. Tint: Clear.
b. Coating: Self-cleaning type, on #1 surface.
c. Coating: Low-E (solar control type), on #2 surface.
4. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
a. Tint: Clear.
5. Total Thickness: 1-5/16 inch (31.69 mm).
6. Thermal Transmittance (U-Value), Summer - Center of Glass: .21, nominal.
7. Visible Light Transmittance (VLT): 68 percent, nominal.
8. Shading Coefficient: 0.41, nominal.
9. Solar Heat Gain Coefficient (SHGC): 0.35, nominal.
10. Visible Light Reflectance, Outside: 10 percent, nominal.
11. Glazing Method: Dry glazing method, gasket glazing.

2.05 PLASTIC FILMS

A. Type F-2 - Safety and Security Plastic Film: Polyester type.
1. Application: Locations as indicated on drawings.
2. Color: Clear.
3. Thickness Without Liner: 0.002 inch (0.051 mm).
4. Visible Light Transmittance (VLT): 85 percent, nominal.
5. Solar Light Transmittance: 78 percent, nominal.
6. Shading Coefficient: 0.94, nominal.
7. Manufacturers:
a. 3M Fasara.
b. Substitutions: See Section 01 6000 - Product Requirements.

2.06 GLAZING COMPOUNDS

A. Type GC-1 - Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; gray color.

B. Type GC-2 - Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

C. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; _____ color.

2.07 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

2.08 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide shop inspection and testing for Type _____ glass.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

END OF SECTION

SECTION 08 8300
MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.
   1. Annealed float glass.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

B. ASTM C1036 - Standard Specification for Flat Glass; 2021.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

1.04 QUALITY ASSURANCE

A. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.05 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass; Type ____: Clear, annealed float glass; ASTM C1036, with copper and silver coatings, and protective overcoating.
   1. Thickness: 1/4 inch (6.4 mm).
   2. Edges: Arrised.
   3. Size: As indicated on drawings.

2.02 GLAZING COMPOUNDS

A. Silicone Sealant; Type ____: ASTM C920, Type S, Grade NS, Class 25, Uses M and A; single component; chemical or solvent curing; non-bleeding, non-staining, cured Shore A hardness of 15 to 25; _____ color.

2.03 ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.

B. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.

C. Mirror Attachment Accessories: Stainless steel clips.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.

B. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install mirrors in accordance with manufacturer's recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

D. Installation in Frames:
   1. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
   2. Place setting blocks at one-quarter points with edge block no more than 6 inches (152 mm) from corners.
   3. Rest mirrors on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
   4. Place glazing tape on free perimeter of mirrors in same manner described above.
   5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

3.04 CLEANING

A. Remove wet glazing materials from finish surfaces.

B. Remove labels after work is complete.

C. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum sheathing.

F. Cementitious backing board.

G. Gypsum wallboard.

H. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Structural steel stud framing.

B. Section 07 2100 - Thermal Insulation: Acoustic insulation.

C. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.

D. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.

C. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

D. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

E. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.

F. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.

G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.

I. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

J. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

K. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

L. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

M. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.

N. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

O. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

P. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

Q. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018.

R. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022.

S. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

T. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

U. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

V. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

W. ASTM E413 - Classification for Rating Sound Insulation; 2022.

X. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

Y. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

C. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

E. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:
   1. ICC-ES Evaluation Report No. _____.

2.02 METAL FRAMING MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
   1. Structural Grade: As required to meet design criteria.
   2. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
   5. Furring Members: Zee-shaped sections, minimum depth of 1 inch (25 mm).

D. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
   3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
   4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
   5. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet (3660 mm).

F. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
      a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
      b. Height: 35-3/4 inches (908 mm).
   3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
   4. Flexible Wood Backing: Fire-retardant-treated wood with sheet steel connectors.
   5. Drywall Corner Clips: Drywall clips help support drywall to reduce wood blocking on top plates, end walls, and corners.
   6. Steel Column and Beam Drywall Clip: UL-listed slip-on clips to connect gypsum board to steel beams and columns for fireproofing.

G. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company; ____: www.americangypsum.com/#sle.
   2. CertainTeed Corporation; ____: www.certainteed.com/#sle.
   3. Georgia-Pacific Gypsum; ____: www.gpgypsum.com/#sle.
   4. Gold Bond Building Products, LLC provided by National Gypsum Company; ____: www.goldbondbuilding.com/#sle.
   5. USG Corporation; ____: www.usg.com/#sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Thickness:
      a. Vertical Surfaces: 5/8 inch (16 mm).
      b. Ceilings: 5/8 inch (16 mm).
      c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

C. Backing Board For Wet Areas: One of the following products:
   1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
   2. Application: Horizontal surfaces behind tile in wet areas including countertops and floors.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   4. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
      a. Thickness: 5/8 inch (16 mm).

D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings, unless otherwise indicated.
   2. Thickness: 1/2 inch (13 mm).
   3. Edges: Tapered.

E. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
   4. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
   5. Core Type: Regular.
   6. Regular Board Thickness: 5/8 inch (16 mm).
   7. Edges: Square.

F. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
   2. Types: Regular, in locations indicated.
   3. Regular Type Thickness: 1/2 inch (13 mm).
   4. Edges: Tapered.

G. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by 24 inches (600 mm) wide, beveled long edges, ends square cut.

1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.

2.04 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: See Section 07 2100.

B. Acoustical Shielding: Recycled ethylene vinyl acetate (EVA) sheet membrane; applied between studs and gypsum board.
   1. Sound Transmission Class (STC): Minimum of 25, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
   2. Fire Resistance: Where fire-resistance rating is specified for the wall in which the acoustical shielding membrane is mounted, provide assemblies that have been tested in accordance with ASTM E119 for the same rating as the wall.

C. Water-Resistive Barrier: See Section 07 2500.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Joint Compound: Setting type, field-mixed.

E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
   1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches (600 mm) on center.
   2. Install studs at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

C. Studs: Space studs at 16 inches on center (at 406 mm on center).
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

C. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
   1. Seal joints, cut edges, and holes with water-resistant sealant.
   2. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

D. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
   1. Seal joints, cut edges, and holes with water-resistant sealant.

E. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
   2. At exterior soffits, not more than 30 feet (10 meters) apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

3.07 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
   2. Taping, filling, and sanding are not required at base layer of double-layer applications.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.09 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean _____.

3.10 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

SECTION 09 3000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Tile for shower receptors.

D. Cementitious backer board as tile substrate.

E. Stone thresholds.

F. Ceramic trim.

1.02 RELATED REQUIREMENTS

A. Section 07 1400 - Fluid-Applied Waterproofing.

1.03 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017 (Reaffirmed 2022).

B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 2017.

C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2021).

D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.

E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2019.

F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 2021.

G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 1999 (Reaffirmed 2019).

H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2019).

I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2019).

J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).

K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.

L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2019).

M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).

N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.

O. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.

P. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.

Q. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.

R. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2014 (Reaffirmed 2019).

S. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).

T. ANSI A136.1 - American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile; 2020.

U. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

V. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).

W. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Installer's Qualification Statement:

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Installer Qualifications: Natural Stone Institute (NSI) Accredited Commercial B Contractor (light commercial): www.naturalstoneinstitute.org/#sle.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

A. Glazed Wall Tile: ANSI A137.1 standard grade.
   1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
   2. Size: As indicated on the drawiongs.
   3. Edges: Cushioned.
   4. Surface Finish: High gloss.
   5. Color(s): As indicated on drawings.
   6. Trim Units: Matching bead, bullnose, cove, and base shapes in sizes coordinated with field tile.

B. Porcelain Tile: ANSI A137.1 standard grade.
   1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
   2. Size: As indicated on the drawings.
   3. Thickness: 3/8 inch (9.5 mm).
   4. Edges: Interlocking shape.

5. Surface Finish: Unglazed.
6. Color(s): As indicated on drawings.
7. Trim Units: Matching bullnose, cove base, and cove shapes in sizes coordinated with field tile.

2.02 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
   1. Manufacturers: Same as for tile.

B. Thresholds: 2 inches (51 mm) wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
   1. Thickness: 1/2 inch (12.7 mm).
   2. Material: Marble, honed finish.
   3. Applications:
      a. At doorways where tile terminates.
      b. At open edges of floor tile where adjacent finish is a different height.

2.03 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Organic Adhesive: ANSI A136.1, thinset mastic type.
   1. Use Type I in areas subject to prolonged moisture exposure.

2.04 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
   1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
   2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
   3. Color(s): As selected by Architect from manufacturer's full line.

2.05 MAINTENANCE MATERIALS

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
   1. Applications: Between tile and plumbing fixtures.
   2. Color(s): As selected by Architect from manufacturer's full line.

B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
   1. Composition: Water-based colorless silicone.

2.06 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
   1. Crack Resistance: No failure at 1/8 inch (3.2 mm) gap, minimum.
   2. Fluid or Trowel Applied Type:
      a. Material: Synthetic rubber or Acrylic.
      b. Thickness: 20 mils (0.5 mm), maximum.

B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
   1. Crack Resistance: No failure at 1/16 inch (1.6 mm) gap, minimum; comply with ANSI A118.12.
   2. Fluid or Trowel Applied Type:
      a. Material: Synthetic rubber or Acrylic.
      b. Thickness: 25 mils (0.6 mm), minimum, dry film thickness.
      c. Products:

1) ARDEX Engineered Cements; ARDEX 8+9: www.ardexamericas.com/#sle.
2) Substitutions: See Section 01 6000 - Product Requirements.

C. Waterproofing Membrane at Showers and Tiled Tubs: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
1. Fluid or Trowel Applied Type:
a. Material: Synthetic rubber.
b. Material: Acrylic.
c. Thickness: 25 mils (0.6 mm), minimum, dry film thickness.
d. Products:
1) USG Corporation; Durock Brand Liquid Waterproofing Membrane: www.usg.com/#sle.
2) Sika Corp; SikaTile 100 Moisture Guard: www.sika.com/#sle.
3) Substitutions: See Section 01 6000 - Product Requirements.

D. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch (11 mm) thick; 2 inch (51 mm) wide coated glass fiber tape for joints and corners.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install thresholds where indicated.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control and expansion joints free of mortar, grout, and adhesive.

I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - FLOATING

A. Install in accordance with manufacturer's instructions.

B. Grout with standard grout as specified above.

3.05 INSTALLATION - SHOWERS AND BATHTUB WALLS

A. At tiled shower receptors install in accordance with TCNA (HB) Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.

B. At bathtub walls install in accordance with TCNA (HB) Method B412, over cementitious backer units with waterproofing membrane.

C. Grout with latex-Portland cement grout.

3.06 INSTALLATION - WALL TILE

A. On exterior walls install in accordance with TCNA (HB) Method W244, thin-set over cementitious backer units, with waterproofing membrane.

B. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms, kitchens, and locker rooms.

3.07 CLEANING

A. Clean tile and grout surfaces.

3.08 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

D. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning.

C. Product Data: Provide data on suspension system components and acoustical units.

1.04 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.05 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc; ____: www.armstrongceilings.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Suspension Systems:
   1. Same as for acoustical units.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. VOC Content: Certified as Low Emission by one of the following:
      a. Product listing in UL (GGG).

B. Acoustical Tiles: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type III.
   2. Size: 24 by 24 inches (610 by 610 mm).
   3. Thickness: 3/4 inch (19 mm).
   4. Tile Edge: Beveled.
      a. Joint: Kerfed and rabbeted.
   5. Color: White.
   6. Suspension System: Exposed grid.
   7. Suspension System: Concealed.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   1. Materials:
      a. Aluminum Grid: Aluminum sheet, ASTM B209/B209M.

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.

C. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

F. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

G. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean surfaces.

C. Replace damaged or abraded components.

END OF SECTION

SECTION 09 5426
SUSPENDED WOOD CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Linear wood planks.

B. Wood grilles.

C. Metal suspension system.

1.02 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

D. CISCA (WC) - Wood Ceilings Technical Guidelines; 2009.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure ceilings are not installed until building is enclosed, dust generating activities have terminated, and overhead work is completed.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning, attachment of wood ceiling components to grid, accessory attachments, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

C. Product Data: Provide data on wood ceiling components and suspension system components.

D. Samples: Submit two full size samples illustrating material and finish of wood ceiling components.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Designer Qualifications for Seismic Design: Perform design under direct supervision of Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least three years documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood ceiling components to project site in original, unopened packages.

B. Store in fully enclosed space, flat, level and off the floor.

1.07 FIELD CONDITIONS

A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.

B. Maintain room temperature between 60 degrees F (16 degrees C) and 75 degrees F (24 degrees C) and relative humidity between 35 to 55 percent before, during, and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Suspended Wood Ceilings:
   1. 9Wood: www.9wood.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SUSPENDED WOOD CEILING SYSTEM

A. Performance Requirements:
   1. Design for maximum deflection of 1/360 of span.

B. Wood-Based Materials:
   1. Certified as sustainably harvested as specified in Section 01 6000.
   2. Solid Wood: Clear, dry, sound, plain sawn, selected for compatible species, grain and color, no defects.
   3. Composite Wood Panels: Containing no urea-formaldehyde resin binders.

C. Linear Wood Planks: Composite wood core with wood veneer finish.
   1. Type: Pre-assembled module of linear planks with battens attached perpendicularly to back of planks.
   2. Basis of Design: 9Wood 2100 Series Linear Wood, Tel. (888) 767-9990, sales@9wood.com
      a. Member Size: See drawings for size requirements.
      b. Species: Western Hemlock (Solid, Clear, Mixed Grain)
      c. Finish: Ex. Clear Finish
      d. Panel Sizes: Ex. 4’ to 12’ (nominal)
      e. Fire Rating: Class A Components
      f. Reveal Scrim: Black
   3. Products:
      a. 9Wood; Linear Wood Ceilings 2000 Series: www.9wood.com/ceilings/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

D. Wood Grilles: Pre-assembled module of solid wood grilles with battens.
   1. Module Size: 24 by 48 inches (610 by 1219 mm), nominal.
   2. Acoustical Backer: Fiberglass, 1 inch (25 mm) thick.
      a. Color: Black.
   3. Veneer Species: Red oak.
      a. Veneer Cut: Plain sliced.
      b. Veneer Matching: Random matched.
      c. End Matching: Manufacturer's recommended matching.
      d. Factory Finish: Clear sealer.
   4. Products:
      a. 9Wood; Wood Ceiling Grilles 1000 Series: www.9wood.com/products/grilles/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

E. Metal Suspension System:
   1. General: Comply with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   2. Metal T-Grid Suspension System: Provide standard interior Metal Heavy Duty 15/16” suspension T-Grid system using Main Runners, Cross-tees, Wall Angle or Shadow Moldings of types, structural classifications, and black finishes indicated and that comply with applicable ASTM C 635 requirements. Comply with all applicable
   3. Attachment Devices: Size for 3 times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
   4. C.Wire, Braces, Ties, Hanger Rods, Flat Hangers and Angle Hangers: Provide wires, rods and hangers that comply with applicable ASTM specifications.
   5. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement.

F. Accessories: Manufacturer's standard accessories for installation method indicated, seismic requirements and above-ceiling accessibility.

2.03 FABRICATION

A. Shop fabricate wood ceiling components to the greatest extent possible.

B. Fabricate components to allow access to ceiling plenum as required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not install ceiling until after interior wet work is dry.

3.02 PREPARATION

A. Coordinate the location of hangers with other work.

B. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

C. Layout wood ceiling components in pattern according to reflected ceiling plan and as shown on shop drawings.

D. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 48 hours prior to installation.

3.03 INSTALLATION

A. General: Install suspended wood ceiling system in accordance with CISCA (WC).

B. Suspension System:
   1. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
   2. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
   3. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
   4. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
   5. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
   6. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
   7. Do not eccentrically load system or induce rotation of runners.
   8. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.

C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.

D. Wood Ceiling:
   1. Install wood ceilings in accordance with manufacturer's instructions.
   2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
   3. Install components in uniform plane, and free from twist, warp, and dents.
   4. Cut to fit irregular grid and perimeter edge trim.
   5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.
   6. Install clips, stabilizer bars, and other attachments as indicated to secure wood ceiling components tight to the grid system.
   7. Install acoustical backer above wood ceiling components; fit tight between grid members.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

3.05 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION

SECTION 09 6566
RESILIENT ATHLETIC FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interlocking, loose-laid rubber tile.

1.02 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

C. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver materials to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.

C. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

PART 2 PRODUCTS

2.01 PREFORMED ATHLETIC FLOORING

A. Rubber Tile Flooring: Recycled SBR (styrene butadiene rubber) and colored EPDM granules with urethane binder.
   1. Backing: Recycled black rubber, laminated to colored top layer.
   2. VOC Content: Certified as Low Emission by one of the following:
      a. Product listing in UL (GGG).
   3. Thickness: Minimum 5/16 inch (8.0 mm).
   4. Size: Nominal __ inch (___ mm) square.
   5. Tensile Strength: Minimum 150 psi (1.0 MPa), per ASTM D412.
   6. Durometer Hardness, Type A: Minimum of 55, when tested in accordance with ASTM D2240.
   7. Surface Texture: Smooth.
   8. Color: As selected from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of athletic flooring to substrate.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Concrete: Use leveling compound as necessary to achieve substrate flatness of plus or minus 1/8 inch within 10 ft radius (1/1000).

B. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.

C. Broom clean areas to receive athletic flooring immediately before beginning installation.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Rubber Tile Flooring:

1. Lay out center lines in spaces to receive tile flooring, based on location of principal walls. Start tile installation from center, and adjust as necessary to avoid tiles less than one-half width at perimeter.
2. Lay tiles square with room axis, matching for color and pattern by selecting from cartons and mixing as recommended by manufacturer.

3.04 CLEANING

A. Clean flooring using methods recommended by manufacturer.

3.05 PROTECTION

A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

END OF SECTION

SECTION 09 6813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

1.03 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

C. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

D. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tile Carpeting, Type CPT1: Multi Level Pattern Loop, manufactured in one color dye lot.
   1. Product: REVERSE TILE 5T069 manufactured by Shaw.
   2. Tile Size: 24 by 24 inch (610 by 610 mm), nominal.
   3. Pattern: Monolithic.
   4. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.

2.02 ACCESSORIES

A. Edge Strips: Embossed aluminum, color as selected by Architect.

B. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Trim carpet tile neatly at walls and around interruptions.

G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

FABRIC-REINFORCED RESINOUS WALL COATING

PART 1 - GENERAL

PART 2 - RELATED DOCUMENTS

PART 3 - Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 4 - SUMMARY

PART 5 - This Section includes the following:

PART 6 - Fabric-reinforced resinous wall coating system as shown on the drawings and in schedules.

PART 7 - Related Sections include the following

PART 8 - Division 9 section “Gypsum Board”
PART 9 - Division 9 section “Painting”

PART 10 - SUBMITTALS

PART 11 - Submit in accordance with Section 01 33 00.

PART 12 - Product Data: For each type of product specified.

PART 13 - Samples for Initial Selection: Manufacturer's color charts consisting of sections of units showing the full range of colors.

PART 14 - Samples for Verification: In manufacturer's standard size, but not less than 6-by-6-inch (150-by-150-mm) section of color specified, showing the full range of variations expected in these characteristics.

PART 15 - Manufacturer and Installer Qualification data: Provide certificates of qualifications and references of completed work of similar size and complexity.

PART 16 - Maintenance Data: For fabric-reinforced resinous wall coating system to include installation instructions. Include procedures for stain removal, repairing surfaces and cleaning.

PART 17 - QUALITY ASSURANCE

PART 18 - The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of resinous industrial wall coating, urethanes and related materials.

PART 19 - Installer Qualifications: Engage installers who are certified by manufacturer in all phases of surface preparation and application of the product specified.

PART 20 - Application: Company specializing in resinous matrix wall coating application with five years experience with at least five completed projects of similar size and complexity

PART 21 - Source Limitations: Obtain each product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

PART 22 - System shall be in compliance with requirements of United States Department of Agriculture (USDA), and local Health Department

PART 23 - Fire-Test-Response Characteristics: Conform to applicable codes for wall coating flame/fuel/smoke ratings.

PART 24 - A pre-installation conference shall be held between Applicator, General Contractor, Architect and the Owner to review requirements, application procedures, quality control, and acceptance criteria. The Contractor shall install with the Owner's approval, a mutually agreed upon mock-up to show final color, texture, detailing, and over all general appearance of finished system. The mock-up shall include the butt fabric seam joint condition and demonstrate the final appearance of the wall coating at seamless joints. This mock-up shall serve as a job standard for the final installation.

PART 25 - DELIVERY, STORAGE, AND HANDLING

PART 26 - Deliver product to site under provisions of the General Conditions.

PART 27 - Have materials checked by installing contractor for completeness and shipping damage prior to start of this work.

PART 28 - Store and protect products under provision of the General Conditions.

PART 29 - Store resin materials in a dry, secure area.

PART 30 - Materials shall be stored indoors, protected from damage, moisture, direct sunlight and temperatures below 70 degrees F or above 90 degrees F

PART 31 - Keep product away from open flame.

PART 32 - Waste Disposal

PART 33 - The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

PART 34 - PROJECT CONDITIONS

PART 35 - Refer to manufacturer's instructions for environmental conditions.

PART 36 - Surface and surrounding air temperatures must exceed 55 degrees F, but must be less than 90 degrees F, with materials at no less than 70 degrees F during application. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.

PART 37 - Maintain this temperature range 24 hours before, during and 72 hours after installation of fabric- reinforced resinous wall coating. Record material and environmental conditions for the period described above. Record shall include material, ambient and substrate temperatures; and relative humidity. Provide record to Architect upon request.

PART 38 - Ventilate area where fabric-reinforced resinous wall coating is being installed. Post and enforce NO SMOKING or OPEN FLAME signs until wall coating has cured.

PART 39 - Provide uniform lighting of 25 fc measured at area of installation.

PART 40 - Restrict traffic from area where wall coating is being installed or is curing.

PART 41 - Backerboard shall be completely clean and free of any oils, soap residue, and gypsum dust and prepared to a level 3 finish at walls and a level 4 finish at ceilings.

PART 42 - WARRANTY

PART 43 - Provide three year warranty.

PART 44 - Warranty: Include coverage against delamination from substrate, degradation of surface finish.

PART 45 - PRODUCTS

PART 46 - GENERAL

PART 47 - Provide complete resinous based wall coating system, with fiberglass fabric reinforcing and epoxy based topcoat.

PART 48 - MANUFACTURERS

PART 49 - Available Products: Subject to compliance with requirements, fabric-reinforced resinous based wall coating system to be incorporated into the Work includes, but is not limited to:

PART 50 - Basis of Design: Stranlok Mat lay-up, fiberglass fabric-reinforced resinous wall system by Tnemec Company, Inc.
PART 51 - Basis of Design for Epoxy product at ceiling: Tneme-Glaze 12 mil min. dry film thickness by Tnemec Company, Inc.
PART 52 - Or Approved Equal.

PART 53 - Colors and Patterns: As scheduled on drawings or as selected by Owner from full range of manufacturer’s colors.

PART 54 - Fiberglass Fabric Mat: Manufacturer's specially designed reinforcing mat.

PART 55 - Joint Sealant: Manufacturer's flexible epoxy or urethane sealant intended for use in expansion and control joint.

PART 56 - EXECUTION

PART 57 - GENERAL

PART 58 - The work shall consist of preparation of the substrate, and the furnishing and application of a fiber-reinforced resinous based wall coating system. It shall be applied to the prepared areas as defined in the plans strictly in accordance with the Manufacturer's recommendations.

PART 59 - EXAMINATION

PART 60 - Examine substrates, areas and conditions where installation of fiber-reinforced resinous based wall coating system will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for fiber-reinforced resinous based wall coating system installation and comply with requirements specified.

PART 61 - Remove laitance, contaminants and provide clean and dry substrate. Voids, bug holes and other defects should be filled with as recommended by manufacturer.

PART 62 - Do not proceed with installation until unsatisfactory conditions have been corrected.

PART 63 - INSTALLATION

PART 64 - Install fabric-reinforced resinous based wall coating system per manufacturer’s installation instructions

PART 65 - Primer: Components shall be squeegee-applied, then back-rolled with a short nap roller per manufacturer's recommendations.

PART 66 - Install saturant coat according to manufacturer’s system installation requirements.

PART 67 - Install manufacturer’s reinforced fabric mat per installation requirements into saturant coat. Provide butt fabric seams for a seamless application with no overlapping of fabric material at seams.

PART 68 - Fill coat: The fill coat shall be applied to fill fabric by brush or roller. Sand out or otherwise remove imperfections: swirls, snail tracks, runs drips and sags and the like after cure. Apply fill coat at 16 to 20 dry film thickness.

PART 69 - Topcoat and sealer application: 1-coat topcoat application minimum

PART 70 - Apply final coat at 6 to 8 dry film thickness.

PART 71 - Sealant: Install bead of manufacturer's recommended sealant prior to finish installation around outlets eschetchons and similar penetrations. Allow sealant to cure as indicated on mfg instructions. Prepare glaze coating to receive sealant. Abrade 100% of surface in contact with sealant or follow sealant mfg instruction for over coating glaze coatings.

PART 72 - DETAILS

PART 73 - Integral Cove Base: A cove base shall be installed with an integral Cant with the wall system installation. Coordinate installation to provide watertight system.

PART 74 - Mask off transitions to finish floor for a clean, straight line.

PART 75 - CLEANING AND PROTECTING

PART 76 - Protect fabric-reinforced resinous based wall coating system against mars, marks, indentations and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by manufacturer.

END OF SECTION

SECTION 09 9113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels and ledge angles.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
   7. Floors, unless specifically indicated.
   8. Ceramic and other types of tiles.
   9. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
   10. Glass.
   11. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting.

1.03 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 12" x 12" in size.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. If a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
   2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
   3. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:

C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.
      a. Products:
         1) Sherwin-Williams Pro Industrial Acrylic, Semi-Gloss.
         2) Sherwin-Williams SuperPaint Exterior.
         3) Substitutions: See Section 01 6000 - Product Requirements

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Alkali-Resistant Water-Based Primer.
      a. Products:

1) Zinsser by Rust-Oleum Corporation Bulls Eye 1-2-3 Water-Base Primer: www.rustoleum.com/#sle. (MPI #3)

2. Water Based Primer for Galvanized Metal; MPI #134.
   a. Products:
      1) Sherwin-Williams DTM Primer/Finish (MPI #134)
      2) Substitutions: See Section 01 6000 - Product Requirements
3. Rust-Inhibitive Water Based Primer; MPI #107.
   a. Products:
      1) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer. (MPI #107)
      2) Substitutions: See Section 01 6000 - Product Requirements

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Sacrificial Anti-Graffiti Coating: Clear, wax emulsion for coating porous or painted surfaces; capable of being removed from substrate with only hot water.

C. Patching Material: Latex filler.

D. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 09 9113 - Exterior Painting.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

E. SSPC-SP 2 - Hand Tool Cleaning; 2018.

F. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

G. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum _____ years experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
   2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
   3. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:
   1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
   1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
         1) Opaque, Flat: 50 g/L, maximum.
         2) Opaque, Nonflat: 150 g/L, maximum.
         3) Opaque, High Gloss: 250 g/L, maximum.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, wood, and plaster.
   1. Two top coats and one coat primer.

2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
    a. Products:
        1) Sherwin-Williams ProMar 200 HP Series, Eg-Shel. (MPI #139)
        2) Sherwin-Williams Scuff Tuff, Eg-Shel, S24W00051. (MPI #139)
        3) Substitutions: See Section 01 6000 - Product Requirements

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
2. Two top coats and one coat primer.
3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #151, 153, or 154.
    a. Products:
        1) Sherwin-Williams Pro Industrial Acrylic Coating, Semi-Gloss. (MPI #153)
        2) Substitutions: See Section 01 6000 - Product Requirements

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Alkali Resistant Water Based Primer; MPI #3.
    a. Products:
        1) Sherwin-Williams Loxon Water Blocking Primer/Finish.
        2) Substitutions: See Section 01 6000 - Product Requirements
2. Interior Drywall Primer Sealer.
    a. Products:
        1) Zinsser by Rust-Oleum Corporation Drywall Primer: www.rustoleum.com/#sle.
        2) Substitutions: See Section 01 6000 - Product Requirements
3. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
    a. Products:
        1) Rust-Oleum Corporation Commercial Universal Alkyd Primer: www.rustoleum.com/#sle. (MPI #79)
        2) Substitutions: See Section 01 6000 - Product Requirements
4. Stain Blocking Primer; MPI #136.
    a. Products:
        1) Sherwin-Williams Extreme Block Stain Blocking Primer. (MPI #136)
        2) Zinsser by Rust-Oleum Corporation High Hide Cover-Stain Primer: www.rustoleum.com/#sle. (MPI #136)

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
1. Gypsum Wallboard: 12 percent.
2. Plaster and Stucco: 12 percent.

3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Concrete:
1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

F. Masonry:

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

H. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.

I. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

J. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
2. Prepare surface according to SSPC-SP 2.

K. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.

L. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

M. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Sand wood and metal surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower and bath accessories.

C. Under-lavatory pipe supply covers.

D. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 8300 - Mirrors: Other mirrors.

B. Section 09 3000 - Tiling: Ceramic washroom accessories.

C. Section 22 4000 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM C1036 - Standard Specification for Flat Glass; 2021.

C. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

F. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

2.02 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.03 COMMERCIAL TOILET ACCESSORIES

A. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: As indicated on drawings.
   3. Frame: 0.05 inch (1.3 mm)angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   4. Backing: Full-mirror sized, minimum 0.03 inch (0.8 mm) galvanized steel sheet and nonabsorptive filler material.
   5. Adjustable Tilt Mirrors: Stainless steel piano hinge full width of base and elbow hinges at sides of mirror, for minimum tilt forward from top of 6 inches (150 mm).
   6. Shelf: Stainless steel; gauge and finish to match mirror frame, turned down edges, welded to frame; 5 inches (125 mm) deep, full width of mirror.

B. Grab Bars: Stainless steel, textured surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
      b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
      c. Finish: Satin.
      d. Length and Configuration: As indicated on drawings.

C. Combination Sanitary Napkin/Tampon Dispenser with Disposal: Stainless steel, surface-mounted.
   1. Door: Seamless 0.05 inch (1.3 mm) door with returned edges and tumbler lock.
   2. Cabinet: Fully welded, 0.03 inch (0.8 mm) thick sheet.
   3. Operation: No charge; no coin slots.
   4. Identify dispensers slots without using brand names.
   5. Minimum capacity: 15 napkins and 20 tampons.

2.04 COMMERCIAL SHOWER AND BATH ACCESSORIES

A. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for concealed mounting.

B. Shower Curtain:
   1. Material: Nylon reinforced vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
   2. Size:as shown on drawings, hemmed edges.
   3. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
   4. Color: White.
   5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.

C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
   1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
   2. Size: ADA Standards compliant.

D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.

E. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.05 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:
   1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
   2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
   3. Construction: 1/8 inch (3.2 mm) flexible PVC.
      a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
      b. Comply with ICC A117.1.
      c. Microbial and Fungal Resistance: Comply with ASTM G21.
   4. Color: White.

2.06 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.

1. Drying rod: Stainless steel, 1/4 inch (6 mm) diameter.
2. Hooks: Two, 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
4. Length: Manufacturer's standard length for number of holders/hooks.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. Verify that field measurements are as indicated on drawings.

D. See Section 06 1000 for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
   1. Grab Bars: As indicated on drawings.
   2. Other Accessories: As indicated on drawings.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

1.02 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

PART 2 PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Cartridge Operated: Spun shell.
   2. Class: A:B:C type.
   3. Size: 20 pound (9.1 kg).
   4. Finish: Baked polyester powder coat, color as selected.
   5. Temperature range: Minus 65 degrees F (Minus 54 degrees C) to ___ degrees F (___ degrees C).

2.02 FIRE EXTINGUISHER CABINETS

A. Cabinet Construction: Non-fire rated.
   1. Formed stainless steel sheet; 0.036 inch (0.9 mm) thick base metal.

B. Cabinet Configuration: Recessed type.
   1. Size to accommodate accessories.
   2. Trimless type.

C. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

D. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.

E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

F. Fabrication: Weld, fill, and grind components smooth.

G. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.

H. Finish of Cabinet Interior: White colored enamel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure rigidly in place.

C. Place extinguishers in cabinets.

END OF SECTION

SECTION 10 5113
METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lockers.

B. Design, fabrication and installation of Tubular Frame Wall structure as specified herein.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.

B. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
   1. Wired Access Control: Include power requirements and standard wiring diagrams for specified products.

C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
   1. Wired Access Control: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

D. Samples: Submit two samples in size showing color and finish of metal locker material.

E. Manufacturer's Installation Instructions: Indicate component installation assembly.

F. Owner’s Manual: Provide maintenance manual at closeout.

G. Warranty: Submit manufacturer’s standard warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Lockers:
   1. GearGrid Corporation, 670 SW 15th Street, Forest Lake, MN 55025. Toll-free 888-643-6694. Phone 651-464-4468. Fax 651-464-4780. Web site www.geargrid.com. Email sales@geargrid.com..
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LOCKER APPLICATIONS

A. Open-Front Turnout Gear Lockers: Metal lockers, Wall-mounted.
   1. Width: 24 inches (610 mm).
   2. Depth: 20 inches (508 mm).
   3. Height: 74.5 inches (1,892 m).
   4. Configuration: Single tier.
   5. Fittings: Size and configuration as indicated on drawings.
      a. Upper shelf.
      b. Coat rod.
      c. Hooks: 3 per locker.
      d. Gear Dryer Hanger.
      e. Glove Drying Hanger
   6. Ventilation: Perforated side panels, doors, and back panels.
   7. Color: To be selected from manufacturer's full range by Architect.

2.03 METAL LOCKERS

A. Locker Case Construction:
   1. Units shall be welded at all applicable joints. Forming of metal shall be completed by standard cold-forming operations. Use of fasteners will only be required to allow for knockdown shipping, securing units to mounting surface and on applicable accessories.

B. Vertical Dividers:
   1. Outer Frames: 1.25” O.D. x 16 gauge wall thickness ASTM A513 steel tubing.
   2. Inner Grid: .25” diameter ASTM 510 cold drawn steel wire resistance welded to a 3” square pattern.
   3. Inner Grid wires must be full length and width of inside vertical divider frame. Wires not running full length or width, thus creating exposed wire ends will not be acceptable.
   4. Inner Grid wires must run horizontally and vertically creating a square or rectangular grid pattern only. Grid wires not creating a square or rectangular grid pattern will not be acceptable.
   5. Inner Grid wires shall intersect and cross all perpendicular wires, and shall be welded at all intersections.
   6. Heavy-Duty, Knocked Down Construction: Made of formed sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
      a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
         1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
            (a) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
         2) Shelves: 16 gauge, 0.0598 inch (1.52 mm).
            (a) (1) Upper, (1) Lower. .25” diameter ASTM 510 cold drawn steel wire resistance welded and cold formed. Upper shelf shall include an integrated 20 gauge steel bracket to accept a 2” x 16” name placard.
         3) Apparel Hooks: (3) per locker opening.
            (a) .192” diameter ASTM 510 cold drawn steel wire resistance welded, cold formed and powder coated. Apparel hooks must securely engage and snap onto side or back grid, to prevent unintentional disengagement of hook.
         4) Hang Bar
            (a) Hang Bars must be manufactured to allow each locker user to install at their desired height. Hang Bars that span multiple locker openings are not acceptable.
            (b) Tube: 1.25”O.D. x 16 gauge 304 stainless steel tubing.
            (c) Brackets: Allow Hang Bars to be securely attached to each vertical divider, powder coated.
         5) Gear Dryer Hanger
            (a) .25” diameter 304 stainless steel wire cold formed and resistance welded. Includes formed loops to prop open sleeves on jackets to promote better circulation throughout the garment.
            (b) Black vinyl coating on hook end.
         6) Glove Drying Hanger
            (a) .25” diameter 304 stainless steel wire cold formed and resistance welded.
            (b) Black vinyl coating on hook end.
         7) Top Side Storage
            (a) Shelf spanning across the top of the lockers for additional gear storage above lockers. .25” diameter ASTM 510 cold drawn steel wire resistance welded to a 3” square pattern. Powder coated finish in specified color.
         8) Backs: 18 gauge, 0.0478 inch (1.21 mm).
            (a) Required on each locker to protect the locker contents and wall substrate, as well as provide an additional panel for accessory attachment.

(b) Grid: .25” diameter ASTM 510 cold drawn steel wire resistance welded to a 3” square pattern.
(c) Back panel must engage and be secured to vertical dividers via horizontal wires which extend into mounting holes pre-drilled in vertical dividers. Back panels are sandwiched between vertical dividers, preventing them from being removed after assembly is complete.
(d) Inner Grid wires must be full length and width of inside vertical divider frame. Wires not running full length or width, thus creating exposed wire ends will not be acceptable.
(e) Inner Grid wires must run horizontally and vertically creating a square or rectangular grid pattern only. Grid wires not creating a square or rectangular grid pattern will not be acceptable.
(f) Inner Grid wires shall intersect and cross all perpendicular wires, and shall be welded at all intersections.

9) Base: 18 gauge, 0.0478 inch (1.21 mm).
(a) Height: 4 inch (100 mm).

b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.
c. Where ends or sides are exposed, provide flush panel closures.
d. Provide filler strips where indicated, securely attached to lockers.

C. FInish
1. General: All system components excluding assembly and mounting hardware and stainless steel components are to receive the standard finish.
2. Standard Finish: Components to be cleaned using a phosphatized bath, clear water rinse and electro-statically coated with a durable and UV-stable TGIC powder coating process. Thickness of applied finish shall be 3 – 4 mm for added protection.
3. Color: As selected from manufascturer's standard range by the Architect.

D. Latches and Door Handles: Manufacturer's standard.

2.04 TUBULAR FRAME WALL STRUCTURE

A. Model: Tubular Frame Wall Structure Units

B. Tubular Frame Wall Structures are engineered specifically for each installation and are designed to ship in a knocked-down configuration for efficient shipping. Wall structure components are bolted together with hardware as supplied or identified.

C. Construction: Units shall be welded at all applicable joints. Forming of metal shall be completed by standard cold-forming operations. Use of fasteners will only be required to allow for knock shipping, securing units to mounting surface and on applicable accessories.

D. Vertical Posts: 4” x 4”, .250” wall thickness ASTM A513 steel tube.

E. Floor Mounting Plates: ½” steel plate welded to Vertical Posts. 3/8” mounting holes as needed.

F. Horizontal Frames: 4” x 4”, .1875” wall thickness ASTM A513 steel tube. Frames mechanically fastened to Vertical Posts with supplied or identified hardware.
1. Note: If PowerBars (Electric Raceway) are used, top Horizontal Frame will be 6” high x 4” wide, .1875” wall thickness steel tube.

G. Finish: General: All system components excluding assembly and mounting hardware and stainless steel components are to receive the standard finish. Standard Finish: Components to be cleaned using a phosphatized bath, clear water rinse and electro-statically coated with a durable TGIC powder coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases and embedded anchors are properly sized.

C. Verify that power and ethernet are installed and enabled. See manufacturer drawings for recommended outlet or junction box placement.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).

E. Bolt adjoining locker units together to provide rigid installation.

F. Install end panels, filler panels, and sloped tops.

G. Install fittings if not factory installed.

H. Replace components that do not operate smoothly.

3.03 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 10 7500
FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum Flagpoles.

1.02 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016 (Reapproved 2020).

B. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.

C. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pole, accessories, and configurations.

C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flagpoles:
   1. Concord American Flagpole; External - Continental: www.concordamericanflagpole.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001
   1. Material: Aluminum.
   2. Design: Cone tapered.
   3. Mounting: Ground mounted type.
   4. Outside Butt Diameter: 8 inches (200 mm).
   5. Nominal Height: 30 ft (9.144 m); measured from nominal ground elevation.
   6. Halyard: External type, cam cleat.

2.03 POLE MATERIALS

A. Aluminum: ASTM B241/B241M , 6063 alloy , T6 temper.

2.04 ACCESSORIES

A. Finial Ball: Aluminum, 6 inch (150 mm) diameter.

B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.

C. Flag: _____ design, 5 ft by 8 ft (1.5 m by 2.4 m) size, nylon fabric, brass grommets, hemmed edges.

D. Cleats: 9 inch (230 mm) size, aluminum with galvanized steel fastenings, one per halyard.

E. Cleat Box: Aluminum, with built-in hinge and hasp assembly, attached to pole with tamper proof screws inside box.

F. Halyard: 5/16 inch (8 mm) diameter nylon, braided, white.

2.05 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gauge, 0.0598 inch (1.52 mm) steel, galvanized, depth of ____ inches (____ mm) as indicated.

B. Pole Base Attachment: Flush; steel base with base cover.

C. Lightning Ground Rod: 36 inch (914 mm) long copper rod, 3/4 inch (19 mm) diameter.

2.06 FINISHING

A. Aluminum: Mill finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.02 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

A. Install flagpole , base assembly, and fittings in accordance with manufacturer's instructions.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1 inch (25 mm).

3.05 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 12 2400
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior manual roller shades.

1.02 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Selection Samples: Include fabric samples in full range of available colors and patterns.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Interior Roller Shades - Basis of Design: Draper, Inc; Manual LightBloc FlexShade: www.draperinc.com/#sle.
   1. Description: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and other components necessary for complete installation.
      a. Drop Position: Regular roll.
      b. Mounting: Wall mounted.
      c. Roll Direction: Roll down, closed position is at window sill.
      d. Size: As indicated on drawings.
      e. Fabric: As indicated under Shade Fabric article.
   2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Hardware Type: Headbox.
   3. Roller Tubes: As required for type of shade operation; designed for removal without removing mounting hardware.
      a. Material: Extruded aluminum or steel, with wall thickness and material selected by manufacturer.

b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
c. Fabric Attachment: Utilize double-sided adhesive tape.
d. Take-Up Roller: Manufacturer's standard roller tube pretensioned for winding lift cable in bottom-up type shades.
e. Capable of being removed and reinstalled without affecting roller shade limit adjustments.

4. Hembars: Designed to maintain bottom of shade straight and flat, selected from manufacturer's standard options.
   a. Style: Closed pocket; aluminum elliptical slat inside pocket with heat-sealed ends.
   b. Room-Darkening Shades: Provide a slot in bottom bar with wool-pile light seal.
5. Accessories:
   a. Light Gap Reduction Channels: Provide extruded aluminum side, center, and sill channels as required for room-darkening shade applications.
   b. Fabric Retention System: Manufacturer's system of side channels with fabric retainer and light seal, and shade fabric fabricated with steel stays.
   c. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to mounting end caps, without exposed fasteners; clear anodized finish.
   d. Exposed Headbox: Extruded aluminum, size as required to conceal shade mounting; clear anodized finish.

2.02 SHADE FABRIC

A. Fabric Type 1 - Black Out Solar Shade: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Manufacturers:
      a. Mermet Corporation; Verona Twilight -0%: www.mermetusa.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.
   2. Material: Polyester with acrylic backing.
   3. Performance Requirements:
      a. Flammability: Pass NFPA 701 large and small tests.
      b. Fungal Resistance: No growth when tested according to ASTM G21.
      c. Solar Transmittance (Ts): 0%.
      d. Visible Light Transmittance (Tv): 0%.
      e. Solar Absorption (As): 30% street side.
      f. Solar Reflectance (Rs): 70% street side.
   4. Openness Factor: 0%.
   5. Weight: 11.65 ounces per square yard (395 grams per square meter).
   6. Color: As selected by Architect from manufacturer’s full range of colors.
   7. Fabrication:
      a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
      b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
      c. Battens: Full width of shade, enclose in welded shade fabric pocket.

B. Fabric Type 2 - Solar Shade 1% Openness: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Manufacturers:
      a. Mermet Corporation; GreenScreen Revive - 1%: www.mermetusa.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.
   2. Material: 100 percent polyester.
   3. Performance Requirements:
      a. Flammability: Pass NFPA 701 large and small tests.
      b. Fungal Resistance: No growth when tested according to ASTM G21.
      c. Solar Transmittance (Ts): 20%.
      d. Visible Light Transmittance (Tv): 10%.
      e. Solar Absorption (As): 34%.

f. Solar Reflectance (Rs): 46.
4. Openness Factor: 1%.
5. Weight: 5.87 ounces per square yard (199 grams per square meter).
6. Roll Width: 72 inches (1829 mm).
7. Color: As selected by Architect from manufacturer's full range of colors.
8. Fabrication:
   a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
   b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
   c. Battens: Full width of shade, enclose in welded shade fabric pocket.

C. Fabric Type 3 - Solar Shade 3% Openness: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
1. Manufacturers:
   a. Mermet Corporation; GreenScreen Evolve - 3%: www.mermetusa.com/#sle.
   b. Substitutions: See Section 01 6000 - Product Requirements.
2. Material: 100 percent polyester.
3. Performance Requirements:
   a. Flammability: Pass NFPA 701 large and small tests.
   b. Fungal Resistance: No growth when tested according to ASTM G21.
   c. Solar Transmittance (Ts): 18%.
   d. Visible Light Transmittance (Tv): 11%.
   e. Solar Absorption (As): 31%.
   f. Solar Reflectance (Rs): 51%.
4. Openness Factor: _____.
5. Roll Width: 72 inches (1829 mm).
6. Color: As selected by Architect from manufacturer's full range of colors.
7. Fabrication:
   a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
   b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
   c. Battens: Full width of shade, enclose in welded shade fabric pocket.

2.03 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: As recommended in writing by manufacturer.

C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 3600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Wall-hung counters and vanity tops.

C. Window Sills.

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Architectural Wood Casework.

B. Section 22 4000 - Plumbing Fixtures: Sinks.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

C. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

E. PS 1 - Structural Plywood; 2019.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

C. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

B. Quality Certification:
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch (1.2 mm) nominal thickness.
      a. Manufacturers:
         1) Arborite; _____: www.arborite.com/#sle.
         2) Formica Corporation; _____: www.formica.com/#sle.
         3) Lamin-Art, Inc; _____: www.laminart.com/#sle.
         4) Wilsonart; _____: www.wilsonart.com/#sle.
         5) Substitutions: See Section 01 6000 - Product Requirements.
      b. Finish: Matte or suede, gloss rating of 5 to 20.
      c. Surface Color and Pattern: As selected by Architect from the manufacturer's full line.
   2. Exposed Edge Treatment: Molded rubber edge with T-spline, sized to completely cover edge of panel.
      a. Color: As selected by Architect from the manufacturer's full line.
   3. Back and End Splashes: Same material, same construction.
   4. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade.

C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Avonite Surfaces; _____: www.avonitesurfaces.com/#sle.
         2) Dupont; _____: www.corian.com/#sle.
         3) Formica Corporation; _____: www.formica.com/#sle.
         4) Wilsonart; _____: www.wilsonart.com/#sle.
         5) Substitutions: See Section 01 6000 - Product Requirements.
      b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
      c. Color and Pattern: As selected by Architect from manufacturer's full line.
   3. Other Components Thickness: 1/2 inch (12 mm), minimum.
   4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; radiused edge.
   5. Back and End Splashes: Same sheet material, radiused top; minimum 4 inches (102 mm) high.
   6. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.

2.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

C. Joint Sealant: Mildew-resistant silicone sealant, white.

2.03 ACCESSORIES

A. Fixed Top-Mounted Countertop Support Brackets:

2.04 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.

3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches (102 mm), unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3,657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).

C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.

B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.

C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 12 93 00
SITE FURNISHINGS

PART 1 - GENERAL

1.01 SUMMAR

A. Scope: the Contractor shall furnish all labor, materials, equipment, transportation, services and necessary appurtenant work required to complete the work shown on the Plans and/or specified herein.

B. Extent of work shall include but not be limited to:

1. Bicycle hoops
2. Basketball hoop

1.02 RELATED DOCUMENTS

A. Attention is directed to Bidding and Contracting requirements, drawings and general provisions of the Contract, including eneral Conditions and Division 1 Specification sections, which are hereby made part of this section.

B. elated Sections:

1. Article 10: Construction Specifications (Ann Arbor Public Services Standard Specifications 2024)

1.03 REFERENCE SPECIFICATION

A. Materials and ork covered under this Section shall be in accordance with Ann Arbor Public Services Department 2024 Standard Specifications unless otherwise indicated. All work under this Contract which is not included in the Ann Arbor Public Services Department 2024 Standard Specifications, or which is performed using modifications to those Standard Specifications, shall be performed in accordance with the Detailed Specifications included in these contract documents. If a conflict exists between specifications, the more rigorous shall govern.

1.05 QUALIT ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 - PRODUCTS

2.01 BIC CLE HOOPS

A. Manufactured by CycleSafe, Inc.

B. Model: 12700 Surface Mount Classic U ack

C. Mount: Surface

D. Finish: Black Powder-coated

E. Install per manufacturer s instructions.

2.02 BAS ETBALL HOOPS

A. Manufactured by Bison Inc. (800) 247-7668 bisoninc.com

B. Product Description: 4-1/2 Heavy Duty Steel ectangle Playground Basketball System with 60 safe-play area. Item number: P 60 L. See attached document for manufacturer instructions.

PART 3 - EXECUTION

3.1 BIC CLE HOOP INSTALLATION

A. Bicycle hoops shall be installed Surface Mount as recommended by manufacturer and as indicated in the drawings and specifications.

3.2 BAS ETBALL HOOP INSTALLATION

A. Basketball Hoop shall be installed per manufactures standards and specifications and as shown on drawings.
B. Footing depth per drawing detail.

END OF SECTION

(See next page for manufacturer instructions for basketball hoop.)

—— Installation & Safe Use Manual ——

MODELS: PR52, PR52XL, PR55, PR55XL, PR60, PR60XL, PR70, PR70XL, PR70G, AND BA777 OR BA777XL POLES ORDERED SEPARATELY

Heavy Duty Gooseneck Basketball Systems

Customer Service
(800) 247-7668

PARTS LIST

Item	Qty	Description	Item	Qty	Description
A	1	Gooseneck Pole	L	2	7/16” Lock Washer
B	1	Backboard Mounting Bracket	M	2	7/16” Hex Nut
C	3	Band Clamp	N	2	Backboard Brace
D	2	7/16” x 2” Carriage Bolt	O	2	1/2” Set Screw, Square Head
E	2	3/8” x 1” Hex Bolt	P	2	1/2” Jam Nut
F	2	3/8” Flat Washer	Q	1	Backboard (packaged separately)
G	2	3/8” Lock Washer	R	1	Rim, Mounting Hardware, & Net (packaged separately)
H	3	5/16” x 2” Carriage Bolt	S	1	1/4” x 1” Roll Pin
I	2	5/16” x 1” Carriage Bolt	T	TBD	Quick Dry Concrete (supplied by customer)
J	5	5/16” Flange Nut	U	1	Pole Pad (optional)
K	2	7/16” Flat Washer			

- **Inspect all contents prior to installation. Report any missing parts to dealer immediately.**
- **Read all instructions before proceeding.**
- **Save this instruction in the event that the manufacturer must be contacted in the future**

1. Call your local utility locating service, usually by dialing 811, before digging to avoid serious injury or service interruption.

2. Select the location for the concrete base footing. Note that the face of the *Backboard* (Q) will be approximately 48” from the center of the footing for a BA777 Pole and 60” for a BA777XL Pole. Dig a 12” diameter hole that is 48” deep. Remove additional soil from the bottom 1/3-1/2 of the hole in a bell shape to add pole stability. In areas where the normal frost line is below 48” it is advisable to dig to the normal frost line. See Figure 1.

3. Make sure that you have a level and a broomstick or similar pole to vibrate air pockets out of concrete. A 12” diameter by 36” deep hole with a bell bottom will require approximately 4 cubic ft. or 3000 PSI *Quick Dry Concrete* (T). You will need to adjust the amount depending on the size of hole you prepared. Having too much is better than having too little.

4. Mix concrete according to the directions on the bag. It is advantageous to have the mixture “wet”. This will increase your working time and allow batches to mix in the hole. Pour the hole full to ground level.

5. Attach one *Band Clamp* (C) with *5/16" x 2" Carriage Bolt* (H), and *5/16" Flange Nut* (I) approximately 12" from the bottom end of pole and insert pole into concrete while vibrating concrete to allow it to surround the pole completely. The horizontal extension section of the pole should be parallel to the playing surface, perpendicular to the intended court end line and the lower surface of the horizontal portion of the tube should be 9' 6 1/2" above the playing surface. You will need to brace the pole to maintain this dimension to insure the rim height will be at official 10'.
See Figure 1 & 2

6. Trowel the top of the concrete smooth and clean any excess off the *Gooseneck Pole* (A). **Allow the footing to cure for at least 48 hours.** Do not proceed any further until concrete is completely cured.

7. Attach the *Rim* (R) and *Backboard* (Q) to the *Backboard Mounting Bracket* (B) using the hardware provided with the *Rim* (R). See Figure 3.

8. Slide two *Band Clamps* (C) onto the horizontal portion of the *Gooseneck Pole* (A). See Figure 4.

9. Install the *Backboard Mounting Bracket* (B), *Backboard* (Q), and *Rim* (R) assembly onto the end of the *Gooseneck Pole* (A). It is easiest to install the assembly upside down and then rotate 180° before installing and tensioning the *1/2" Square Head Set Screws* (O). Confirm that the *Rim* (R) and *Backboard* (Q) are level before tightening the *1/2" Square Head Set Screws* (O) against the *Gooseneck Pole* (A). Install and tighten the *1/2" Jam Nuts* (P) to lock the *1/2" Square Head Set Screws* (O) in place. See Figure 4

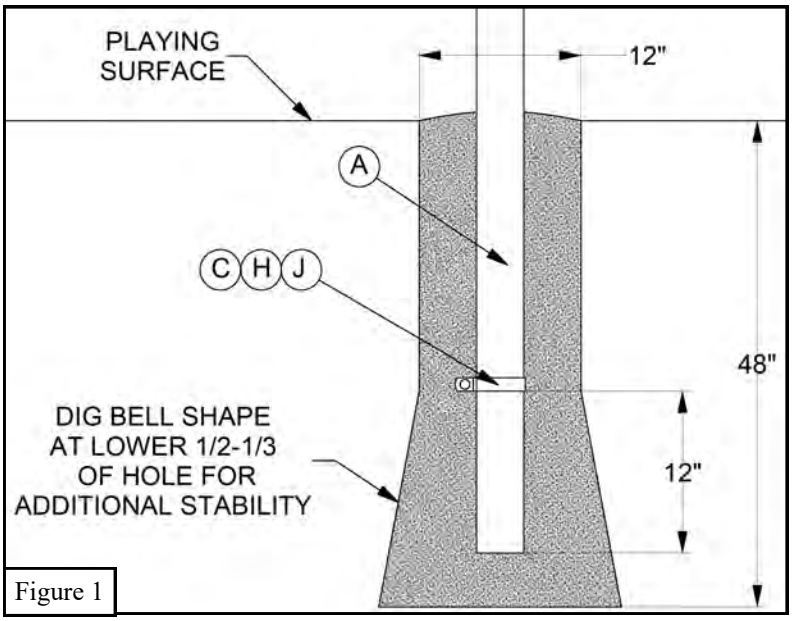


Figure 1

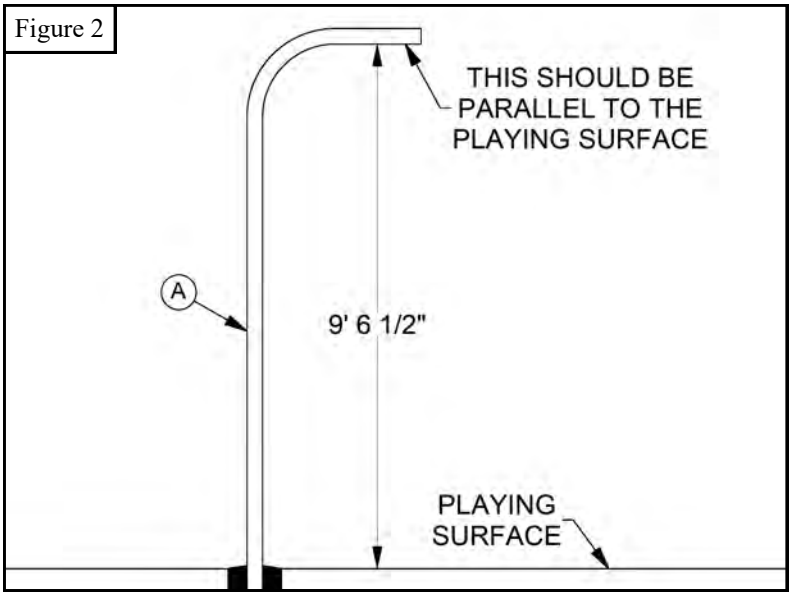


Figure 2

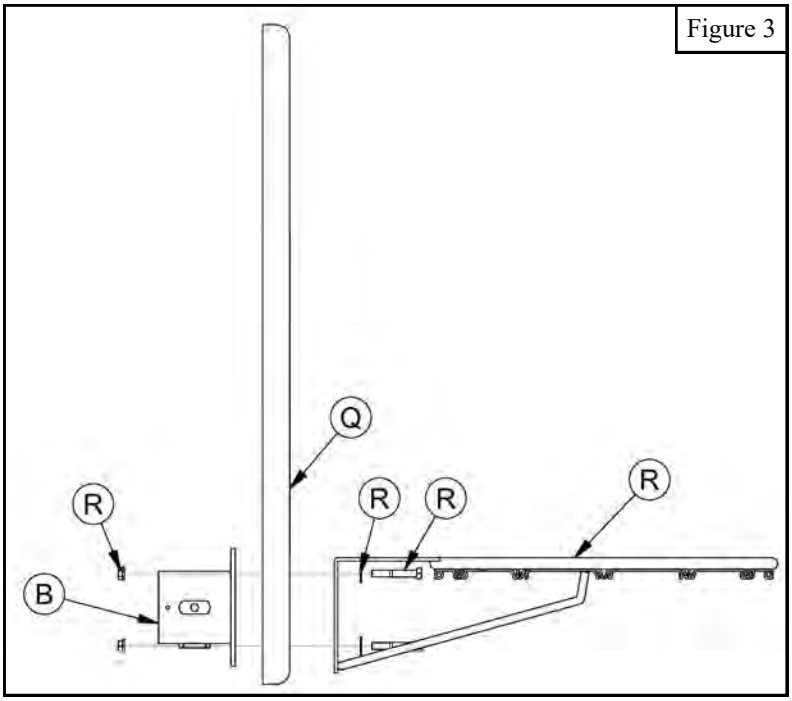


Figure 3

Figure 4

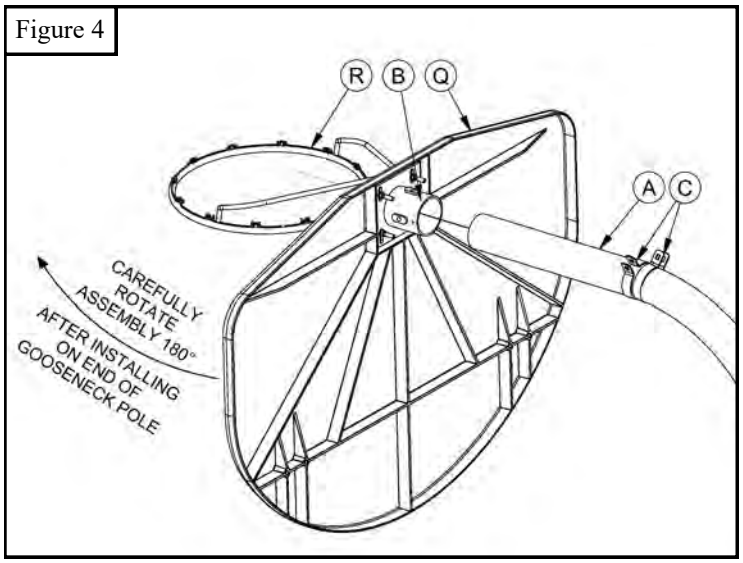
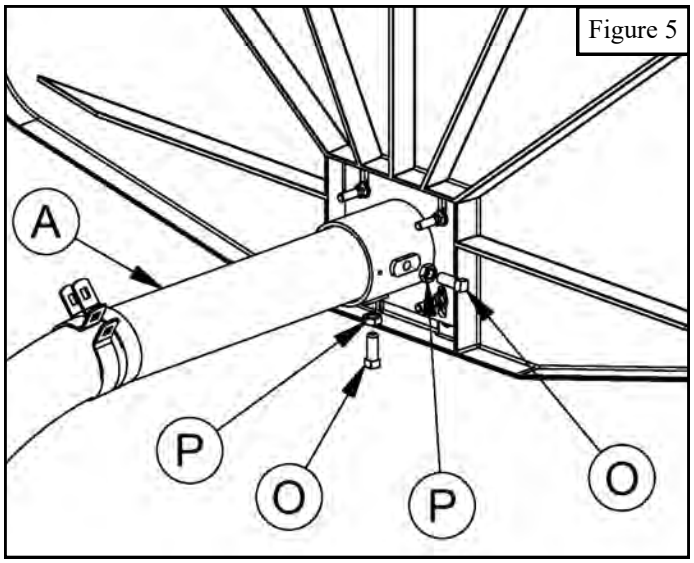
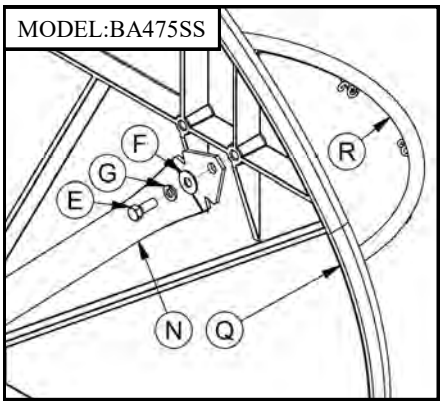


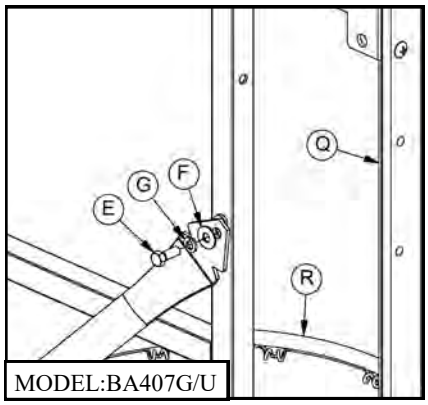
Figure 5



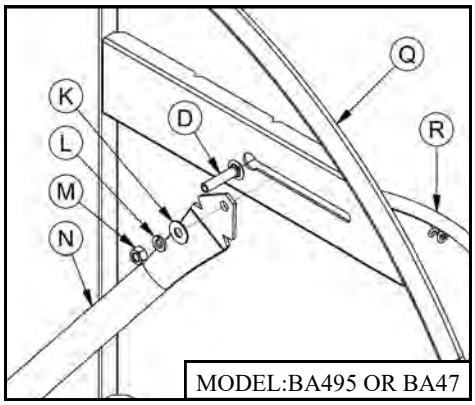
10. Referencing the illustrations below fasten *Backboard Braces* (N) to the *Backboard* (Q). Each model will require different hardware to attach the Backboard Braces (N) to the Backboard (Q). **BA475SS & BA407G/U** require *3/8" x 1" Hex Bolts* (E), *3/8" Flat Washers* (F), and *3/8" Lock Washers* (G). **BA495 & BA47** require *7/16" x 2" Carriage Bolts* (D), *7/16" Flat Washers* (K), *7/16" Lock Washers* (L), and *7/16" Hex Nuts* (M). *Backboard Braces* (N) will need to be bent on the ends to match the angles of the *Backboard* (Q) and *Band Clamps* (C). Exact angle will depend on the *Backboard* (Q) model selected. This can easily be accomplished in a number of ways, including contacting the end of the *Backboard Brace* (N) on a concrete surface. See illustrations below.

MODEL:BA475SS





MODEL:BA407G/U



MODEL:BA495 OR BA47

11. Attach the other ends of the *Backboard Braces* (N) to the *Band Clamps* (C) using the *5/16" x 2" Carriage Bolts* (H) and *5/16" Flange Nuts* (J). See Figure 6.

12. Confirm *Backboard* (Q) and *Rim* (R) are still level before drilling a 1/4" diameter hole into the *Gooseneck Pole* (A) using the pilot hole in the *Backboard Mounting Bracket* (B) as a guide. Install the *1/4" X 1" Roll Pin* (S) into the hole you just drilled with a hammer to further reduce the risk of rotation or movement. See Figure 7

13. Attach *Net* (R) and optional *Pole Pad* (U) if applicable. The system is now ready for play.

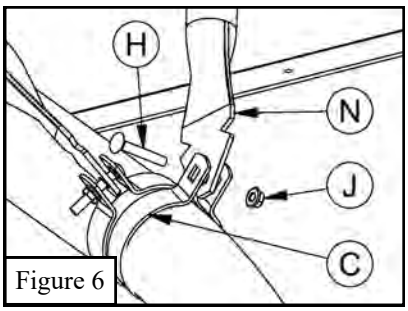
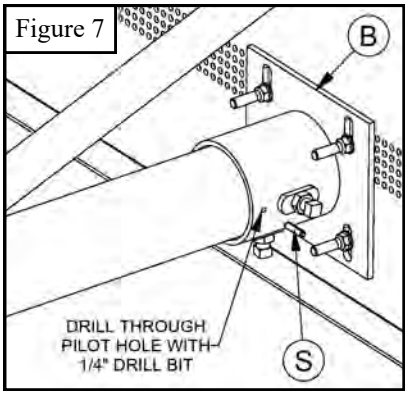


Figure 6

Figure 7



SECTION 14 2100
ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electric traction elevator systems.

B. Maintenance Contract.

1.02 RELATED REQUIREMENTS

A. Section 09 6816 - Sheet Carpeting.

B. Section 21 1300 - Fire-Suppression Sprinkler Systems.

C. Section 26 0533.13 - Conduit for Electrical Systems: Electrical conduit requirements.

D. Section 26 0583 - Wiring Connections: Wiring connection requirements.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

C. AISC 360 - Specification for Structural Steel Buildings; 2022.

D. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2019, with Errata (2021).

E. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, and Dumbwaiters; 2020.

F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

K. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

L. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

O. PS 1 - Structural Plywood; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
   1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
   2. Review use of elevator for construction purposes, hours of use, scheduling of use, cleanliness of car, employment of operator, and maintenance of system.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit data on following items:
   1. Signal and operating fixtures, operating panels, and indicators.
   2. Car design, dimensions, layout, and components.
   3. Car and hoistway door and frame details.
   4. Electrical characteristics and connection requirements.

C. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
   1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
   2. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.
   3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
   4. Individual weight of principal components; load reaction at points of support.
   5. Loads on hoisting beams.
   6. Clearances and over-travel of car and counterweight.
   7. Locations in hoistway of traveling cables and connections for car lighting and telephone.
   8. Location and sizes of hoistway and car doors and frames.
   9. Electrical characteristics and connection requirements.
   10. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.

D. Samples: Submit samples illustrating car floor material, car interior finishes, car and hoistway door and frame finishes, and handrail material and finish in the form of cut sheets or finish color selection brochures.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Initial Maintenance Contract.

G. Maintenance Contract: Submit proposal to Owner for standard one year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
   1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.

H. Operation and Maintenance Data:
   1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
   2. Operation and maintenance manual.
   3. Schematic drawings of equipment, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Supervisor along with trained elevator installation personnel on staff of elevator equipment manufacturer.

B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Electric Traction Elevators:
   1. KONE; KONE MonoSpace 300: www.kone.us/#sle.

B. Substitutions: See Section 01 6000 - Product Requirements.

C. Source Limitations: Provide elevator and associated equipment and components produced by the same manufacturer as the other elevator equipment used for this project and obtained from a single supplier.

2.02 ELECTRIC TRACTION ELEVATORS

A. Electric Traction Passenger Elevator:
   1. Electric Traction Elevator Equipment:
      a. Gearless Traction Machine: Single wrapped traction driving sheave, with dual brake.
   2. Drive System:
      a. Variable voltage alternating current (AC).
   3. Operation Control Type:
      a. Selective Collective Automatic Operation Control.
   4. Service Control Type:
      a. Standard service control only.
   5. Interior Car Height: 7'-6".
   6. Electrical Power: 208 volts; alternating current (AC); three phase; 60 Hz.
   7. Rated Net Capacity: 2500 pounds (1135 kgs).
   8. Rated Speed: 150 feet per minute (0.75 m per second).
   9. Hoistway Size: As indicated on drawings.
   10. Interior Car Platform Size: As indicated on drawings.
   11. Elevator Pit Depth: 60 inch (1524 mm).
   12. Overhead Clearance at Top Floor: 156 inches.
   13. Travel Distance: As indicated on drawings.
   14. Number of Stops: As indicated on drawings.
   15. Number of Openings: _____ Front; ___ Rear.
   16. Traction Machine Location: Top of hoistway shaft.

2.03 COMPONENTS

A. Elevator Equipment:
   1. Motors, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with NFPA 70 requirements, and see Section 26 0583 for additional information.
   2. Guide Rails, Cables, Counterweights, Sheaves, Buffers, Attachment Brackets and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
   3. Buffers:
      a. Spring type for elevators with speed less than or equal to 200 feet per minute (1 m per second).
   4. Lubrication Equipment:
      a. Provide grease fittings for periodic lubrication of bearings.
      b. Grease Cups: Automatic feed type.
      c. Lubrication Points: Visible and easily accessible.

2.04 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).

B. Accessibility Requirements: Comply with ADA Standards.

C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.

D. Perform welding of steel in accordance with AWS D1.1/D1.1M.

E. Fabricate and install door and frame assemblies in accordance with NFPA 80 and complying with requirements of authorities having jurisdiction (AHJ).

F. Perform electrical work in accordance with NFPA 70.

G. Comply with venting or pressurization of hoistway design in accordance with HVAC system requirements and authorities having jurisdiction (AHJ).

H. Comply with fire protection sprinkler system of hoistway design in accordance with NFPA 13 requirements and authorities having jurisdiction (AHJ). See Section 21 1300.

2.05 OPERATION CONTROLS

A. Elevator Controls: Provide landing operating panels and landing indicator panels.
   1. Landing Operating Panels: Metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators.
   2. Landing Indicator Panels: Illuminating.
   3. Comply with ADA Standards for elevator controls.

B. Interconnect elevator control system with building fire alarm and smoke alarm systems.

C. Door Operation Controls:
   1. Program door control to open doors automatically when car arrives at floor landing.
   2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
   3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.

D. Provide "Firefighter's Emergency Operation" in accordance with ASME A17.1, applicable building codes, and authorities having jurisdiction (AHJ).
   1. Designated Landing: Main Lobby.

2.06 OPERATION CONTROL TYPE

A. Selective Collective Automatic Operation Control: Applies to car in single elevator shaft.
   1. Refer to description provided in ASME A17.1.
   2. Automatic operation by means of one button in the car for each landing served and by "UP" and "DOWN" buttons at the landings.
   3. Stops are registered by momentary actuation of landing car buttons without consideration of the number of buttons actuated or the sequence buttons are actuated, but the stops are made in the order that landings are reached in each direction of travel.
   4. All "UP" landing calls are made when car is traveling in the up direction.
   5. All "DOWN" landing calls are made when car is traveling in the down direction.
   6. Uppermost and lowermost calls are answered as soon as they are reached without consideration of the car travel direction.

2.07 EMERGENCY POWER

A. Set-up elevator operation to run with building emergency power supply when the normal building power supply fails, and in compliance with ASME A17.1 requirements.

B. Building Emergency Power Supply: Supplied by backup generator; provide elevator system components as required for emergency power characteristics with phase rotation the same as for normal power.
   1. Provide transfer switches and auxiliary contacts.
   2. Install connections to power feeders.

C. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.

D. Provide operational control circuitry for adapting the change from normal to emergency power.

E. Upon transfer to emergency power, advance one elevator at a time to a pre-selected landing, stop car, open doors, disable operating circuits, and hold in standby condition.

2.08 MATERIALS

A. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated.

B. Extruded Aluminum: ASTM B221 (ASTM B221M), natural anodized finish unless otherwise indicated.

C. Aluminum Sheet: ASTM B209/B209M, 3105 alloy, O temper.

D. Plywood: PS 1, Structural I, Grade C-D or better, sanded.

E. Carpet Flooring: See Section 09 6816.

F. Plastic Laminate: NEMA LD 3, Type HGS, color as selected by Architect from manufacturer's standard line of colors.

2.09 CAR AND HOISTWAY ENTRANCES

A. Elevator:
   1. Car and Hoistway Entrances:
      a. Framed Opening Finish and Material: Brushed stainless steel.
      b. Car Door Material: Stainless steel, with rigid sandwich panel construction.
      c. Hoistway Door Material: Stainless steel, with rigid sandwich panel construction.

B. Sills/Thresholds: Configure to align with frame return and coordinate with floor finish.

C. Gasketing: Provide acoustic type gasketing at hoistway doors and frames to eliminate audible noise due to car activities in the hoistway, and air pressure differential between hoistway and landing floors.

2.10 CAR EQUIPMENT AND MATERIALS

A. Elevator Car:
   1. Car Operating Panel: Provide main and auxiliary; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons, "Door Open" button, "Door Close" button, and alarm button.
      a. Panel Material: Integral with front return; one per car.
      b. Car Floor Position Indicator: Above door with illuminating position indicators.
      c. Locate alarm button where it is unlikely to be accidentally actuated; not more than 54 inch (1372 mm) above car finished floor.
      d. Provide matching service cabinet integral with front return panel, with hinged door and keyed lock in each car.
   2. Flooring: Carpeting.
   3. Wall Base: Resilient base, 4 inch (102 mm) high.
   4. Front Return Panel: Match material of car door.
   5. Door Wall: Plastic laminate on plywood.
   6. Hand Rail: Aluminum, at three side walls. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall.
      a. Aluminum Finish: Clear anodized.
   7. Ceiling:
      a. Canopy Ceiling: Plastic laminate on plywood.
      b. Frame Finish: Color anodized aluminum.
      c. Lay-in Panel: Aluminum sheet.
      d. Lighting: As selected from manufacturer's standard line.
   8. Provide emergency access panel for egress from car at ceiling.

B. Car Accessories:
   1. Protective Pads: Canvas cover, padded with impact-resistant fill material, sewn with piping edges; fire resistant in compliance with ASME A17.1; brass grommets for supports, covering side and rear walls and front return, with cut-out for control panel; provide one set for each elevator.
      a. Color: Tan.
      b. Provide at least 4 inch (102 mm) clearance from bottom of pad to finished floor.
      c. Pad Supports: Stainless steel studs, and mounted from ceiling frame.

2.11 FINISHES

A. Clear Anodized Finish: Class I, AAMA 611 AA-M12C22A41 Clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils, 0.0007 inch (0.018 mm) thick.

B. Color Anodized Finish: Class I, AAMA 611 AA-M12C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils, 0.0007 inch (0.018 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify that hoistway and pit are ready for work of this section.

C. Verify hoistway shaft and openings are of correct size and within tolerance.

D. Verify location and size of machine foundation and position of machine foundation bolts.

E. Verify that electrical power is available and of correct characteristics.

3.02 PREPARATION

A. Arrange for temporary electrical power for installation work and testing of elevator components. See Section 01 5000 - Temporary Facilities and Controls for additional requirements.

B. Maintain elevator pit excavation free of water.

3.03 INSTALLATION

A. Coordinate this work with installation of hoistway wall construction.

B. Install system components, and connect equipment to building utilities.

C. Provide conduit, electrical boxes, wiring, and accessories; see Sections 26 0533.13 and 26 0583.

D. Mount machines and motors on vibration and acoustic isolators.
   1. Place on structural supports and bearing plates.
   2. Securely fasten to building supports.
   3. Prevent lateral displacement.

E. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.

F. Install guide rails to allow for expansion and contraction movement of guide rails.

G. Accurately machine and align guide rails, forming smooth joints with machined splice plates.

H. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.

I. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime with two coats.

J. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.

K. Adjust equipment for smooth and quiet operation.

3.04 TOLERANCES

A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.

B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Testing and inspection by regulatory agencies certified in accordance with ASME QEI 1 will be performed at their discretion.
   1. Schedule tests with agencies and notify Owner and Architect.
   2. Obtain permits as required to perform tests.
   3. Document regulatory agency tests and inspections in accordance with requirements.
   4. Perform tests required by regulatory agencies.
   5. Furnish test and approval certificates issued by authorities having jurisdiction (AHJ).

3.06 ADJUSTING

A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.

B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch (6.4 mm) maximum from flush with sill.

3.07 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove protective coverings from finished surfaces.

C. Clean surfaces and components in accordance with manufacturers written instructions.

3.08 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals for closeout submittals.

B. Demonstrate proper operation of equipment to Owner's designated representative.

C. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, cleaning and maintenance of each component.

3.09 PROTECTION

A. Do not permit construction traffic within car after cleaning.

B. Protect installed products until Date of Substantial Completion.

C. Touch-up, repair, or replace damaged products and materials before Date of Substantial Completion.

3.10 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements relating to initial maintenance service.

B. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for three months from Date of Substantial Completion.

C. Include systematic examination, adjustment, and lubrication of elevator equipment.

D. Perform work without removing cars from use during peak traffic periods.

END OF SECTION

SECTION 20 0500 - MECHANICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this Section.

1.02 SUMMARY

A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

1.03 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
3. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
4. ABMA - American Boiler Manufacturers Association; www.abma.com.
5. AGA - American Gas Association; www.aga.org.
6. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
7. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
8. ANSI - American National Standards Institute; www.ansi.org.
9. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
10. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.

11. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
12. ASTM - ASTM International; www.astm.org.
13. AWS - American Welding Society; www.aws.org.
14. AWWA - American Water Works Association; www.awwa.org.
15. CDA - Copper Development Association; www.copper.org.
16. CGA - Compressed Gas Association; www.cganet.com.
17. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
18. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
19. CSI - Construction Specifications Institute (The); www.csiresources.org.
20. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
21. FM Approvals - FM Approvals LLC; www.fmglobal.com.
22. HI - Hydraulic Institute; www.pumps.org.
23. ICC - International Code Council; www.iccsafe.org.
24. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
25. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
26. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
27. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org
28. NADCA - National Air Duct Cleaners Association; www.nadca.com.
29. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
30. NEBB - National Environmental Balancing Bureau; www.nebb.org.
31. NECA - National Electrical Contractors Association; www.necanet.org.
32. NEMA - National Electrical Manufacturers Association; www.nema.org.
33. NETA - InterNational Electrical Testing Association; www.netaworld.org.
34. NFPA - National Fire Protection Association; www.nfpa.org.
35. NSF - NSF International; www.nsf.org.
36. NSPE - National Society of Professional Engineers; www.nspe.org.
37. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
38. STI - Steel Tank Institute; www.steeltank.com.
39. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
40. UL - Underwriters Laboratories Inc.; www.ul.com.
41. USGBC - U.S. Green Building Council; www.usgbc.org.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.04 PERFORMANCE REQUIREMENTS

A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.05 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.
   1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.
   1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.
   2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner's Representatives causes interference.

G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.06 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.

B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

D. Refer to Division 22 Section "Domestic Water Piping" for purchase and installation of potable water meters.

1.07 DRAWINGS

A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.

C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.08 MATERIAL AND EQUIPMENT MANUFACTURERS

A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through

all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.

C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.

D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.09 INSPECTION OF SITE

A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 ACTION SUBMITTALS

A. Submit for review in compliance with Division 01.

B. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.

C. Submittals shall be in groupings of similar or related items. Plumbing fixture submittals shall be in one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned “Rejected”. Submit product data with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.

D. Submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned “Rejected”.

E. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be included with the submittal for approval.

1.12 INFORMATIONAL SUBMITTALS

A. Shop Drawings:
   1. Prepare shop drawings to scale for the Architect/Engineer for review.
   2. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
   3. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
      a. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
      b. Contractor is responsible for:
         1) Dimensions, which shall be confirmed and correlated at the job site.
         2) Fabrication processes and techniques of construction.
         3) Quantities.
         4) Coordination of Contractor's work with all other trades.
         5) Satisfactory performance of Contractor's work.
         6) Temporary aspects of the construction process.
   4. Submit detailed shop drawings of piping systems showing pipe routing and types and locations of all pipe hangers.

B. Coordination Drawings:
   1. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Instructional Manuals:
   1. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
   2. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
   3. For Commissioned Projects: Operation and maintenance instructional manuals shall be submitted a minimum of four weeks prior to functional testing.
   4. Format: Submit operation and maintenance manuals in the following format:
      a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
         1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
         2) Enable inserted reviewer comments on draft submittals.
   5. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
      a. Routine maintenance procedures.
      b. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
      c. Trouble-shooting procedures.

d. Contractor's telephone numbers for warranty repair service.
e. Submittals.
f. Recommended spare parts list.
g. Names and telephone numbers of major material suppliers and subcontractors.
h. System schematic drawings.

B. Record Drawings:
1. Submit record drawings in compliance with Division 01.
2. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
3. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

C. Warranties:
1. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
2. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.14 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 WARRANTY

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 MECHANICAL DEMOLITION WORK

A. Demolition of existing mechanical equipment and materials shall be done by the Contractor unless otherwise indicated. Include items such as, but not limited to, existing piping, pumps, ductwork, supports, and equipment where such items are not required for the proper operation of the modified system.

B. Include draining of piping systems where required for demolition, modification of, or connection to existing systems.
C. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this Work.
D. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse.
    1. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived.
    2. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner will move and store these materials.
    3. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
E. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.
F. Clean and flush the interior and exterior of existing relocated equipment and its related piping, valves, and accessories that are to be reused of mud, debris, pipe dope, oils, welding slag, loose mill scale, rust, and other extraneous material so that the existing equipment and accessories can be repainted and repaired as required for the proper operation and performance of the relocated equipment.
G. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling, or at mains.
H. Cap ductwork and cap piping immediately adjacent to demolition as soon as demolition commences in order to allow existing systems to remain in operation.
    1. Cap or plug piping with same or compatible piping material.
    2. Cap or plug ducts with same or compatible ductwork material.

3.02 TEMPORARY SERVICES

A. Provide temporary service as described in Division 01.
B. The existing building will be occupied during construction. Maintain mechanical services and provide necessary temporary connections and their removal at no additional cost to the Owner.

3.03 WORK INVOLVING OTHER TRADES

A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.04 ACCEPTANCE PROCEDURE

A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.
B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.
C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.
D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.
E. Operation of the following systems shall be demonstrated:
    1. Air Handling Systems.
    2. Refrigeration Systems.
    3. Chilled Water Systems.
    4. Condenser Water Systems.
    5. Process Cooling Systems.
    6. Heating Systems.
    7. Steam Pressure Reducing Stations.

8. Condensate Receivers.
9. Domestic Water Booster Systems.
10. Domestic Hot Water Heaters.
11. Domestic Hot Water Mixing Stations.
12. Compressed Air Systems.
13. Vacuum Systems.
14. Purified Water Systems.
15. Chemical Treatment Systems.
16. Energy Recovery Systems.
17. Temperature Controls.
18. Building Automation System.
19. Lab Airflow Controls.
20. Exhaust Systems.
21. Smoke Purge Systems.

F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

3.05 PROJECT COMMISSIONING

A. Refer to Division 01 “Project Commissioning” and the Commissioning Manual.

B. Purpose: Training, documentation and verification of the operation and functional performance of mechanical systems for compliance with the “design intent.”

END OF SECTION 20 0500

SECTION 20 0510 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 22 Section “Domestic Water Piping” for flushing and cleaning of potable water piping.
3. Division 23 Section “Piping Systems Flushing and Chemical Cleaning” for flushing and cleaning of HVAC piping.

1.02 SUMMARY

A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheet metal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

D. Comply with NSF 372, “Drinking Water System Components – Lead Content” for potable domestic water piping and components.

E. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

F. Duct Joint and Seam Welding: Qualify procedures and personnel according to the following:

1. AWS D9.1, "Sheet Metal Welding Code."

G. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."

H. Installer Qualifications:

1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.
2. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
3. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.
1. Protect equipment and materials from theft, injury or damage.
2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.
B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.
D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.
B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.
B. Unions: Pipe Size 2 Inches and Smaller:

1. Ferrous pipe: Malleable iron ground joint type unions.
2. Unions in galvanized piping system shall be galvanized.
3. Copper tube and pipe: Bronze unions with soldered joints.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: Alloys meeting AWS A5.8.
1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.

F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

G. Solvent Cements for Joining PVC to ABS Piping Transition: ASTM D 3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 PIPE THREAD COMPOUNDS

A. General: Pipe thread compounds for the fluid service compatible with piping materials provided.

B. Potable Water Service and Similar Applications: Compounds acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.

C. Natural Gas System: Use either of the following:
1. Tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for threaded joints.
a. Manufacturers:
1) Cadillac Plastic.
2) Permacel.
3) Other approved.
2. Lead-free pipe thread compounds suitable for service.
a. Manufacturers:
1) HCC Holdings, Inc.; Hercules Pro Dope.
2) Mill-Rose Company (The); Clean-Fit Products; Blue Monster Thread Sealant.
3) Oatey; Great Blue Pipe Joint Compound.
4) RectorSeal LLC: A CSW Industrials Company; No. 5, No.5 Special, and No. 5 Sub-Zero Pipe Thread Sealants.

2.05 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:
a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.
2. Aboveground Pressure Piping: Pipe fitting.

2.06 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.

D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.

c. Capitol Manufacturing Co.
d. GF Piping Systems; George Fischer Central Plastics.
e. Epco Sales, Inc.
f. Pipeline Seal and Insulator, Inc.
g. Watts Water Technologies, Inc.; Watts Regulator Co.
h. Zurn Industries, Inc.; Wilkins Div.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.

1. Manufacturers:
a. ASC Engineered Solutions; Gruvlok Manufacturing; DI-LOK Nipples.
b. Elster Group; Perfection Corp.; ClearFlow.
c. Precision Plumbing Products, Inc.; ClearFlow.
d. Sioux Chief Manufacturing Co., Inc.
e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
f. Victaulic Co. of America; Style 47 ClearFlow.

2.07 SLEEVES

A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.

B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.

C. Water Stop: Cast or ductile-iron; fabricated steel; PVC; or rotationally molded HDPE pipe; with plain ends and integral water stop, unless otherwise indicated.

1. Manufacturers:
a. Advance Products & Systems, Inc.; Infinity and Gal-Vo-Plast Sleeves.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.08 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

1. New Piping:
a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2. Existing Piping: Use the following:
a. Chrome-Plated Piping or Piping in High Humidity Areas: Split-casting, cast-brass type with chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
c. Bare Piping: Split-plate, stamped-steel type with set screw or spring clips.

2.09 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.10 EPOXY BONDING COMPOUND

A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.

B. Manufacturers:

1. Euco 452 #450; Euclid Chemical Co.
2. Epobond; L & M Construction Chemicals.
3. Sikadur 87; Sika Corp.

2.11 LEAK DETECTOR SOLUTION

A. Commercial leak detector solution for pipe system testing.

B. Manufacturers:

1. American Gas and Chemicals Inc.; Leak Tec.
2. Cole-Parmer Inst. Co.; Leak Detector.
3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Refer to piping application schedules on the Drawings.

B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer's instructions.

C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. The Drawings shall be followed as closely as elements of construction will permit.

D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.

E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.

F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

H. Clean and lubricate elastomer joints prior to assembly.

I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

J. Install piping to conserve building space and not interfere with use of space.

K. Group piping whenever practical at common elevations.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.

M. Slope piping and arrange systems to drain at low points.

N. Slope horizontal piping containing non-condensable gases 1 inch per 100 feet, upward in the direction of the flow.

O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

P. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.

R. Do not penetrate building structural members unless specifically indicated on drawings.
S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.
T. Install valves with stems upright or horizontal, not inverted.
U. Provide clearance for installation of insulation and access to valves and fittings.
V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.
W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.
X. Install piping free of sags and bends.
Y. Install fittings for changes in direction and branch connections.
Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:
    1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
    2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.
AA. Install piping to allow application of insulation.
BB. Select system components with pressure rating equal to or greater than system operating pressure.
CC. After completion, fill, clean, and treat systems. Refer to Division 23 Sections “Hydronic Piping,” “Piping Systems Flushing and Chemical Cleaning,” and “HVAC Water Treatment.”
DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.
EE. Sleeves are not required for core-drilled holes in poured concrete walls.
FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.
GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
    1. Cut sleeves to length for mounting flush with both surfaces of walls.
        a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
    2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
    3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
        a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
        b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
        c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
        d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
        e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.
    4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
    5. Seal sleeves in plaster/gypsum-board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
    6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
HH. Existing Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Seal core drilled pipe penetrations using modular mechanical seals. Allow for 1-inch annular clear space between pipe and cored opening for installing modular mechanical seals.
    1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of cored hole. Assemble modular mechanical seals and install in annular space between pipe and cored opening. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
II. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.
2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.

JJ. Verify final equipment locations for roughing-in.

KK. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

B. Cut piping square.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.

E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.

G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.

H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.

I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.

J. Provide temperature sensing device thermal wells and similar piping specialty connections.

K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.

L. Locate instrument connections in accordance with manufacturer’s instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.

M. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

O. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face

down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.

R. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

S. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

T. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.

U. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

V. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

W. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.03 ACCESS DOORS

A. Provide access doors for installation by architectural trades. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section "Access Doors and Frames" for manufacturers and model numbers and additional information.

B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

3.04 EQUIPMENT CONNECTIONS

A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.

1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer's submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.

B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.05 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
   2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.06 INSTALLATION OF PIPE CONCEALMENT SYSTEM

A. Install cover system, brackets, and cover components for piping according to manufacturer's "Installation Manual."

3.07 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.
B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
D. Install equipment to allow right of way for piping installed at required slope.
E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.
F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.
G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer’s name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.08 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09.
B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.09 CONCRETE BASES

A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.
B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
   1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Where pipe and/or equipment support members must be welded to structural building framing, Contractor shall seek prior approval from Architect and structural engineer. Scrape, brush clean, and apply one coat of zinc rich primer after welding.

D. Field Welding: Comply with AWS D1.1.

3.11 JACKING OF PIPE

A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.12 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.13 CUTTING, CORING AND PATCHING

A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.

B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.14 FLASHING

A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.15 LUBRICATION

A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.16 FILTERS

A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment,without all prefilters and final filters as specified.Immediately prior to final building acceptance by the Owner, Contractor shall:

1. Replace all disposable type air filters with new units.

3.17 CLEANING

A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

B. After equipment, steam, condensate and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

C. Prior to connection of new HVAC piping to existing HVAC piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

D. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section “Domestic Water Piping.”

E. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.
F. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION 20 0510

SECTION 20 0513 - MOTORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
3. Division 20 Section “Variable Frequency Controllers”.
4. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
5. Division 26 Section “Enclosed Switches and Circuit Breakers”.
6. Division 26 Section “Enclosed Controllers”.
7. Division 26 Section “Fuses”.

1.02 SUMMARY

A. This Section includes basic requirements for factory-installed motors.DEFINITIONS

A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)

B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

C. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

D. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.06 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
   1. Compatible with the following:
      a. Magnetic controllers.
      b. Multispeed controllers.
      c. Reduced-voltage controllers.
      d. Solid-state controllers.
      e. Variable frequency controllers.
   2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
   3. Matched to torque and horsepower requirements of the load.
   4. Matched to ratings and characteristics of supply circuit and required control sequence.
B. Coordinate electrical scope of work to be provided by Division 20, 21, 22, and 23 with this Section, related Division 20, 21, 22, and 23 Specifications, Division 26 Specifications and the Drawings.
C. Electrical work provided under Division 20, 21, 22, and 23: Furnish UL Listed components in accordance with this section, Division 26, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.
D. Furnished, installed and wired under Division 20, 21, 22, and 23 unless otherwise indicated:
   1. Disconnected components in packaged self-contained equipment that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.

PART 2 PRODUCTS

2.01 MOTOR REQUIREMENTS

A. Motor requirements apply to factory-installed motors except as follows:
   1. Different ratings, performance, or characteristics for a motor are specified in another Section.
   2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
   3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.
B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.
C. Electrical Power System Characteristics: As scheduled on the Drawings.
D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.02 MOTOR CHARACTERISTICS

A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.
B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.
C. Frequency Rating: 60 Hz.
D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.
I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

	1800 RPM OPEN DRIP-PROOF MOTORS 4 POLE		1800 RPM ENCLOSED MOTORS 4 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
1	80	78.5	--	--
1.5	84	82.5	82.5	81.5
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
100	94.1	93.6	93	92.4
125	94.1	93.6	93.6	93
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts for 5kV or Less (Form Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

D. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

E. Rotor: Squirrel cage, unless otherwise indicated.
F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
G. Temperature Rise: Match insulation rating, unless otherwise indicated.
H. Insulation: Class F, unless otherwise indicated.
I. Code Letter Designation:
    1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.
    2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.
    3. Fire Pump Motors: NEMA starting Code (KVA Code) B.
J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
    1. Finish: Gray enamel.
K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.04 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Furnish for equipment where specified or scheduled with ECM.
    1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
    2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
    3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
    4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
    5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
    6. Integrated motor protection verified by UL to protect equipment against over-/undervoltage, overtemperature of motor, electronics, or both, overcurrent, locked rotor, and dry run (no-load condition).

2.05 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:
    1. Permanent-split capacitor.
    2. Split-phase start, capacitor run.
    3. Capacitor start, capacitor run.
B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

2.06 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

A. Provide enclosed switches and circuit breakers in accordance with requirements specified in Division 26 Section “Enclosed Switches and Circuit Breakers”.

PART 3 EXECUTION

3.01 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.02 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 20 0513

SECTION 20 0516 - PIPE FLEXIBLE CONNECTORS, EXPANSION FITTINGS AND LOOPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Refrigerant Piping.”

1.02 DEFINITIONS

A. BR: Butyl rubber.

B. CR: Chlorosulfonated polyethylene synthetic rubber (Neoprene).

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. NBR: Buna-N/Nitrile rubber.

E. PTFE: Polytetrafluoroethylene plastic.

1.03 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.

B. Capability: Products shall absorb 150 percent of maximum axial movement between anchors.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of pipe flexible connector, expansion joint and alignment guide indicated.

1.05 INFORMATIONAL SUBMITTALS

A. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pipe expansion joints to include in operation and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FLEXIBLE CONNECTORS

A. Hose and Braid Flexible Connectors:

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Hose Co., Inc.
   c. Flex-Weld, Inc.
   d. Hyspan Precision Products, Inc.
   e. Metraflex, Inc.
   f. Senior Flexonics, Inc.; Pathway Division.
   g. Twin City Hose, Inc.
2. Flexible Connectors for Copper Piping: Multiple-ply phosphor-bronze corrugated hose with bronze outer braid, copper ferrule, and copper pipe end connections.
3. Flexible Connectors for Steel Piping: Multiple-ply stainless-steel corrugated hose with stainless steel outer braid, and steel pipe end connections.
4. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
5. Maximum Temperature Rating: 450 deg F for copper piping connectors, 800 deg F for steel piping connectors.

B. Grooved Mechanical Flexible/Expansion Joint:

1. Manufacturers:
   a. Anvil International, Inc.; Fig. 7420 Expansion Joint.
   b. Victaulic Company; Model 77 Flexible Coupling, W77 AGS Flexible Coupling, and 177N QuickVic Installation-Ready Flexible Coupling.
2. Description: Comprised of multiple flexible style couplings, and precision machined grooved end pipe nipples. Assembly uses factory installed ties to custom preset expansion joint in the expanded, compressed, or intermediate position.
3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.
4. Couplings: Ductile-iron housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   a. Flexible Type: To provide a flexible pipe joint which allows for vibration isolation, expansion, contraction, and deflection. Quantity and arrangement as recommended by manufacturer.

PART 3 EXECUTION

3.01 FLEXIBLE CONNECTOR APPLICATIONS

A. Use hose and braid

END OF SECTION 20 0516

SECTION 20 0519 - METERS AND GAGES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 21 Section “Fire-Suppression Piping” for listed or approved pressure gages.
4. Division 21 fire pump sections for fire-pump flowmeter systems.
5. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.

1.02 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Schedule for the following indicating manufacturer's number, scale range, and location for each:

1. Thermometers.
2. Gages.
3. Flowmeters.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the following to include in operation and maintenance manuals:

1. Flowmeters.
2. Thermal-energy meters.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Miljoco Corporation.
3. REOTEMP Instrument Corporation.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or Chrome-plated brass, 9 inches long.

C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanent scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.03 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Brass for compatible services less than 353 degrees F; ANSI 18-8 stainless steel for all others to suit service. Furnish extension neck to accommodate insulation where applicable.

2.04 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Cambridge.
3. Dwyer Instruments, Inc.
4. Marsh Bellofram.
5. Miljoco Corporation.
6. Trerice, H. O. Co.
7. Weiss Instruments, Inc.
8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Stainless steel, aluminum, or FRP, 6-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.

5. Dial: Satin-faced, nonreflective aluminum with permanent scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or plastic.
8. Ring: Stainless steel or chrome plated metal.

C. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
1. Water: 0-100 PSIG (1 psi divisions to 50 psi; 5 psi divisions above 50 psi), liquid filled.
2. Range for Fluids under Pressure: 1-1/2 times expected working pressure. If not a standard scale, select next largest scale.

D. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass ball type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.05 TEST PLUGS

A. Manufacturers:
1. Peterson Equipment Co., Inc.
2. Miljoco Corporation.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F for cold services.

D. Core Inserts: One or two self-sealing rubber valves.
1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be Neoprene.

PART 3 EXECUTION

3.01 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:
1. Inlet and outlet of geo exchange field.
2. Inlet and outlet of each hydronic heat pump.
3. Outside air duct upstream and downstream of energy recovery ventilator.
4. Return/exhaust duct upstream and downstream of energy recovery ventilator.

B. Provide the following temperature ranges for thermometers:
1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 30 to 130 deg F, with 2-degree scale divisions.
3. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
4. Geo Exchange Water: 30 to 160 deg F, with 2-degree scale divisions.
5. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.

3.02 GAGE APPLICATIONS

A. Install dry-case-type pressure gages on inlet and outlet of each pressure-reducing valve.

B. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.

C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.03 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

C. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install ball valve and snubber fitting in piping for each pressure gage for fluids.

F. Install test plugs in tees in piping.

G. Install flow indicators, in accessible positions for easy viewing, in piping systems.

H. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

I. Install flowmeter elements in accessible positions in piping systems.
J. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
K. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.04 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
B. Connect flowmeter-system elements to meters.
C. Connect flowmeter transmitters to meters.
D. Connect thermal-energy-meter transmitters to meters.
E. Ground equipment according to Division 26 Section "Grounding and Bonding."
F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.
B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 20 0519

SECTION 20 0529 - HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 20 Section “Basic Mechanical Materials and Methods.”
4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
5. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops" for pipe guides and anchors.
6. Division 21 Section "Fire-Suppression System" for pipe hangers for fire-protection piping.
7. Division 23 Section(s) "Metal Ducts" for duct hangers and support.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. MFMA: Metal Framing Manufacturers Association.

1.03 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.

1.05 QUALITY ASSURANCE

A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
   1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture, Selection, Application, and Installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 HANGER ROD MATERIAL

A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
   1. Rod continuously threaded.
   2. Use of rod couplings is prohibited.

2.03 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.
   1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.

B. Manufacturers:
   1. Anvil; ASC Engineered Solutions.
   2. B-Line by Eaton.
   3. Carpenter & Paterson, Inc.
   4. Hilti USA.
   5. nVent Electric plc; CADDY.
   6. PHD Manufacturing, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.04 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.05 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
   1. Anvil; Anvil-Strut; ASC Engineered Solutions.
   2. B-Line by Eaton.
   3. nVent Electrical plc; ERISTRUT Div.
   4. Power-Strut; a part of Atkore International.
   5. Unistrut; a part of Atkore International.
   6. Hilti USA.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

E. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.06 PIPE COVERING PROTECTION SADDLES

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.
1. Saddles shall match insulation thickness.
2. Saddle length: 12 inches.
3. Furnish with center rib for pipe sized NPS 12 and larger.

2.07 THERMAL-HANGER SHIELDS

A. Manufacturers:
1. American Mechanical Insulation Sales Inc. (AMIS).
2. B-Line by Eaton.
3. nVent Electric plc; CADDY.
4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.
1. Minimum Compressive Strength of Insert Material:
a. 100-psig- for sizes smaller than NPS 6.

C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.

G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:
1. Manufacturer:
a. B-Line by Eaton/Armacell; Armafix IPH.
b. Aeroflex USA, Inc,; Aerofix-U.
c. ZSi-Foster, Inc.; Cush-A-Therm.
2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:
a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.

H. Thermal-Hanger Shields for Small Diameter Piping:
1. Manufacturer:
a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.
2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:
a. Rigid Hytrel thermoplastic insulation coupling designed for use with pipe or tube NPS 4 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

2.08 FASTENER SYSTEMS

A. Post-Installed Anchors:
1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
a. Manufacturers:
1) B-Line by Eaton.

2) DeWalt Engineered by Powers.
3) Hilti, Inc.
4) ITW Ramset/Red Head.
5) MKT Fastening, LLC.

2. Internally Threaded Screw Anchors: Internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck.
   a. UL Listed or FMG approved for fire sprinkler piping.
   b. Available Sizes: For1/4-inch, 3/8-inch, and 1/2-inch diameter rod sizes
   c. Manufacturers:
      1) B-Line by Eaton; Rapid Rod Hangers.
      2) DeWalt Engineered by Powers; Snake+.

B. Cast-in-Place Anchors:
   a. Threaded Inserts: Galvanized malleable iron or galvanized steel for 3/4 inch bolts.
   b. Manufacturers:
      1) B-Line by Eaton.
      2) DeWalt Engineered by Powers.
      3) Empire Industries, Inc.
      4) Hilti, Inc.
      5) ITW Ramset/Red Head.
      6) MKT Fastening, LLC.
      7) Richmond Screw Anchor Co.

2. Slotted Inserts: Continuous galvanized steel with temporary slot fillers and complete with nuts, studs, washers and the like, for 3/4 inch bolts.
   a. Manufacturers:
      1) B-Line by Eaton; B22-I Continuous Concrete Insert.
      2) Hilti, Inc.; CIS13812/PG.
      3) Hohman and Barnard, Inc.
      4) Richmond Screw Anchor Co.
      5) Unistrut; a part of Atkore International; P-3200 Continuous Insert.

2.09 ROOF MOUNTED EQUIPMENT SUPPORTS

A. Equipment Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted equipment.

B. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.
   1. Manufacturers:
      a. B-Line by Eaton; Dura-Blok.
      b. Eco Support Products.
      c. MIFAB, Inc.; C-Port.
      d. MIRO Industries; HD and LD Mechanical Unit Supports.
      e. nVent Electric plc; CADDY.
      f. Portable Pipe Hangers.
   2. Base: Plastic, stainless steel, or recycled rubber.
   3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rood, and accessories.

C. Roof Rail-Type Equipment Stands: Welded 18 gage galvanized steel shell, base plate and counter flashing. Factory installed chemically treated wood nailer. Fully mitered end sections. Internal bulkhead reinforcement.
   1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
      a. Manufacturers:
         1) Pate.
         2) Thybar; TEMS Series.

3) Roof Products and Systems.
4) Greenheck.
5) Creative Metals.

2.10 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.11 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Refer to application schedules on the Drawings.
B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.
C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
D. Comply with MSS SP-58 for pipe hanger selections and applications that are not specified in piping system Sections.
E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.
F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.
G. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.
H. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
I. Use padded hangers for piping that is subject to scratching.
J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. MSS Type 8 or spring type to meet system requirements.
K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
L. Concrete Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Anchor Devices, Concrete and Masonry: in accordance with Group I, Group II, Type 2, Class 2, Style 1 and Style 2, Group III and Group VIII or FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry, unless otherwise approved by the Architect. Powder actuated anchoring devices shall not be used to support any mechanical systems components.
   2. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
   3. Use mechanical-expansion anchors where required in concrete construction.
M. Steel Frame Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Beam Clamps:
    a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
    b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.

N. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.

B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.

C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.

D. Use copper plated or plastic coated supporting element in contact with copper tubing.

E. File and paint cut ends and shop or field prime paint supporting element components.

F. Secure Type 40 shields to support elements in a manner that prevents movement and damage to insulation and jacket materials.

G. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.

H. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.

I. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.

J. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment.

K. Where necessary, brace piping and supports against reaction, sway and vibration.

L. Do not hang piping from concrete joist pans, floor decks, roof decks, equipment, ductwork, or other piping.

M. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.

N. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.

O. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.

P. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical

risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.

Q. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.

R. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.

S. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.

T. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.

U. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.

V. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.

W. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.

X. Building structure shall not be reinforced except as approved by the Architect in writing.

Y. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor in accordance with applicable codes but in no case less than 5. Coordinate installation of all imbedded items in accordance with manufacturer's instructions. Position anchorage and imbedded items as indicated and/or where required and support against displacement during placing of concrete. Cutting or repositioning of concrete beam or girder or reinforcing steel to accommodate inserts will not be allowed. Provide removable closures in imbedded device openings to prevent entry of concrete.

Z. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.

AA. Use cast-in-place inserts in concrete beams and girders. Drilled anchors/wedge type inserts shall be used on vertical surfaces only. Coordinate with structural engineer.

BB. Attach piping supports to the side of concrete beams and concrete joist. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete beams and concrete joist.

CC. Attach piping supports to the side of concrete beams or concrete joist. Where intermediate hangers are required to meet the hanger spacing schedule, the Contractor may propose attachment of intermediate pipe supports to the bottom of the concrete slab pending submittal of a satisfactory pull out test. The Contractor shall submit pull out test criteria, pull out test results, proposed hanger detail and hanger point loads to the Architect for written approval.

DD. Trapeze Pipe Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

EE. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

FF. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

GG. Roof-Mounting Pipe and Equipment Stand Installation:
1. Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb or Rail Mounting Type Stands: Assemble components or fabricate stand and mount on permanent, stationary roof curb or rail. Refer to Division 07 Section "Roof Accessories" for curb and rail installation.
3. Maintain support manufacturer's recommended spacing.

HH. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

II. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

JJ. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

KK. Install lateral bracing with pipe hangers and supports to prevent swaying.

LL. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

MM. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

NN. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

OO. Refer to individual piping sections for hanger spacing and hanger rod sizes.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Equipment Supports: Painting is specified in Division 09 painting Sections.

C. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 20 0529

SECTION 20 0533 - ELECTRIC HEAT TRACING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections:

1. Division 20 Section “Mechanical General Requirements.”

1.02 SUMMARY

A. Section includes electric heat tracing for piping freeze prevention and flow control.

1.03 PERFORMANCE REQUIREMENTS

A. Pipe Heat Tracing: Select electric heat tracing cable capable of providing freeze protection and flow control with outside temperature at minus 10 deg F.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.05 INFORMATIONAL SUBMITTALS

A. Delegated-Design Submittal:

1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable.

1. Include plans, elevations, sections, and attachment details.
2. Accurately record actual locations of heating cable, thermostats, and branch circuit connections.
3. Include diagrams for power, signal, and control wiring.

1.06 CLOSEOUT SUBMITTALS

A. Field quality-control reports.

B. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1. Include description of operating controls.
2. Include repair methods and parts list of components.

1.07 COORDINATION

A. Coordinate with installation of piping insulation.

PART 2 PRODUCTS

2.01 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Thermon Americas Inc.; FLX Self-Regulating Heating Cable.
   2. Raychem; nVent Electric plc; XLTrace.
   3. Delta-Therm Corporation; IN Series.
   4. Chromalox Advanced Thermal Technologies; a business of Spirax-Sarco Engineering PLC.

B. Comply with IEEE 515.1.

C. Heating Element: Pair of No. 16 AWG, parallel, nickel-coated copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Cable Cover: Tinned-copper braid and polyolefin outer jacket.

F. Maximum Operating Temperature (Power On): 150 deg F.

G. Maximum Exposure Temperature (Power Off): 185 deg F.

H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL acceptable to authorities having jurisdiction, and marked for intended location and application.

I. Capacities and Characteristics:
   1. Maximum Heat Output: W/ft. as recommended by manufacturer.
   2. Piping Diameter: As indicated on the Drawings.
   3. Number of Parallel Cables: As recommended by manufacturer.
   4. Electrical Characteristics for Single-Circuit Connection: Coordinate electrical system requirements with Division 26.

J. Electrical Power System Characteristics: As scheduled on the Drawings.

2.02 CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Thermon Americas Inc.
   2. Raychem; nVent Electric plc.
   3. Delta-Therm Corporation.
   4. Chromalox Advanced Thermal Technologies; a business of Spirax-Sarco Engineering PLC.

B. Pipe-Mounted Thermostats for Freeze Protection:
   1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
   2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
   3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
   4. Corrosion-resistant, waterproof control enclosure.

2.03 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Self-adhesive labels with legend “ELECTRIC HEAT TRACING.” Refer to Division 20 Section "Mechanical Identification" for additional requirements

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
   1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
   2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Freeze Protection for Piping:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install electric heating cables according to IEEE 515.1.
3. Install insulation over piping with electric cables according to Division 20 Section "Mechanical Insulation."
4. Install warning labels at 10 foot intervals, or install continuous warning tape on piping insulation where piping is equipped with electric heating cables.

C. Set field-adjustable switches and circuit-breaker trip ranges.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
2. Test cables for electrical continuity and insulation integrity before energizing using 2500 Vdc megohmmeter (megger).
3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Remove and replace damaged heat-tracing cables.

E. Prepare test and inspection reports.

3.05 PROTECTION

A. Protect installed heating cables, including non-heating leads, from damage during construction.

END OF SECTION 20 0533

SECTION 20 0547 - MECHANICAL VIBRATION CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: Include load deflection curves for each vibration isolation device.

1.03 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Installation of these items is specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 VIBRATION ISOLATORS

A. **Type 1a** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type W, Super W, WSW, and WSWSW or comparable products by one of the following:
   Amber/Booth; a VMC Group Company.
   Kinetics Noise Control, Inc.
   Korfund Dynamics; a VMC Group Company.
   Vibration Eliminator Co., Inc.
   Vibration Mountings & Controls; a VMC Group Company.
   Vibro-Acoustics.
2. Material: Standard neoprene for indoor applications.
3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.

B. **Type 1b** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, single layer, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and 1/4 inch steel load bearing plate. Factory cut to sizes that match requirements of supported equipment.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type Super WMSW and MBSW or a comparable product by one of the following:
      Amber/Booth; a VMC Group Company.
      Kinetics Noise Control, Inc.
      Korfund Dynamics; a VMC Group Company.
      Vibration Eliminator Co., Inc.
      Vibration Mountings & Controls; a VMC Group Company.
      Vibro-Acoustics.
   2. Material: Standard neoprene for indoor applications.
   3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.

C. **Type 2** Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ND or a comparable product by one of the following:
      Amber/Booth; a VMC Group Company.
      Kinetics Noise Control, Inc.
      Korfund Dynamics; a VMC Group Company.
      Vibration Eliminator Co., Inc.
      Vibration Mountings & Controls; a VMC Group Company.
      Vibro-Acoustics.
   2. Durometer Rating: Selected for maximum possible static deflection with the loading of each piece of equipment.
   3. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
   4. Neoprene: Bridge-bearing neoprene as defined by AASHTO.

D. **Type 3** Spring Isolators: Freestanding, open-spring isolators.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type SLF or a comparable product by one of the following:
      Amber/Booth; a VMC Group Company.
      Kinetics Noise Control, Inc.
      Korfund Dynamics; a VMC Group Company.
      Vibration Eliminator Co., Inc.
      Vibration Mountings & Controls; a VMC Group Company.
      Vibro-Acoustics.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. **Type 4** Restrained Spring Isolators: Restrained single and multiple spring mounts.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Types SLR and SLRS or comparable products by one of the following:
      Amber/Booth; a VMC Group Company.
      Kinetics Noise Control, Inc.

Korfund Dynamics; a VMC Group Company.
Vibration Eliminator Co., Inc.
Vibration Mountings & Controls; a VMC Group Company.
Vibro-Acoustics.

2. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.02 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07 Section "Roof Accessories."
B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

3.03 APPLICATION

A. Refer to Vibration Isolator Application Schedule on the drawings for isolator application and minimum deflection.

3.04 CONNECTIONS

A. Vibration isolate piping connected to vibration isolated equipment using Type 8a or 8b spring hangers, and with distance to be isolated as scheduled on the Drawings. Maximum spacing between isolators same as maximum distance between pipe hangers and supports.
B. Vibration isolate ductwork connected to air handling units, return air fans, and vibration isolated equipment using Type 8a or 8b spring hangers, and in accordance with isolation distances scheduled on the Drawings.

3.05 EQUIPMENT BASES

A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.
1. Cast-in-place concrete materials and placement requirements are specified in Division 03.
B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions.
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.06 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Adjust active height of spring isolators.

3.07 CLEANING

A. After completing equipment installation, inspect vibration isolation devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION 20 0547

SECTION 20 0553 - MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Samples: For color, letter style, and graphic representation required for each identification material and device.

B. Valve numbering scheme.

1.04 CLOSEOUT SUBMITTALS

A. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.05 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.06 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. Seton.
2. Brady.
3. EMED.
4. Craftmark.
5. Brimar Industries, Inc.
6. Marking Services Inc. (MSI).
7. Kolbi Pipe Marker Co.

2.02 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
   1. Data:
      a. Manufacturer, product name, model number, and serial number.
      b. Capacity, operating and power characteristics, and essential data.
      c. Labels of tested compliances.
   2. Location: Accessible and visible.
   3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
   1. Terminology: Match schedules as closely as possible.
   2. Data:
      a. Name and plan number.
      b. Equipment service.
      c. Design capacity.
      d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
   3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
   1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.03 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
   1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
   2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
   3. Legends: Spelled out in full or commonly used and accepted abbreviations.
   4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
   5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

D. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.04 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

PART 3 EXECUTION

3.01 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
   1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
   2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
   3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
   4. Fans, blowers, primary balancing dampers, and mixing boxes.
   5. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
   1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
   3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
      a. Gas outlets.
      b. Pumps.
      c. Fans, blowers, and hoods.
      d. Heat pumps and energy recovery devices.
      e. Tanks and pressure vessels.

C. Install access panel markers with screws on equipment access panels.

D. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.03 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
   1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.04 DUCT IDENTIFICATION

A. Identify ductwork with vinyl markers and flow direction arrows.

B. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.06 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.07 SCHEDULES

A. Paint colors are listed here for reference only. Painting is specified under Division 9.

PIPE LABELING AND COLOR CODING

Pipe System Label	Drawing Abbrev.	Labels	Piping
Sanitary Sewer	SAN	White on Green	Dark Brown
Sanitary Vent	V	White on Green	Dark Brown
Rain Conductor	RC	White on Green	Dark Brown
Domestic Cold Water	CW	White on Green	Light Green
Non-Potable Cold Water	NPCW	Black on Yellow	
Domestic Hot Water	HW	Black on Yellow	Dark Green
Domestic Hot Water Return	HWR	Black on Yellow	Dark Green
Compressed Air (90psig)	A(90psig)	Black on Yellow	Dark Blue
Compressed Air (25psig)	A	White on Green	Dark Blue
Heat Pump Loop Water Supply	CWS	White on Green	Light Green
Heat Pump Loop Return	CWR	White on Green	Light Green
Fire Protection	FP	White on Red	Bright Red

SHEET METAL WORK

Service	Abbrev.	Labels	Ductwork
Air Conditioning Supply	Supply Air	White on Green	White
Air Conditioning Return	Return Air	White on Green	White
Exhaust Systems	Exhaust Air	Black on Yellow	Green
Outside Air Intake	Outside Air	White on Green	White
Mixed Air	Mixed Air	White on Green	White

END OF SECTION 20 0553

SECTION 20 0700 - MECHANICAL INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section “Hanger and Supports” for thermal hanger shield inserts.
4. Division 22 Section “Plumbing Fixtures: for protective shielding guards.
5. Division 23 Section "Metal Ducts" for duct liners.

1.02 SUMMARY

A. This Section includes mechanical insulation for pipe, duct, and equipment.

1.03 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. PVC: Polyvinyl Chloride.

D. SSL: Self-sealing lap.

1.04 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

B. Sanitary Waste Piping Where Heat Tracing Is Installed, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 1-1/2 inches thick.

1.05 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.06 EQUIPMENT INSULATION SYSTEMS DESCRIPTION

A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

1.07 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.08 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer’s original packaging.

1.10 COORDINATION

A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.11 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS, GENERAL REQUIREMENTS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.02 PIPE INSULATION MATERIALS

A. Glass-Fiber, Preformed Pipe Insulation, Type I:

1. Products: Subject to compliance with requirements, provide one of the products specified.
    a. Johns Manville; Micro-Lok.
    b. Knauf Insulation; 1000 Pipe Insulation.
    c. Manson Insulation Inc.; Alley-K.
    d. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.03 DUCTWORK INSULATION MATERIALS

A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
    1. Products: Subject to compliance with requirements, provide one of the products specified.
        a. CertainTeed Corp.; Duct Wrap.
        b. Johns Manville; Microlite EQ.
        c. Knauf Insulation; Duct Wrap.
        d. Manson Insulation Inc.; Alley Wrap B.
        e. Owens Corning; All-Service Duct Wrap.
B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
    1. Products: Subject to compliance with requirements, provide one of the products specified.
        a. CertainTeed Corp.; Commercial Board.
        b. Fibrex Insulations Inc.; FBX.
        c. Johns Manville; 800 Series Spin-Glas.
        d. Knauf Insulation; Insulation Board.
        e. Manson Insulation Inc.; AK Board.
        f. Owens Corning; Fiberglas 700 Series.

2.04 EQUIPMENT INSULATION MATERIALS

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
    1. Products: Subject to compliance with requirements, provide one of the products specified.
        a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
        b. Armacell LLC; AP Armaflex.
        c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.
B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
    1. Products: Subject to compliance with requirements, provide one of the products specified.
        a. CertainTeed Corp.; Commercial Board.
        b. Fibrex Insulations Inc.; FBX.
        c. Johns Manville; 800 Series Spin-Glas.
        d. Knauf Insulation; Insulation Board.
        e. Manson Insulation Inc.; AK Board.
        f. Owens Corning; Fiberglas 700 Series.
C. Large Diameter Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
    1. Products: Subject to compliance with requirements, provide one of the products specified.
        a. CertainTeed Corp.; CrimpWrap.
        b. Johns Manville; MicroFlex.

c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.05 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.

B. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the products specified.
a. Childers Products, H.B. Fuller Company; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. Johns Manville Industrial Insulation; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

C. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the products specified.
a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Red Devil, Inc.; Celulon Ultra Clear.
e. Speedline Corporation; Speedline Vinyl Adhesive.

2.06 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.
a. Childers Products, H.B. Fuller Company; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. Johns Manville Industrial Insulation; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.07 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
a. Childers Products, H.B. Fuller Company; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
a. Childers Products, H.B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

D. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Airex Manufacturing, Inc.; E-Flex Guard.
   b. Johns Manville; Zeston and Ceel-Co.
   c. P.I.C. Plastics, Inc.; FG Series.
   d. Proto PVC Corporation; LoSmoke.
   e. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated tank heads and tank side panels.

E. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Airex Manufacturing, Inc.
   b. Johns Manville; Zeston and Ceel-Co.
   c. P.I.C. Plastics, Inc.; FG Series.
   d. Proto PVC Corporation; LoSmoke.
   e. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers:
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 728 Cold Seal ASJ or comparable products by one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division.
   b. 3M Venture Tape.
2. Width: 3 inches.
3. Thickness: 9 mils.
4. Adhesion: 70 ounces force/inch in width.
5. Elongation: 3 percent.
6. Tensile Strength: 45 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with rubber or acrylic adhesive; complying with ASTM C 1136 and UL listed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 491 FSK or 791 Cold Seal Acrylic FSK, or comparable products by one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division.
   b. 3M Venture Tape.
2. Width: 3 inches.

3. Thickness: 6 mils.
4. Adhesion (Rubber Adhesive): 100 ounces force/inch in width.
5. Adhesion (Acrylic Adhesive): 90 ounces force/inch in width.
6. Elongation: 3 percent.
7. Tensile Strength: 35 lbf/inch in width.
8. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

A. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
a. Products: Subject to compliance with requirements, provide one of the products specified.
1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
a. Products: Subject to compliance with requirements, provide one of the products specified.
1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers:
a. ACS Industries, Inc.
b. C & F Wire.
c. PABCO-Childers Metals; Johns Manville Industrial Insulation.
d. RPR Products, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive as recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.
J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. Seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
    1. Install insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    3. Install thermal hanger insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
    4. Cover thermal hanger inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
L. Install insulation with factory-applied jackets as follows:
    1. Draw jacket tight and smooth.
    2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
    3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
        a. For below ambient services, apply vapor-barrier mastic over staples.
    4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
    5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.
N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
P. For above ambient services, do not install insulation to the following:
    1. Vibration-control devices.
    2. Testing agency labels and stamps.
    3. Nameplates and data plates.
    4. Manholes.
    5. Handholes.
    6. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
    1. Seal penetrations with flashing sealant.
    2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations that Are Not Fire Rated: Install insulation through walls and partitions as detailed.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations:
1. Terminate ductwork insulation at angle closure of fire damper sleeves.
2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
a. Firestopping is specified in Division 07 Section “Through-Penetration Firestop Systems.”

E. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
2. Pipe: Install insulation continuously through floor penetrations.
a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services.

Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible Elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.06 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:
   a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.07 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.
1. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not over compress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
3. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not over compress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.08 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.
B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
D. Do not field paint aluminum or stainless-steel jackets.

END OF SECTION 20 0700

SECTION 21 1100 - FIRE-SUPPRESSION SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Provisions of Division 20 Section “Mechanical General Requirements” apply to this Section.

C. Related Sections include the following:
   1. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
   2. Division 20 Section “Basic Mechanical Materials and Methods.”
   3. Division 20 Section "Hangers and Supports.”
   4. Division 28 Section "Fire Alarm" for alarm devices not specified in this Section.

1.02 DEFINITIONS

A. Underground Service-Entrance Piping: Underground service piping below the building.
B. Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.
C. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

1.03 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.04 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
C. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
   1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   2. Sprinkler Occupancy Hazard Classifications, for bidding purposes, as follows:
      a. Automobile Parking Areas: Ordinary Hazard, Group 1.
      b. Building Service Areas: Ordinary Hazard, Group 1.
      c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
      d. General Storage Areas: Ordinary Hazard, Group 1.
      e. Laundries: Ordinary Hazard, Group 1.
      f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
      g. Office and Public Areas: Light Hazard.
   3. Minimum Density for Automatic-Sprinkler Piping Design:
      a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500-sq. ft. area.
      b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
   4. Maximum Protection Area per Sprinkler:
      a. Office Spaces: 120 sq. ft.
      b. Storage Areas: 130 sq. ft.
      c. Mechanical Equipment Rooms: 130 sq. ft.
      d. Electrical Equipment Rooms: 130 sq. ft.
      e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
   5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
      a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
      b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
D. Water velocity in the piping system shall not exceed the following:
   1. Underground mains: 16 ft./sec.
   2. Aboveground mains: 32 ft./sec.
   3. Sprinkler branch lines: 24 ft./sec.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.06 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

B. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
    1. Domestic water piping.
    2. Compressed air piping.
    3. HVAC hydronic piping.
    4. Items penetrating finished ceiling include the following:
        a. Lighting fixtures.
        b. Air outlets and inlets.
D. Qualification Data: For qualified Installer.
E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
    1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification number (SIN) or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
F. Fire-hydrant flow test report.

1.07 CLOSEOUT SUBMITTALS

A. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
B. Field quality-control reports.
C. Operation and Maintenance Data: For sprinkler specialties to include in operation and maintenance manuals.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:
    1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
        a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
B. The provisions and requirements of the NFPA and the Owner’s insurance underwriter constitute mandatory minimum requirements for the work of this Section.
C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
    1. NFPA 13, "Installation of Sprinkler Systems."
D. UL Standards: Comply with the following:
    1. UL 2901,” Antifreeze Solutions for Use in Fire Sprinkler Systems.”
E. Grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1.09 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
B. Coordinate with ceiling installer to ensure proper grid type and installation for use with flexible sprinkler drops.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 STANDARD-WEIGHT BLACK STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends, and with factory applied antimicrobial coating on inner wall of pipe.
   1. Cast-Iron Threaded Flanges: ASME B16.1.
   2. Malleable-Iron Threaded Fittings: ASME B16.3.
   3. Gray-Iron Threaded Fittings: ASME B16.4.
   4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
   5. Steel Threaded Couplings: ASTM A 865.

B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, and with factory applied antimicrobial coating on inner wall of pipe.
   1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
   2. Steel Flanges and Flanged Fittings: ASME B16.5.

C. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll- grooved ends, and with factory applied antimicrobial coating on inner wall of pipe. Note: Grooved end pipe size NPS 2 and smaller shall be Type E or Type S only.
   1. Grooved-Joint Piping Systems:
      a. Manufacturers:
         1) Anvil; Models 74FP and 7401; ASC Engineered Solutions.
         2) Tyco Fire Protection Products by Johnson Controls Company; Grinnell G-Fire.
         3) Victaulic Co. of America; Style 005H, 009N, 107N and 109.
      b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
      c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.03 BACKFLOW PREVENTION DEVICES

A. Double-Check, Detector-Assembly Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.
      b. FEBCO; a Division of Watts Water Technologies, Inc.
      c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
      d. Watts Water Technologies, Inc.; Watts Regulator Co.
      e. Zurn Plumbing Products Group; Wilkins Div.
   2. Standard: ASSE 1048 and FMG approved or UL listed.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 5 psi maximum, through middle 1/3 of flow range.
   5. Size and Capacities: As scheduled on the drawings.
   6. Body: Cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved.
   7. End Connections: Flanged.
   8. Configuration: Designed for horizontal, straight through vertical flow.
   9. Accessories:
      a. Valves: Outside screw and yoke gate-type with flanged, or grooved ends on inlet and outlet.

b. Bypass: With displacement-type water meter, shutoff valves, and double-check backflow prevention device.

B. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.
b. FEBCO; a Division of Watts Water Technologies, Inc.
c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
d. Watts Water Technologies, Inc.; Watts Regulator Co.
e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1047 and Factory Mutual Global (FMG) approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved.
7. End Connections: Flanged.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

2.04 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 300-psig working-pressure rating if fittings are components of high-pressure piping system.

B. Sprinkler Drain and Alarm Test Fittings: Cast-bronze or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
1. Manufacturers:
a. Tyco Fire Protection Products by Johnson Controls Company.
b. Fire-End and Croker Corp.
c. Viking Corp.
d. Victaulic Co. of America; Series UTD Universal Test and Drain.

C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
1. Manufacturers:
a. Elkhart Brass Mfg. Co., Inc.

D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
1. Manufacturers:
a. AGF Manufacturing Co.
b. G/J Innovations, Inc.
c. Triple R Specialty of Ajax, Inc.
d. Tyco Fire Protection Products by Johnson Controls Company.

E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
1. Manufacturers:
a. CECA, LLC.
b. Merit.

2.05 LISTED FIRE-PROTECTION VALVES

A. Valves: UL listed or FMG approved.
1. Valves shall have 175-psig minimum pressure rating.

B. Gate Valves with Wall Indicator Posts:

1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with, extension rod, locking device, and cast-iron barrel.
3. Manufacturers:
    a. McWane, Inc.; Kennedy Valve Div.
    b. NIBCO.
    c. Crane Co.; Crane Valve Group; Stockham Valves.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
3. NPS 3: Ductile-iron body with grooved ends.
4. Manufacturers:
    a. NIBCO.
    b. Victaulic Co. of America.

D. Butterfly Valves: UL 1091.
1. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
    a. Manufacturers:
        1) McWane, Inc.; Kennedy Valve Div.
        2) Mueller Company; ASC Engineered Solutions.
        3) NIBCO.
        4) Tyco Fire Protection Products by Johnson Controls Company.
        5) Victaulic Co. of America; Series 705.

E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
1. Manufacturers:
    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Valves.
    d. Hammond Valve.
    e. McWane, Inc.; Kennedy Valve Div.
    f. Mueller Company; ASC Engineered Solutions.
    g. NIBCO.
    h. Tyco Fire Protection Products by Johnson Controls.
    i. Victaulic Co. of America.
    j. Watts Water Technologies, Inc.; Watts Regulator Co.

F. Gate Valves: UL 262, OS&Y type.
1. NPS 2 and Smaller: Bronze body with threaded ends.
    a. Manufacturers:
        1) Crane Co.; Crane Valve Group; Crane Valves.
        2) Hammond Valve.
        3) NIBCO.
2. NPS 2-1/2 and Larger: Cast or ductile -iron body with flanged or grooved ends.
    a. Manufacturers:
        1) McWane, Inc.; Clow Valve Co.
        2) Crane Co.; Crane Valve Group; Crane Valves.
        3) Crane Co.; Crane Valve Group; Jenkins Valves.
        4) Hammond Valve.
        5) Milwaukee Valve Company.
        6) Mueller Company.
        7) NIBCO.
        8) Victaulic Co. of America: Series 771.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch, Electrical, 115-V ac, prewired, 2-circuit, supervisory switch or Visual.
2. NPS 2 and Smaller: Ball or butterfly valve with brass or bronze body and threaded ends.
    a. Manufacturers:
        1) Milwaukee Valve Company.
        2) NIBCO.
        3) Victaulic Co. of America; Series 728.
3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
    a. Manufacturers:
        1) Tyco Fire Protection Products by Johnson Controls.
        2) McWane, Inc.; Kennedy Valve Div.
        3) Milwaukee Valve Company.
        4) NIBCO.
        5) Victaulic Co. of America.

2.06 RISER MANIFOLD ASSEMBLIES

A. Contractor Option: Factory preassembled riser manifold assemblies may be used.
B. Available Sizes: NPS 1-1/4 to NPS 8.
C. Standard: UL listed and FMG approved.
D. Pressure Rating:
    1. Standard-Pressure Valves: 175 psig minimum.
E. Assembly Includes:
    1. Pressure Gages: Listed an approved as specified in this Section.
    2. Waterflow Alarm Switch: Listed and approved vane type waterflow detector.
    3. Inspector's Test and Drain Valve with Pressure Relief Valve: As specified under Sprinkler Specialty Fittings in this Section.
F. Manufacturers:
    1. Victaulic Co. of America; Series UM Universal Manifold Assembly.
    2. Viking Corp.; EasyPac Commercial Riser Assemblies.

2.07 ALARM CHECK VALVES

A. General Requirements:
    1. Standard: UL listed or FMG approved.
    2. Pressure Rating:
        a. Standard-Pressure Valves: 175 psig minimum.
        b. High-Pressure Valves: 300 psig.
    3. Body Material: Cast or ductile iron.
    4. Size: Same as connected piping.
    5. End Connections: Flanged or grooved.
B. Manufacturers:
    1. Reliable Automatic Sprinkler Co., Inc.
    2. Tyco Fire Protection Products by Johnson Controls Company.
    3. Viking Corp.
    4. Victaulic Co. of America.
C. Description: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
    1. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
    2. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

2.08 AUTOMATIC (BALL DRIP) DRAIN VALVES

A. General:
    1. Standard: UL 1726.
    2. Pressure Rating: 175 psig minimum.
    3. Type: Automatic draining, ball check.

4. Size: NPS 3/4.
5. End Connections: Threaded.

B. Manufacturer:
1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire Protection Products by Johnson Controls Company.

2.09 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 300-psig pressure rating if sprinklers are components of high-pressure piping system.

B. Manufacturers:
1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire Protection Products by Johnson Controls Company.
3. Victaulic Co. of America.
4. Viking Corp.

C. Automatic Sprinklers:
1. With heat-responsive glass bulb element complying with the following:
a. UL 199, for nonresidential applications.
b. UL 1626, for residential applications.
c. UL 1767, for early-suppression, fast-response applications.
2. Open Sprinklers: UL 199, without heat-responsive element.
a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for 165 deg F "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:
1. Concealed ceiling sprinklers, including cover plate.
2. Extended-coverage sprinklers.
3. Flush ceiling sprinklers, including escutcheon.
4. High-pressure sprinklers.
5. Institution sprinklers, made with a small, breakaway projection.
6. Open sprinklers.
7. Pendent sprinklers.
8. Pendent, dry-type sprinklers.
9. Quick-response sprinklers.
10. Recessed sprinklers, including escutcheon.
11. Sidewall sprinklers.
12. Sidewall, dry-type sprinklers.
13. Concealed sidewall sprinklers, including cover plate.
14. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers. Escutcheons listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 3/4-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Sprinkler guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.10 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:
1. Elkhart Brass Mfg. Co., Inc.
2. Potter Roemer Fire Pro; A Member of Morris Group International.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and

brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."

1. Type: Exposed, projecting, with two inlets and round escutcheon plate.
2. Type: Flush, with two, three, four inlets and square or rectangular escutcheon plate.
3. Finish: Polished chrome-plated, Rough chrome-plated, Polished brass.

2.11 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 inlet and NPS 1 drain connections.

1. Manufacturers:
    a. AFAC Inc.
    b. Firematic Sprinkler Devices, Inc.
    c. Reliable Automatic Sprinkler Co., Inc.
    d. Tyco Fire Protection Products by Johnson Controls Company.
    e. Viking Corp.

C. Electrically Operated Alarm: UL 464, with 6-inch- minimum-diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.

1. Manufacturers:
    a. Potter Electric Signal Company, LLC.
    b. System Sensor.

D. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

1. Manufacturers:
    a. Potter Electric Signal Company, LLC.
    b. System Sensor.

E. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

1. Manufacturers:
    a. Potter Electric Signal Company, LLC.
    b. System Sensor.

F. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

1. Manufacturers:
    a. Potter Electric Signal Company, LLC.
    b. System Sensor.

G. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

1. Manufacturers:
    a. Potter Electric Signal Company, LLC.
    b. System Sensor.

2.12 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge.
2. Ashcroft Inc.
3. Marsh Bellofram.
4. Viking Corp.

5. Weiss Instruments, Inc.

B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
   1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
   2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

PART 3 EXECUTION

3.01 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.02 EARTHWORK

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.03 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 PIPING APPLICATIONS, GENERAL

A. Flanges, flanged fittings, unions, nipples, grooved-joint couplings, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints; or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

C. Underground Service-Entrance Piping: Ductile-iron, push-on or mechanical-joint pipe and fittings and restrained joints.

3.05 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Wet-Pipe Sprinklers: Use the following:

Pipe Type	1 ½" & Smaller	2"	2 ½" – 3 ½"	4"	5" – 6"
Standard weight steel, threaded fittings	YES	YES	YES	YES	NO
Standard weight steel, grooved fittings	NO	NO	YES	YES	YES
Standard weight steel, welded fittings	NO	YES	YES	YES	YES

3.06 VALVE APPLICATIONS

A. The following requirements apply:
   1. Listed Fire-Protection Valves: UL listed or FMG approved for applications where required by NFPA 13.
      a. Shutoff Duty: Use ball, butterfly, or gate valves.
   2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
      a. Shutoff Duty: Use ball, butterfly, or gate valves.
      b. Throttling Duty: Use ball or globe valves.

3.07 JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

C. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
D. Use of saddle style tees is not acceptable.
E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
   1. All grooved couplings, fittings, gaskets, valves, and specialties shall be the product of a single manufacturer.
   2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
F. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Division 20 Section “Basic Mechanical Materials and Methods” for additional requirements.

3.08 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 33 Section "Water Distribution" for exterior piping.
B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.09 PIPING INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.
B. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints.
C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
G. Install sprinkler piping with drains for complete system drainage.
H. Install drain valves on standpipes.
I. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
J. Install alarm devices in piping systems.
K. Hangers and Supports: Comply with NFPA 13 for hanger materials.
   1. Install standpipe system piping according to NFPA 14.
   2. Install sprinkler system piping according to NFPA 13, except use of “C” clamps, or beam clamps of “C” pattern, or any modification thereof, is prohibited for supporting pipes larger than NPS 2-1/2.
   3. Refer to Division 20 Section “Hangers and Supports” for additional requirements.
L. Install pressure gages on riser or feed main, at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

3.10 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
C. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.
D. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

E. Specialty Valves:
1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

3.11 SPRINKLER APPLICATIONS

A. Use the following sprinkler types:
1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
5. Sprinkler Finishes:
a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes; white polyester finish in natatoriums.
b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
c. Flush Sprinklers: Bright chrome, with painted white escutcheon.
d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
6. Sprinkler Guards: For exposed sprinkler heads subject to damage.

3.12 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.
B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.13 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire department connections in vertical wall.
B. Install freestanding-type, fire department connections in level surface.
1. Install protective pipe bollards on two or three sides of each fire department connection. Refer to Division 05 Section "Metal Fabrications" for pipe bollards.
C. Install ball drip valve at each check valve for fire department connection.

3.14 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.
B. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.15 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 20 Section "Mechanical Identification."

3.16 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Verify that equipment hose threads are same as local fire department equipment.
5. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.
B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
C. Verify that specified tests of piping are complete.

D. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
E. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
F. Adjust operating controls and pressure settings.
G. Coordinate with fire alarm tests. Operate as required.
H. Coordinate with fire-pump tests. Operate as required.
I. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.17 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.
B. Remove and replace sprinklers with paint other than factory finish.
C. Protect sprinklers from damage until Substantial Completion.

3.18 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION 21 1100

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section "Mechanical Identification" for valve tags and charts.
2. Division 21 Fire-Suppression Piping System.
3. Division 22 Piping Sections for specialty valves applicable to those Sections only.
4. Division 23 Section “General-Duty Valves for HVAC” for HVAC.
5. Division 23 Section "Temperature Controls" for control valves and actuators.

1.02 SUMMARY

A. This Section includes valves for general plumbing applications. Refer to piping Sections for specialty valve applications.

1.03 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.

9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
   1. Certification that products for use in potable water systems comply with NSF 61 and NSF 372.

1.05 QUALITY ASSURANCE

A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.
B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 VALVES, GENERAL

A. Isolation valves are scheduled on the Drawings. For other general plumbing valve applications, use the following:
   1. Shutoff Service: Ball, butterfly valves.
   2. Throttling Service: Angle, ball, butterfly, or globe valves.
   3. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.
B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
D. For valves not indicated in the Application Schedules, select valves with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
   3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
   5. For Grooved-End Systems: Valve ends may be grooved.
E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless otherwise noted.
F. Wetted surfaces of valves contacted by consumable water shall contain not more than 0.25 percent weighted average lead content.
   1. Exceptions:
      a. Valves in pumped sanitary systems.

b. Drain valves.
c. Valves in general air systems.
d. Valves in irrigation systems.
e. Valves in non-potable water systems.
f. Valves in other plumbing systems not intended for human consumption.

G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
H. Extended Valve Stems: On insulated valves.
I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
J. Valve Grooved Ends: AWWA C606.
K. Solder Joint: With sockets according to ASME B16.18.
1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.
L. Threaded: With threads according to ASME B1.20.1.
M. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.
B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Series 77CLF-A Series.
b. Hammond Valve.
c. Kitz Corporation; Kitz Valves.
d. Milwaukee Valve Company; UPBA400S/450S.
e. NIBCO INC.; Models S-585-70-66-LF/T-585-70-66-LF.
f. Watts Water Technologies, Inc.; Series LFB6080G2/LFB6081G2.

2.03 GENERAL SERVICE BUTTERFLY VALVES

A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:
1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.
B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
b. Bray International, Inc.
c. DeZurik.
d. Emerson Automation Solutions; Keystone.
e. Forum Energy Technologies; ABZ Valve.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.; LD-2000-3/5.
i. Tyco Flow Control; Grinnell Flow Control.
j. Watts Water Technologies.

2.04 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 125, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; by Conbraco Industries, Inc.; Model 162T-LF and 163T-LF (61YLF Series).
    b. Milwaukee Valve Company; Model UP509/UP1509.
    c. NIBCO INC.; Models S-413-B-LF or T-413-B-LF.
    d. Watts Water Technologies; LFCVY/LFCVYS.

2.05 IRON SWING CHECK VALVES

A. Iron Swing Check Valves, General: MSS SP-71.

B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; by Conbraco Industries, Inc.; Model 910F.
    b. Crane Co.; Crane Valves.
    c. Crane Co.; Stockham Div.
    d. Hammond Valve; IR1124-HI.
    e. Milwaukee Valve Company; Model F-2974.
    f. NIBCO INC.; Model F-918-B.
    g. Watts Water Technologies.

C. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; nonasbestos, synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Mueller Co.
    b. NIBCO, INC.; Model G-917-W.
    c. Victaulic Co. of America.

2.06 LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; by Conbraco Industries, Inc.; Model CBV-LF (61LF Series).
    b. Bonomi USA, Inc.; Series 100002 and 100003.
    c. Hammond Valve; UP943 and UP947.
    d. Milwaukee Valve Company; UP548T and UP1548T.
    e. NIBCO INC.; Model S-480-Y-LF and T-480-Y-LF.
    f. Watts Water Technologies; LF600.
2. Description:
    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 250 psig.
    c. Body Design: Vertical flow.
    d. Body Material: Lead free brass or bronze.
    e. Ends: Threaded or Solder.
    f. Disc: PTFE, TFE, or Polyethermide.

2.07 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.

B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.; Model W-910-B-LF.
      b. Mueller Steam Specialty.
      c. Milwaukee Valve Company.
      d. Hammond Valve.

C. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends and having 200 psig CWP rating.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.; Model F-910-B-LF.
      b. Mueller Steam Specialty.
      c. Milwaukee Valve Company.
      d. Hammond Valve.

2.08 BRONZE GLOBE VALVES

A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.

B. Class 125, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 200 psig CWP rating.
   1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
      a. Apollo Valves; by Conbraco Industries, Inc.; Model 121T-LF.
      b. Hammond Valve; UP418 and UP440.
      c. Milwaukee Valve Company; Model UP502 and UP1502.
      d. Watts Water Technologies, Inc.; LFGLV.

2.09 CAST-IRON GLOBE VALVES

A. Cast-Iron Globe Valves, General: MSS SP-85 with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.

B. Class 125, Metal Seat, Cast-Iron Globe Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim and having 200 psig CWP rating.
   1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
      a. Apollo Valves; by Conbraco Industries, Inc.; Model 711F.
      b. Crane Co.; Crane Valves.
      c. Crane Co.; Stockham Valves.
      d. Hammond Valve.
      e. Milwaukee Valve Company; Model F-2981.
      f. NIBCO INC.; Model F-718-B.
      g. Watts Water Technologies, Inc.

2.10 CAST-IRON ANGLE VALVES

A. Cast-Iron Angle Valves, General: MSS SP-85, Type II; having ASTM A 126, Class B cast-iron body and bolted bonnet; bronze mounted, non-asbestos packing and gaskets; and flanged-end connections.

B. Class 125, Cast-Iron, Standard Angle Valves: 200-psig CWP rating.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.; Model F-818-B.
      b. Crane Co.; Stockham Valves.
      c. Crane Co.; Crane Valves.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
   1. Bronze ball valve as specified in this Section. Lead free construction is not required.

2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 SOURCE QUALITY CONTROL

A. Identification: Factory label or color coding to identify lead free valves.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
D. Examine threads on valve and mating pipe for form and cleanliness.
E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
C. Locate valves for easy access and provide separate support where necessary.
D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
E. Install valves in position to allow full stem movement.
F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb.

3.03 JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.04 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 0523

SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods” for materials and methods common to mechanical piping systems.
3. Division 20 Section “Hangers and Supports.”
4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
5. Division 22 Section “General-Duty Valves for Plumbing.”
6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.02 SUMMARY

A. This Section includes domestic water piping and water meters inside the building.

B. Water meters will be furnished by utility company for installation by Contractor.

1.03 PERFORMANCE REQUIREMENTS

A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1. Exception: PEX plastic piping insert fittings specified are limited to 100 psig.

1.04 SYSTEMS DESCRIPTION

A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.

B. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 22 Section “Facility Water Distribution.”

C. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
2. Drain Duty: Hose-end drain valves.
3. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2 and Smaller: Class 150, bronze.
4. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.

D. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.05 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.
2. Domestic water piping.
3. Compressed air piping.
4. HVAC hydronic piping.

1.07 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

1.08 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

E. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

1.09 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.03 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Grooved-Joint Systems:
1. Manufacturers:
a. ASC Engineered Solutions; Gruvlok; Fig. 64 CTS SlideLOK.
b. Victaulic Company; Style 606 and Style 607.
2. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
3. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

2.04 VALVES

A. General-duty plumbing valves; and drain valves are specified in Division 22 Section "Plumbing Valves."

B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

2.05 SPECIALTY VALVES

A. Bronze Gate Valves: MSS SP-80, with malleable-iron handwheel.
1. Class 150, Rising-Stem, Bronze Gate Valves: ASTM B-62 bronze body, bonnet, and wedge, copper-silicone bronze stem, screw-in bonnet, threaded end connections; and having 300 psig CWP rating.
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) Milwaukee Valve Company; Model 1150.
4) NIBCO INC.; Models T-131, S-134 or T-134.
5) Watts Water Technologies, Inc.; Series B-3110.

B. Cast-Iron Gate Valves: MSS SP-70, with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.
1. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim, and solid-wedge disc; and having 200 psig CWP rating.
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) Milwaukee Valve Company; Model F-2885.
4) NIBCO INC.; Model F-617-O.
5) Watts Water Technologies.

PART 3 EXECUTION

3.01 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.02 PIPING SYSTEM INSTALLATION

A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Install under-building-slab copper tubing according to Copper Development Association’s "Copper Tube Handbook." Joints under slab are not allowed. Install PVC sleeve where piping penetrates slab.

C. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 20 Section "Basic Mechanical Materials and Methods."

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 20 Section "Meters and Gages," and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."

F. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.

G. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
   1. Install hose-end drain valves at low points in water mains, risers, and branches.
   2. Install stop-and-waste drain valves where indicated.

H. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

I. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 22 Section "Domestic Water Piping Specialties."

J. Install domestic water piping level without pitch and plumb.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

3.04 WATER METER INSTALLATION

A. Water meters will be furnished and installed by utility company.

B. Rough-in domestic water piping for water meter installation and install water meters according to utility company's requirements.

C. Install water meters according to AWWA M6 and utility's requirements.
   1. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
   2. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
   3. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
   4. Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.
   5. Install remote registration system according to standards of utility and of authorities having jurisdiction.

3.05 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 20 Section "Hangers and Supports." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for drawn-temper copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60-inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Soft copper tube: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

H. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic water piping to distribution side of water meter with shutoff valve.

C. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 20 Section “Basic Mechanical Materials and Methods” for dielectric fittings.

D. Install piping adjacent to equipment and machines to allow service and maintenance.

E. Connect domestic water piping to the following:

1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
3. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3.07 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.08 ADJUSTING

A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.09 CLEANING AND DISINFECTION

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
B. Clean and disinfect potable and non-potable domestic water piping as follows:
1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:
1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 22 1116

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
4. Division 22 Section "Domestic Water Piping " for water meters.
5. Division 22 Section "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
6. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
7. Division 22 Section "Drinking Fountains, Water Coolers and Cuspidors" for water filters for water coolers.

1.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Flow Reports and Settings: For calibrated balancing valves.
C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
C. NSF Compliance:
    1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
    2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
    3. Comply with NSF 372, “Drinking Water System Components – Lead Content” for components with wetted surfaces in contact with potable water.

PART 2 PRODUCTS

2.01 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Apollo Valves; Conbraco Industries, Inc.
        b. FEBCO; a Division of Watts Water Technologies, Inc.
        c. Watts Water Technologies, Inc.; Watts Regulator Co.
        d. Zurn Plumbing Products Group; Wilkins Div.
    2. Standard: ASSE 1001.
    3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
    4. Body: Bronze.
    5. Inlet and Outlet Connections: Threaded.
    6. Finish: Chrome plated.
B. Pressure Vacuum Breakers:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Apollo Valves; Conbraco Industries, Inc.
        b. FEBCO; a Division of Watts Water Technologies, Inc.
        c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
        d. Watts Water Technologies, Inc.; Watts Regulator Co.
        e. Zurn Plumbing Products Group; Wilkins Div.
    2. Standard: ASSE 1020.
    3. Operation: Continuous-pressure applications.
    4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
    5. Size and Capacity: As indicated on the drawings.
    6. Accessories:
        a. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Apollo Valves; Conbraco Industries, Inc.
        b. FEBCO; a Division of Watts Water Technologies, Inc.
        c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
        d. Watts Water Technologies, Inc.; Watts Regulator Co; Model LF009 (main 3” RPZ).
        e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
    c. Y-Pattern strainer and soft-seated check valve.

B. Double-Check Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; Conbraco Industries, Inc.
    b. FEBCO; a Division of Watts Water Technologies, Inc.
    c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
    d. Watts Water Technologies, Inc.; Watts Regulator Co.
    e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

C. Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; Conbraco Industries, Inc.
    b. FEBCO; a Division of Watts Water Technologies, Inc.
    c. Watts Water Technologies, Inc.; Watts Regulator Co.
    d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Size: As indicated on the drawings.
5. Body: Bronze with union inlet.

2.03 BALANCING VALVES

A. Calibrated Balancing Valves NPS 1/2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Armstrong International, Inc.
    b. Armstrong Pumps, Inc.
    c. Apollo Valves; by Conbraco Industries, Inc.
    d. Bell & Gossett; Xylem Inc.
    e. Flo Fab Inc.
    f. Flow Design Inc.

g. Griswold Controls.
h. NIBCO INC.
i. IMI Indoor Climate; Tour & Andersson.
j. Taco, Inc.
k. Watts Water Technologies, Inc.; Watts Regulator Co.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant brass, or bronze.
4. Minimum Flow Rate: 0.3 gpm.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Calibrated Balancing Valves NPS 3/4 to NPS 2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong International, Inc.
b. Armstrong Pumps, Inc.
c. Apollo Valves; by Conbraco Industries, Inc.
d. Bell & Gossett; Xylem Inc.
e. Flo Fab Inc.
f. Flow Design Inc.
g. Griswold Controls.
h. NIBCO INC.
i. IMI Indoor Climate; Tour & Andersson.
j. Taco, Inc.
k. Watts Water Technologies, Inc.; Watts Regulator Co.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant brass, or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.04 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Controls; Morris Group International.
b. Apollo Valves; Conbraco Industries, Inc.
c. Bradley Corporation.
d. Lawler Manufacturing Company, Inc.
e. Leonard Valve Company.
f. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series LFe480, LFG480, and LFLM495.
g. Watts Water Technologies, Inc.; Watts Regulator Co.
h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: 1/2-inch union or 3/8-inch compression; with integral check valves.
7. Accessories: Adjustable temperature-control knob.
8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F.
9. Minimum Flow Rate: 0.5 gpm.
10. Valve Finish: Rough bronze.

2.05 PREPIPED TEMPERED WATER MIXING SYSTEM

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Controls; Morris Group International.

b. Armstrong International, Inc. (RADA).
c. Bradley Corporation.
d. Lawler Manufacturing Company, Inc.; Prepiped 802 Hi-Low Tempered water Mixing System.
e. Leonard Valve Company.
f. Symmons Industries, Inc.
g. Watts Water Technologies, Inc.; Powers Division.
h. Watts Water Technologies, Inc.; Watts Regulator Co.

2. Description: Completely assembled and tested prepiped manifold system including mixing valve(s), recirculation pump, circuit setting balancing valve, aquastat, circulator switch box, thermometers, isolation valves, mounting strut, and test connection.
3. Standard: ASSE 1017.
4. Mixing Valve: Exposed-mounting, thermostatically controlled water mixing valve.
   a. Material: Bronze body with corrosion-resistant interior components.
   b. Connections: Threaded union inlets and outlet.
   c. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control handle.
   d. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
   e. Size, Settings, and Capacities: As scheduled on the drawings.
   f. Valve Finish: Rough bronze.
5. Pump: Meeting requirements in Division 22 Section “Domestic Water Circulation Pumps.”
6. Mounting Strut: Meeting requirements in Division 20 Section “Hangers and Supports.”

2.06 OUTLET BOXES

A. Clothes Washer Outlet Boxes:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
      b. Oatey SCS.
      c. Guy Gray Manufacturing Co., Inc.
   2. Mounting: Recessed.
   3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.
   4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
   5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
   6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
   7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
   8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
      b. Oatey SCS.
      c. LSP Products Group, Inc.
      d. Acorn Engineering Company.
   2. Mounting: Recessed.
   3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.
   4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
   5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.07 HOSE STATIONS (HS-1)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ARCHON Industries, Inc.
   2. Armstrong International, Inc.

3. Cooney Brothers, Inc.
4. DynaFluid Ltd.
5. Leonard Valve Company; SW-75-EVBD W/10 HDH Hose and N2 Nozzle.
6. Strahman Valves, Inc.
7. T & S Brass and Bronze Works, Inc.

B. Hot- and Cold-Water Hose Stations:
1. Standard: ASME A112.18.1.
2. Type Faucet: Thermostatic mixing valve.
3. Cabinet: Stainless-steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.
5. Body Material: Bronze with stainless-steel wetted parts.
6. Body Finish: Rough bronze or chrome plate.
7. Mounting: Wall, with reinforcement.
8. Supply Fittings: Two NPS 3/4 gate, globe, or ball valves and check valves and NPS 3/4 copper, water tubing. Omit check valves if check stops are included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 10 feet long.
10. Nozzle: With hand squeeze on-off control.
11. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

2.08 HOSE BIBBS

A. Hose Bibbs HB-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc; Model 5670.
d. Tyler Pipe; Wade Div.
e. Watts Water Technologies, Inc.; Watts Regulator co.
f. Woodford Manufacturing Company.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.09 WALL HYDRANTS

A. Nonfreeze Wall Hydrants WH-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company.

b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc; Model 5515.
d. Tyler Pipe; Wade Div.
e. Watts Water Technologies, Inc.; Watts Regulator co.
f. Woodford Manufacturing Company.
g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze or chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.

2.10 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. MIFAB, Inc.
b. PPP Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

B. Water Hammer Arresters (Metal Bellows Type):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. AMTROL, Inc.
b. Josam Company.
c. MIFAB, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Precharged stainless steel bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

C. Water Hammer Arresters (Custom Type):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. AMTROL, Inc.
b. Josam Company.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Type: Factory precharged stainless steel pressure chamber with stainless steel bellows and non-toxic hydraulic fluid having pressure gage and air valve with cap.
3. Size: Custom sized for application by manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.
4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve,] and pump.

G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
1. Install shutoff valve on outlet if specified.

I. Install roof hydrants in accordance with manufacturer’s instructions. Pipe drain hole to acceptable discharge point.

J. Install water hammer arresters in water piping according to PDI-WH 201.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check backflow-prevention assemblies.
5. Dual-check-valve backflow preventers.
6. Calibrated balancing valves.
7. Outlet boxes.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
   1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves as follows:
   1. Set calibrated balancing valves at calculated presettings.
   2. Measure flow each station and adjust where necessary.
   3. Record settings and mark balancing devices.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 1119

SECTION 22 1123 - DOMESTIC WATER CIRCULATION PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”

1.02 DEFINITIONS

A. PEI: Pump Energy Index as defined by the Department of Energy.

B. PEI_{CL}: Pump Energy Index – Constant Load, as defined by the Department of Energy.

C. PEI_{VL}: Pump Energy Index – Variable Load, as defined by the Department of Energy.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
C. Department of Energy Requirements: Pumps supplied that are regulated by the Department of Energy pump standards shall bear the acceptable PEI index.
1. Constant load pumps supplied shall bear the acceptable PEI_{CL} index.
2. Variable load pumps supplied with variable speed controls shall bear the acceptable $PEIv_L$ index.
3. Submittals for approval shall clearly identify the applicable PEI index and affirm that that index meets the DOE pump standards.
D. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.
F. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Retain shipping flange protective covers and protective coatings during storage.
B. Protect bearings and couplings against damage.
C. Comply with pump manufacturer's written rigging instructions for handling.

1.08 COORDINATION
A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SMALL CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS WITH INTEGRAL VARIABLE FREQUENCY CONTROL
A. Manufacturers:
1. Bell & Gossett; Xylem Inc.; ecocirc XL.
2. Grundfos Pumps Corporation; Magna Series.
3. Taco, Inc.; Veridian Series.
4. WILO-USA LLC; Stratos Z.
B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.
1. Pump Construction: Bronze fitted.
a. Casing: Lead-free and corrosion resistant, with threaded companion-flange connections.
b. Impeller: Glass-reinforced corrosion-resistant material; keyed to shaft.
c. Shaft: High-strength alloy steel.
d. Seal: Mechanical, carbon/silicon carbide seal.
e. Bearings: Permanently oil-lubricated type.
2. Motor: Electrically commutated electrical motor (ECM) with permanent magnet rotor.
a. Rotor Magnets: Time stable, non-toxic ceramic magnets (Sr-Fe).
b. Electrically Commuted Motor: Driven by frequency converter with integrated PFC filter.
C. Capacities and Characteristics: Refer to Schedule on Drawings.

2.03 CONTROLS
A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
1. Manufacturers:
a. Honeywell International, Inc.; Aquastat.
b. Johnson Controls, Inc.

c. Schneider Electric USA, Inc.
d. Siemens Industry, Inc.; Building Technologies Division.
e. White-Rodgers Div.; Emerson Electric Co.

2. Type: Strap-on sensor, with suitable removable spring clip attaching thermostat to hot-water circulation piping.
3. Range: 65 to 200 deg F.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 24 V, ac or 120 V, ac.
7. Settings: Start pump at 110 deg F and stop pump at 120 deg F.

2.04 FLEXIBLE CONNECTORS

A. Refer to Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”

2.05 BUILDING-AUTOMATION-SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:
1. On-off status of each pump.
2. Alarm status.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.
B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping. Do not use pump motors as a support point.
D. Install centrifugal pumps with motor and pump shafts horizontal.
E. Install continuous-thread hanger rods and elastomeric hangers, spring hangers, spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified in Division 20 Section "Mechanical Vibration Controls." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 20 Section "Hangers and Supports."
F. Install vertical in-line pumps on concrete bases. Install pumps with motor and pump shafts vertical.

3.03 CONTROL INSTALLATION

A. Install thermostats in hot-water return piping.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to pumps to allow service and maintenance.
C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."
1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
a. Close-coupled, horizontally mounted, in-line centrifugal pumps.
b. Close-coupled, vertically mounted, in-line centrifugal pumps.
2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 20 Section "Valves" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 20 Section "Meters and Gages" for pressure gages and gage connectors.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."
E. Connect wiring according to Division 26 Section "Conductors and Cables."
F. Connect thermostats to pumps that they control.
G. Interlock pump with water heater burner and time delay relay.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Set thermostats for automatic starting and stopping operation of pumps.
   5. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   7. Start motor.
   8. Open discharge valve slowly.
   9. Adjust temperature settings on thermostats.
   10. Adjust timer settings.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 22 1123

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements”.
2. Division 20 Section “Basic Mechanical Materials and Methods”.
3. Division 22 Section “Drainage Piping Specialties”.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.03 SYSTEMS DESCRIPTIONS

A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

1.04 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control inspection and test reports.

1.06 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. CISPI, Hubless-Piping Couplings:
1. Manufacturers:
a. ANACO-Husky; McWane Plumbing Group.
b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
c. IDEAL-TRIDON.
d. MIFAB, Inc.
e. Mission Rubber Company; a division of MCP Industries, Inc.
f. Tyler Pipe; McWane Plumbing Group.
2. Standards: CISPI 310.
3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
C. Heavy-Duty, Hubless-Piping Couplings:
1. Manufacturers:
a. ANACO-Husky; McWane Plumbing Group; SD 4000.
b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
c. IDEAL-TRIDON; Heavy-Duty “HD” No-Hub Couplings.
d. Norma Group; Clamp-All Products; HI-TORQ 125.
2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
B. Hard Copper Tube: ASTM B 88, Types M, water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
C. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.04 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.05 SPECIALTY PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      a. Dallas Specialty & Mfg. Co.
      b. Fernco, Inc.
      c. Logan Clay Products Company (The).
      d. Mission Rubber Co.
      e. NDS, Inc.
      f. Plastic Oddities, Inc.
   2. Sleeve Materials:
      a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      a. ANACO.

D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Dresser, Inc.; DMD Div.
      c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
      d. JCM Industries, Inc.
      e. Smith-Blair, Inc.
      f. Viking Johnson.
   2. Center-Sleeve Material: Manufacturer's standard.
   3. Gasket Material: Natural or synthetic rubber.
   4. Metal Component Finish: Corrosion-resistant coating or material.

E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
   1. Manufacturers:
      a. SIGMA Corp.

PART 3 EXECUTION

3.01 EXCAVATION

A. Comply with requirements in Division 31 Section “Earth Moving” for excavating, trenching, and backfilling.

3.02 PIPING SYSTEM INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump

sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Sanitary sewer piping outside the building is specified in Division 22 Section "Sanitary Sewerage."

C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.

K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

M. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.

3.05 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 20 Section "Valves."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.06 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Install individual, straight, horizontal piping runs according to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:
   1. Sanitary Sewer: To exterior force main or sanitary manhole.
   2. Sewage Pumps: To sewage pump discharge.

3.08 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

3.09 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1316

SECTION 22 1319 - DRAINAGE PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Delegated-Design Submittal: For siphonic roof drainage system indicated to comply with performance requirements and design criteria, including analysis data.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

C. Comply with ASPE/ANSI 45-2013 “Siphonic Roof Drainage” for siphonic roof drainage systems.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.01 CAST-IRON CLEANOUTS

A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.

B. Exposed Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.; Series 58910.
    b. MIFAB, Inc.; C1460.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; 4510 Series.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.

C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.; C1220-R.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Spigot.
7. Closure: Brass, bronze, or plastic plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Cast-Iron Wall Cleanouts (Finished Wall Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.; Model 58790-20.
    b. MIFAB,Inc.; C1460-RD.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

E. Exterior Surface Area (Outdoor) Cast-Iron Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M.
3. Type: Cast-iron soil pipe with cast-iron ferrule.
4. Body or Ferrule: Cast iron.
5. Outlet Connection: Spigot.
6. Closure: Brass, bronze, or plastic plug with tapered threads.
7. Access Frame and Cover Material and Finish: Non-skid nickel-bronze, copper alloy.
8. Frame and Cover Shape: Round.
9. Top Loading Classification: Heavy Duty.
10. Riser: ASTM A 74, Extra-Heavy Service class, cast-iron drainage pipe fitting and riser to cleanout.

F. Exterior Unsurfaced Area (Outdoor) Cast-Iron Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M.
3. Type: Cast-iron soil pipe with cast-iron ferrule.
4. Body or Ferrule: Cast iron.
5. Outlet Connection: Inside calk.
6. Cover Material and Finish: Epoxy coated cast- or ductile-iron with neoprene gasket.
7. Cover Shape: Round.
8. Top Loading Classification: Heavy Duty.
9. Riser: ASTM A 74, Extra-Heavy Service class, cast-iron drainage pipe fitting and riser to cleanout.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains FD-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
      d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
      e. Tyler Pipe; Wade Div.
      f. Watts Drainage Products Inc.
      g. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.6.7.
   3. Pattern: Floor drain.
   4. Body Material: Gray iron.
   5. Seepage Flange: Required.
   6. Clamping Device: Required.
   7. Outlet: Bottom unless otherwise noted.
   8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
   9. Top or Strainer Material: Nickel bronze.
   10. Top of Body and Strainer Finish: Nickel bronze.
   11. Top Shape: Round, with vandal proof screws.
   12. Dimensions of Top or Strainer: 7 inch diameter.
   13. Top Loading Classification: Light Duty.
   14. Inlet Fitting: Gray iron, with spigot outlet.

B. Cast-Iron Floor Drains FD-2:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
      d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
      e. Tyler Pipe; Wade Div.
      f. Watts Drainage Products Inc.
      g. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.6.7.
   3. Pattern: Floor drain.
   4. Body Material: Gray iron.
   5. Seepage Flange: Required.
   6. Clamping Device: Required.
   7. Outlet: Bottom unless otherwise noted.
   8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
   9. Top or Strainer Material: Nickel bronze.
   10. Top of Body and Strainer Finish: Nickel bronze.
   11. Top Shape: Round, with vandal proof screws.
   12. Dimensions of Top or Strainer: 5 inch diameter.
   13. Top Loading Classification: Light Duty.
   14. Inlet Fitting: Gray iron, with spigot outlet.

C. Cast-Iron Floor Drains FD-3:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2142.

d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom unless otherwise noted.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Sediment Bucket: 3-3/4 inches deep, slotted sediment bucket with lift bar.
10. Top or Strainer Material: Cast-iron.
11. Top Shape: Round.
12. Dimensions of Top or Strainer: 11-1/2 inch diameter tractor grate, 29 square inches of free area. Provide partial grate where required to accept equipment drains.
13. Top Loading Classification: Heavy Duty.
14. Outlet Fitting: Gray iron, with spigot outlet.

2.03 TRENCH DRAINS

A. Modular Cast-Iron Trench Drains TD-3:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2810 Series.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3 for trench drains.
3. Material: Cast iron or ductile iron.
4. Flange: Anchor.
5. Clamping Device: Not required.
6. Outlet: Bottom unless otherwise indicated.
7. Grate Material: Ductile iron.
8. Grate Finish: Not required.
9. Dimensions of Frame and Grate: 6 inches wide, and length indicated on Drawings.
10. Top Loading Classification: Heavy Duty.
11. Extension Sections: As required to suit project.

2.04 CHANNEL DRAINAGE SYSTEMS

A. Stainless-Steel Channel Drainage Systems TD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Sioux Chief Manufacturing Company, Inc.; Model 823-TX48SP
   b. Blucher Drainage Systems; a Watts Water Technologies Company.
   c. Eric'sons, Inc.; Dura Trench.
   d. MultiDrain Systems.
   e. Zurn Plumbing Products Group; Flo-Thru Operation.
2. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
   a. Channel Sections: Interlocking-joint, stainless steel with level invert.
      1) Dimensions: 6 inches wide. Include number of units required to form total lengths indicated.
   b. Grates: Manufacturer's designation "medium duty," with slots or perforations, and of width and thickness that fit recesses in channels.

1) Material: Stainless steel.
2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

c. Covers: Solid stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.

d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

B. Polymer-Concrete Channel Drainage Systems TD-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABT, Inc.; Polydrain.
   b. ACO Polymer Products, Inc.; SK200K w/SK2-902D catch basin.
   c. Eric'sons, Inc.; Dura Trench.
   d. Josam Company; PRO-PLUS.
   e. MIFAB, Inc.; MEA.
   f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   g. Forte Composites, Inc.
2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
   a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.
      1) Dimensions: 10-inch inside width. Include number of units required to form total lengths indicated.
      2) Frame: Not required.
   b. Grates: Manufacturer's designation "heavy duty," load rating Class C, with slots or perforations, and of width and thickness that fit recesses in channel sections.
      1) Material: Ductile iron.
      2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
   c. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
   d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
   e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

C. Polymer-Concrete, or Glass Fiber Reinforced Polyester Catch Basins:

1. Description: 10-by-33-inch precast, polymer-concrete body, with outlets in number and sizes indicated. Include gray-iron slotted grate.
2. Frame: Not required.

2.05 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 6 inches from pipe, with boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.

3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.06 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
   b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.
2. Standard: ASSE 1072-2007.
3. Sealing Element: Neoprene rubber or chemically resistant elastomer.
4. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.07 ROOF DRAINS

A. Metal Roof Drains RD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1015.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Dimensions of Body: Minimum 10 inch diameter body.
6. Combination Flashing Ring and Gravel Stop: Required.
7. Flow-Control Weirs: Not required.
8. Outlet: Bottom unless otherwise noted.
9. Dome Material: Cast iron, or ductile iron.
10. Extension Collars: Required.
11. Underdeck Clamp: Required.
12. Sump Receiver: Required.

B. Metal Secondary Roof Drains ORD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1045.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Dimensions of Body: Minimum 10 inch diameter body.
6. Combination Flashing Ring and Gravel Stop: Required.
7. Flow-Control Weirs: Not required.
8. Outlet: Bottom unless otherwise noted.
9. Dome Material: Cast iron, or ductile iron.
10. Extension Collars: Required.
11. Underdeck Clamp: Required.
12. Sump Receiver: Required.
13. Standpipe: Cast iron. 2 inches high where overflow drains are indicated.

2.08 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Hub Outlets:
   1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
   2. Size: Same as connected waste piping.
      a. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:
   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

E. Vent Caps:
   1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

F. Expansion Joints:
   1. Standard: ASME A112.21.2M.
   2. Body: Cast iron with bronze sleeve, packing, and gland.
   3. End Connections: Matching connected piping.
   4. Size: Same as connected soil, waste, or vent piping.

G. Conductor Nozzles DNZ-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1770-NB-BS.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Description: Bronze body with threaded inlet, bronze wall flange with mounting holes, and bird screen.
   3. Size: Same as connected conductor.

2.09 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
   2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
   3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.10 OIL SEPARATORS

A. Oil Interceptors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Highland Tank & Manufacturing Co., Inc.
   b. Josam Company; Josam Div.
   c. MIFAB, Inc.
   d. Rockford Sanitary Systems, Inc.
   e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   f. Striem; OS-100.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products Inc.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Type: Factory-fabricated interceptor for separating and removing light oil from wastewater.
3. Body Material: Cast iron, steel, or polypropylene.
4. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
5. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
6. Size and Capacities: As indicated on the drawings.
7. Cleanout: Integral or field installed on outlet.
8. Mounting: Below grade with anchor kit and concrete slab. Include two SR24 and two LR24 risers and heavy duty covers.

2.11 SOLIDS INTERCEPTORS

A. Solids Interceptors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Striem; Aardvark AA-4.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Type: Factory-fabricated interceptor made for removing and retaining lint from wastewater.
3. Body Material: Cast iron, steel, or polypropylene.
4. Interior Separation Device: Screens.
5. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
6. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
7. Size and Capacities: As indicated on the drawings.

8. Mounting: Inline flush with floor.

PART 3 EXECUTION

3.01 CONCRETE BASES

A. Anchor interceptors to concrete bases.
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
   2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.
   5. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
   6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.02 INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.
C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
G. Assemble stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
H. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
I. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
J. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
K. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

L. Assemble open drain fittings and install with top of hub 2 inches above floor.

M. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

N. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

O. Install vent caps on each vent pipe passing through roof.

P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

Q. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

R. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Division 33 Section "Fuel Oil Distribution."

S. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

T. Install wood-blocking reinforcement for wall-mounting-type specialties.

U. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

V. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

W. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
1. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

3.04 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.05 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Solids interceptors.

2. Oil interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.06 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 1319

SECTION 22 1413 - STORM DRAINAGE PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section “Drainage Piping Specialties.”
4. Division 33 Section “Storm Utility Drainage Piping” for piping outside building.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 125 psig.

1.04 SYSTEMS DESCRIPTIONS

A. Storm drainage piping system materials are scheduled on the Drawing.

1.05 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.06 INFORMATIONAL SUBMITTALS

A. Shop Drawings:

1. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.

1.07 CLOSEOUT SUBMITTALS

A. Field quality-control inspection and test reports.

1.08 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).

C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with “NSF-dwv” for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers:
   a. ANACO-Husky; McWane Plumbing Group.
   b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
   c. IDEAL-TRIDON.
   d. MIFAB, Inc.
   e. Mission Rubber Company; a division of MCP Industries, Inc.
   f. Tyler Pipe; McWane Plumbing Group.
2. Standards: CISPI 310.
3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:
   a. ANACO-Husky; McWane Plumbing Group; SD 4000.
   b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
   c. IDEAL-TRIDON; Heavy-Duty “HD” No-Hub Couplings.
   d. Norma Group; Clamp-All Products; HI-TORQ 125.
2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.04 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. Dallas Specialty & Mfg. Co.
   b. Fernco, Inc.
   c. Logan Clay Products Company (The).

d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.

2. Sleeve Materials:
   a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
   b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Mission Rubber Co.
   2. Manufacturers:
      a. ANACO.

C. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Dresser, Inc.; DMD Div.
      c. EBAA Iron Sales, Inc.
      d. Ford Meter Box Company, Inc. (The); Pipe Products Div.
      e. JCM Industries, Inc.
      f. Romac Industries, Inc.
      g. Smith-Blair, Inc.
      h. Viking Johnson.
   2. Center-Sleeve Material: Manufacturer's standard.
   3. Gasket Material: Natural or synthetic rubber.
   4. Metal Component Finish: Corrosion-resistant coating or material.

D. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
   1. Manufacturers:
      a. SIGMA Corp.

PART 3 EXECUTION

3.01 EXCAVATION

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.02 PIPING SYSTEM INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

G. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

I. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
   2. Horizontal Storm-Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.

J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Install PVC storm drainage piping according to ASTM D 2665.

L. Install underground PVC storm drainage piping according to ASTM D 2321.

M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.
   5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.05 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.06 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.07 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1413

SECTION 22 1429 - SUMP PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section “Sewage Pumps” for applications in sanitary drainage systems.

1.02 SUMMARY

A. This Section includes sump pumps and accessories, inside the building, for building storm drainage systems.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of sump pump specified, include certified performance curves with operating points plotted on curves, rated capacities of selected models, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each sump pump to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sump pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.
C. Comply with pump manufacturer's written rigging instructions for handling.

1.08 COORDINATION

A. Coordinate size and location of concrete basins. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SUBMERSIBLE ELEVATOR SUMP PIT PUMPS

A. Manufacturers:
   1. ABS Pumps, Inc.
   2. Bell & Gossett; Xylem Inc.
   3. Crane Pumps and Systems; Barnes.
   4. EBARA International Corporation; Standard Pump Division.
   5. Goulds Pumps; Xylem Inc.
   6. Gorman-Rupp Company (The).
   7. Grundfos Pumps Corporation.
   8. Hydromatic.
   9. Little Giant Pump Co.
   10. Metropolitan Industries, Inc.
   11. Stancor, Inc.
   12. Weil Pump Company, Inc.
   13. Zoeller Company.
B. Description: Factory-assembled and -tested, simplex, single-stage, centrifugal, end-suction, submersible, direct-connected sump pumps complying with UL 778 and Hydraulic Institute HI 1.1-1.2 and HI 1.3 for submersible sump pumps.
C. Casing: Cast iron; with cast-iron inlet strainer, or stainless steel; with stainless-steel inlet strainer; legs that elevate pump to permit flow into impeller, and vertical discharge connection suitable for piping.
D. Impeller: Hardened 17-4ph stainless steel, or ASTM A 532/A 532M, abrasion-resistant cast iron; statically and dynamically balanced, semi-open non-clog design, overhung, single suction, keyed and secured to shaft.
E. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings and mechanical seals constructed of silicon carbide.
F. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; three-conductor waterproof power cable of length required, and with grounding plug and cable-sealing assembly for connection at pump. Comply with requirements in Division 20 Section "Motors."
   1. Moisture-Sensing Probe: Internal moisture sensor with moisture alarm.
G. Pump Discharge Piping: Factory or field fabricated. Refer to Division 22 Section “Sanitary Waste and Vent Piping.”
H. Basin or Pit Cover: Fiberglass grating, or cast iron or steel grating with bituminous coating.
I. Controls:
   1. Electrical Characteristics: 115 volts, single phase.
   2. Controls housed in NEMA 250, Type 4X enclosure having high decibel warning horn with silencing switch. Controls include:
      a. Alarm and separate LED lights for:
         1) Power.
         2) Overload.
         3) Pump run.
         4) Interceptor high oil level.

5) Interceptor high liquid level.
6) General alarm.

3. Furnish additional dry contact for remote alarm.
4. Pump Controllers:
   a. Three-float system for pump off/pump on/ operation, and high level alarm.

2.03 SUMP PUMP BASINS

A. Manufacturer: Sump pump and basin are to be provided by the same manufacturer.
B. Description: Factory fabricated basin with sump, pipe connections, and separate cover.
C. Sump: Fabricate watertight, with sidewall openings for pipe connections.
   1. Material: Concrete.
   2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
   3. Anchor Flange: Same material as or compatible with sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
D. Cover: Fabricate with openings having gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
   1. Material: Cast iron or steel.
   2. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
E. Capacity and Characteristics:
   1. Refer to Drawings for capacity and characteristics.

2.04 BUILDING AUTOMATION SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:
   1. On-off status of each pump.
   2. Alarm status.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.02 CONCRETE

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 20 Section "Basic Mechanical Materials and Methods."
B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.03 SUMP PUMP INSTALLATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."
B. Install sump pumps according to applicable requirements in Hydraulic Institute HI 1.4.
C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.
D. Set submersible sump pumps on basin floor. Make direct connections to storm drainage piping.
E. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.
F. Construct sump pump pits and connect to drainage piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.
G. Install packaged, submersible, drainage pump unit basins on floor or concrete base unless recessed installation is indicated. Make direct connections to storm drainage piping.
H. Support piping so weight of piping is not supported by pumps.

3.04 CONNECTIONS

A. Piping installation requirements are specified in Division 22 Section "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to sump pumps to allow service and maintenance.

C. Connect storm drainage piping to pumps. Install discharge piping equal to pump discharge connection size. If pump discharge connection size is different from storm drainage piping size, provide transition from pump discharge piping size to storm drainage piping size. Refer to Division 22 Section “Storm Drainage Piping.”
   1. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 20 Section "Valves" for general-duty valves for drainage piping.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify bearing lubrication.
   3. Disconnect couplings and check motors for proper direction of rotation.
   4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

B. Start pumps without exceeding safe motor power:
   1. Start motors.
   2. Open discharge valves slowly.
   3. Check general mechanical operation of pumps and motors.

C. Test and adjust controls and safeties.

D. Remove and replace damaged and malfunctioning components.
   1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
   2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION 22 1429

SECTION 22 1513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Meters and Gages" for thermometers and pressure gages.
4. Division 22 Section "General-Service Compressed-Air Equipment" for compressed-air equipment and accessories.

1.02 SUMMARY

A. This Section includes piping and related specialties for general-service (shop) compressed-air systems operating at 200 psig and less.

1.03 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.

C. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 125 and 200 psig.

D. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 125 psig and less.

E. NBR: Acrylonitrile-butadiene rubber.

1.04 SYSTEMS DESCRIPTIONS

A. Low-Pressure Compressed-Air Piping between Air Compressors and Receivers: Use the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

B. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:

1. Pipes, tubes, and fittings.
2. Safety valves.
3. Pressure regulators.
4. Filters.
5. Automatic drain valves.
6. Hose assemblies.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For general-service compressed-air systems. Include relationship to other services that serve same work area.

1.07 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

1.08 QUALITY ASSURANCE

A. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.

B. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Refer to Part 1 "Systems Descriptions" Article for applications of pipe, tube, fittings, valves, and joining materials.

2.02 PIPES, TUBES, AND FITTINGS

A. Black, Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
4. Wrought-Steel Fittings: ASME B16.9, Schedule 40, butt welding.
5. Forged-Steel Fittings: ASME B16.11, socket type.
6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

2.03 JOINING MATERIALS

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for joining materials not in this Section.

2.04 VALVES

A. General Duty Valves: Comply with requirements specified in Division 20 Section "Valves."

2.05 SPECIALTY VALVES

A. Safety-Exhaust, Bronze Ball Valves: Two-piece bronze stem and chrome-plated bronze ball, having exhaust vent opening for pneumatic applications, locking handle, threaded ends, and 600-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.; Apollo Div.; 7K-100-27.
   b. DynaQuip Controls.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.; Model T-585-70-SV.
   f. Watts Water Technologies, Inc.

2.06 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.
   1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Emerson Process Management; Fisher Controls.
      b. IMI Norgren.
      c. Parker-Hannifin Corporation.
   2. Type: Pilot operated.

C. Air-Line Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Emerson Process Management; Fisher Controls.
      b. IMI Norgren.
      c. Parker-Hannifin Corporation.
   2. Type: Diaphragm or pilot operated.

D. Air-Line Pressure Regulators:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Emerson Process Management; Fisher Controls.
      b. IMI Norgren; Excelon Plus Modular System Pressure Regulators.
      c. Parker-Hannifin Corporation.
   2. Aluminum alloy or plastic body, diaphragm operated, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
   3. Outlet pressure adjustable from 4 to 45 psig.
   4. Push-to-lock adjusting knob with tamper resistant feature.

E. Air-Line Lubricators: Sizes and capacities indicated; equip with drip chamber and sight dome for observing oil drop entering airstream; with oil-feed adjustment screw and quick-release collar for easy bowl removal.
   1. Provide with automatic feed device for supplying oil to lubricator.

F. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters in sizes and ratings indicated. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock.

G. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded.

H. Automatic Drain Valves: Corrosion-resistant metal body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

I. Hose-Reel Assemblies: Individual, retractable hose-reel units with steel face plates, steel mounting boxes, factory- or field-fabricated mounting brackets, and service hoses with adjustable ball stop and service connections matching hoses. Include 50 feet of delivery hose, 2 feet of connecting hose, and quick disconnect. Hose and fittings rated for minimum 125 psig service.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reelcraft Industries; 7850 OLP.
      b. Hannay Reels Inc.

PART 3 EXECUTION

3.01 PIPING SYSTEM INSTALLATION

A. Drawings, plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.

C. Install air and drain piping with 1 percent slope downward in direction of airflow.

D. Install eccentric reducers where piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

E. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

F. Install flexible pipe connector on each connection to air compressors.

G. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver; install according to Division 20 Section "Meters and Gages."

3.02 VALVE INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping and valve installation.

B. Install metal general-duty valves according to Division 20 Section "Valves."

C. Install shutoff valve at each connection to and from general-service compressed-air specialties, equipment, and accessories. Install strainer if indicated.

D. Install check valves to maintain correct direction of fluid flow to and from compressed-air piping specialties and equipment.

E. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

F. Install automatic drain valves on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

G. Install safety valves where recommended by specialty manufacturers.

3.03 JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

C. Joining of Dissimilar Metal Piping: Use dielectric fittings. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for dielectric fitting types.

3.04 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 20 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support horizontal piping within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
F. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
    1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
    2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
G. Install supports for vertical, Schedule 40, steel piping every 15 feet.

3.05 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to specialties and equipment to allow service and maintenance.
C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.
D. Use metal general-service compressed-air piping between air compressors and air receivers. Use of plastic piping for this application is prohibited.
E. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
F. Specialty and Equipment Flanged Connections: Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.

3.06 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping systems. Refer to Division 20 Section "Mechanical Identification" for labeling and identification materials.

3.07 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
    1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
    2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
        a. Repair leaks and retest until no leaks exist.
    3. Report results in writing.

END OF SECTION 22 1513

SECTION 22 1519 - GENERAL-SERVICE COMPRESSED-AIR EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section "General-Service Compressed-Air Piping" for compressed-air piping, valves, and related specialties.

1.02 DEFINITIONS

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.

B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

C. PAO: Polyalphaolefin.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design compressed-air equipment mounting.

1.04 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following compressed-air equipment:

1. Air compressors, including receivers and intake filters.
2. Aftercoolers.
3. Compressed-air dryers.
4. Compressed-air filter assemblies.

1.05 INFORMATIONAL SUBMITTALS

A. Shop Drawings:
   1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
   3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   4. Wiring Diagrams: Power, signal, and control wiring.

B. Product Certificates: Certificates of shop inspection and data report for receiver tanks as required by ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Qualification Data: For Installer.

1.06 CLOSEOUT SUBMITTALS

A. Startup service reports.

B. Operation and Maintenance Data: For the following compressed-air equipment and accessories to include in emergency, operation, and maintenance manuals:
   1. Air compressors.
   2. Compressed-air dryers.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of compressed-air equipment manufacturer for both installation and maintenance of units required for this Project.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of compressed-air equipment and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label receiver tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NFPA 70, "National Electrical Code."

1.08 COORDINATION

A. Coordinate size and location of concrete bases. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for concrete bases. Refer to Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 RECIPROCATING AIR COMPRESSORS

A. Pressure Lubricated, Reciprocating Air Compressors:
   1. Manufacturers:
      a. Atlas Copco Compressors, Inc.
      b. FS-Curtis.
      c. Gardner Denver; a Brand of Ingersoll-Rand, Inc.
      d. Ingersoll-Rand; a Brand of Ingersoll-Rand, Inc.
      e. Quincy Compressor.
      f. Saylor-Beall Inc.
   2. General: Packaged air compressor and receiver consisting of compressor, motor, V-belt drive and totally enclosed belt guard all mounted on ASME air receiver, factory piped and wired between compressor controls and receiver.
   3. Number of Compressors: One.

4. Compressor: Single acting, two stage, air-cooled reciprocating type. Cylinders constructed of gray cast iron, with deep cooling fins. Cylinders bolted to the crankcase for ease of maintenance and rebuild. Valve assemblies individually removable without removing the head and inlet or discharge piping. The compressor shall have hardened and lapped disc-type valves for continuous service. Two-piece connecting rods with cast in tubes for positive oil distribution to the piston pins, and having replaceable inserts and bushings. Low pressure pistons shall be aluminum with three automotive type compression rings and one automotive type oil ring. High pressure pistons shall be gray cast iron with three automotive type compression rings and one automotive oil ring. Connecting rod bearings shall be steel backed Babbitt lined automotive type. Crankshafts shall have integral counterweights and be rifle drilled for pressure lubrication to ensure positive oil distribution. Adjustable anti-friction tapered roller bearings shall be mounted on each end of the crankshaft to take both radial and thrust loads. Compressor flywheels dynamically balanced and of the fan type. Finned intercoolers shall be an integral part of all two stage units, and located in the direct blast of air from the fan type flywheel. Compressors equipped with a crankshaft driven oil pump located in the bearing carrier for easy removal and inspection. Include level oil filter located on the bearing carrier. Standard features include low oil protection and automatic loadless starting. Splash lubrication is not acceptable for this application.
5. Performance: Unit shall deliver scheduled CFM free air at 120 psig with ambient inlet conditions. The compressor must have a maximum working pressure of 200-psig.
6. Regulation: Dual Control - Combines auto start-stop with constant speed control. The unit can operate on auto start-stop when air demand is light or on constant speed control when air demand is heavy. Electropneumatic controls shall be incorporated with the control panel and the solenoid valve unloading.
7. Additional Equipment: Intake mufflers in conjunction with intake filter/silencers, vibration isolation pads as specified in Division 20 Section “Mechanical Vibration Controls.”
8. Beltguard: The compressor flywheel, motor flywheel and V-belts shall be totally enclosed within a metal belt guard providing protection on all sides in accordance to OSHA specifications.
9. Miscellaneous Devices: Safety valves, discharge-air pressure gages, pressure regulators, and shutoff valves.

2.03 AIR-INLET FILTERS

A. Manufacturers:
   1. SPX Flow Technology; Dollinger.
   2. Donaldson Filtration Solutions.
   3. Universal Silencer Corp.
   4. Solberg Manufacturing, Inc.; (SMI).
   5. ZEKS Compressed Air Solutions.
B. Description: Combination inlet filter-silencer, suitable for remote installation, for each air compressor.
   1. Construction: Weatherproof housing for cleanable, dry-type filter element, with silencer tubes or other method of sound reduction.
   2. Capacity: Match capacity of air compressor, with collection efficiency of 99 percent retention of particles larger than 20 microns.

2.04 REGENERATIVE DESICCANT COMPRESSED AIR DRYER

A. Manufacturers:
   1. Donaldson Filtration Solutions.
   2. SPX Flow Technology; Deltech.
   3. SPX Flow Technology; Hankison International
   4. Van Air Systems, Inc.
   5. Wilkerson Corp.
   6. ZEKS Compressed Air Solutions.
B. Regenerative desiccant compressed air dryer shall be packaged, heatless, dual tower, skid mounted type. Unit shall be capable of reducing the moisture content of 165 scheduled SCFM at the compressor discharge pressure and temperature to maintain a pressure dewpoint of dried air at minus 40 deg F .

C. Dryer shall have twin ASME code-welded pressure vessels complete with spherical-bead noncorrosive activated alumina desiccant and desiccant fill and empty ports. A continuous supply of dry air shall be provided by the automatically cycled operation of the drying vessels, including a variable drying period, pressure stabilization and a variable reactivation period. Automatic cycling shall be controlled by a micro-processor based control system. Airflow shall be directed through alternate drying vessels by a pneumatically operated shuttle valve which requires no lubrication. Sensors shall be located in the airstream, at the dryer inlet and outlet, to determine moisture content of inlet air; a micro-processor based control system shall select minimum purge duration and minimum purge rate, which can vary from 0 to 20 percent of rated inlet flow in 5 percent increments, for complete regeneration of the desiccant. The micro-processor based control system shall, if dryer load is zero, regenerate desiccant, then turn purge off; when air demand resumes, the micro-processor based control system shall turn dryer on.

D. Purge air control system shall include mufflers to reduce the noise level of purge air exhaust to within OSHA standards, and shall be designed to provide a continuous, minimum flow of purge air should the purge air control regulating valve fail. No electrical or other energy from an outside source shall be supplied to the dryer for reactivation.

E. Dryer shall include pressure relief valve, gauges showing pressure in each drying tower, switch for selecting power "ON-OFF," indicating light signaling power "ON," visible and audible alarms to signal failure of tower cycling, and visible and audible alarms to signal high dew point in process airstream.

2.05 ACCESSORIES

A. General: Include accessories with working-pressure rating not less than system pressure at location where used, and compatible with equipment and piping system used.

B. Intercoolers: Air-cooled, fixed-bundle, tubular; rated at 250 psig and leak tested at 350-psig minimum air pressure; in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum ambient temperature.

C. Intercoolers: Water-cooled, fixed-bundle, tubular; rated at 250 psig and leak tested at 350-psig minimum air pressure; in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum water temperature.

D. Separators: Conical-shaped, centrifugal air-line separator of capacity not less than connected equipment. Equip with water-removal trap and drain. Size units for maximum pressure drop through units of 3 psig from air inlet to outlet.

2.06 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.
   1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Automatic Drain Valves: Electrical- or mechanical-operation type with corrosion-resistant metal body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

C. Pressure Regulators: Bronze body, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
   1. Type: Diaphragm or pilot operated.
   2. Manufacturers:
      a. Emerson Process Management; Fisher Controls.
      b. IMI Norgren.
      c. Watts Fluid Air; Division of Parker-Hannifin.

D. Pressure Regulators: Aluminum alloy or plastic body, diaphragm operated, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
   1. Manufacturers:
      a. Emerson Process Management; Fisher Controls.
      b. IMI Norgren.
      c. Watts Fluid Air; Division of Parker-Hannifin.

E. Compressed-Air Filters:
   1. Manufacturers:

a. Donaldson Filtration Solutions.
b. SPX Flow Technology; Dollinger.
c. SPX Flow Technology; Deltech.
d. Ultrafilter Inc.
e. Zeks Air Drier Corporation.

2. Mechanical-Separation Filters: Two-stage air-line filters of capacity not less than that of connected equipment. Equip with deflector plates; resin-impregnated-ribbon-type filters with edge filtration, 40 micrometers thick; and drain chock.
3. Coalescing Filters: Capacity not less than that of connected equipment; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Equip with activated carbon capable of removing water and oil aerosols.

2.07 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 20 Section "Motors."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.

PART 3 EXECUTION

3.01 CONCRETE BASES

A. Install concrete bases for compressed-air equipment. Concrete base is specified in Division 20 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 03.

3.02 EQUIPMENT INSTALLATION

A. Install air compressors on concrete bases. Install units level, plumb, and anchored to substrate in locations indicated. Maintain manufacturers' recommended clearances. Orient equipment so controls and devices are accessible for servicing.
1. Anchor packaged equipment to concrete base.
a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
b. Install epoxy-coated anchor bolts for supported equipment; extend through concrete base and anchor into structural concrete floor.
c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
d. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Vibration Isolation: Mount equipment with motors larger than 5 hp on vibration isolation equipment base as specified in Division 20 Section "Mechanical Vibration Controls."
C. Maintain manufacturer's recommended clearances for service and maintenance.
D. Install the following devices on compressed-air equipment:
1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
3. Automatic Drain Valves: Install on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to equipment to allow service and maintenance.
C. Connect piping to air compressors and receivers, except safety relief valve connections, with flexible pipe connectors of materials suitable for service. Flexible pipe connectors and their installation are specified in Division 22 Section "General-Service Compressed-Air Piping."
D. Ground equipment according to Division 26 Section "Grounding and Bonding."
E. Connect wiring according to Division 26 Section "Conductors and Cables."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for compressed-air equipment. Refer to Division 20 Section "Mechanical Identification" for labeling and identification materials.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to test, inspect, and adjust components and equipment installation and to perform startup service.

B. Perform the following final checks:

1. Verify that specified tests of piping systems are complete.
2. Verify that potable-water supply connections to equipment have correct backflow preventer.
3. Check for piping connection leaks.
4. Check for lubricating oil in lubricated-type equipment.
5. Check belt drives for proper tension.
6. Verify that air-compressor inlet filters and piping are clear.
7. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
8. Check safety valves for correct settings. Ensure that settings are greater than air-compressor discharge pressure but not greater than rating of system components.
9. Test operation of equipment safety controls and devices.
10. Drain receiver tanks.

C. Verify that compressed-air equipment is installed and connected according to the Contract Documents.

D. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in Division 26 Sections.

E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Complete installation and startup checks according to manufacturer's written instructions.

H. Prepare written report documenting testing procedures and results.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain general-service compressed-air equipment.

END OF SECTION 22 1519

SECTION 22 3313 – WATER SOURCE HEAT PUMP WATER HEATERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

B. Product Certificates: For each type of electric water heater, signed by product manufacturer.

C. Source quality-control test reports.

1.04 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For electric water heaters to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
   1. ASHRAE 90.1, “Energy Efficient Design of New Buildings except Low-Rise Residential Buildings,” for commercial water heaters.
F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.06 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 WATER SOURCE HEAT PUMP WATER HEATERS

A. Commercial Electric Booster Heaters: Comply with UL 1453 requirements for booster-type water heaters.
   1. Manufacturers:
      a. Bradford White Corporation.
      b. Lochinvar Corporation.
      c. Smith, A. O. Water Products Company.
   2. Construction
      a. Constructed with a heavy gauge aluminum jacket assembly and painted on both sides.
      b. Certified for indoor and/or outdoor installation.
      c. Certified and listed by TUV to CSA C22.2 No. 236:2015, UL 1995:2015-07 standards.
      d. Suitable for use with polypropylene glycol, up to 50% concentration. The de-rate associated with the glycol will vary per glycol manufacturer.
   3. Compressor
      a. Scroll compressor or reciprocating compressor, factory charged with R134 refrigerant, NSF61 approved stainless steel circulator pump, and double wall stainless steel condenser for potable water applications.
   4. Evaporator
      a. Stainless-steel single wall heat exchanger evaporator.
   5. Refrigerant Circuit
      a. Adjustable thermal expansion valve, receiver, accumulator, serviceable filter drier and service ports for refrigerant gauges.
   6. Electronic Control System
      a. 24 VDC control circuit and components.
      b. The control system shall have a display (PLC Option) for heat pump set-up, heat pump status, and heat pump diagnostics. All components shall be easily accessed and serviceable.
      c. Equipped with low and high refrigerant pressure switches; short cycle control; outlet water temperature sensor and return water temperature sensor.
   7. Thermal Strips
      a. A low voltage connection board connection points for safety and operating controls, i.e., alarm contacts, runtime contacts and tank thermostat.
      b. A high voltage terminal strip shall be provided for supply voltage.
   8. Communications
      a. Optional control for “Cascade” to sequence and rotate while maintaining operation of up to eight heat pumps of same Btu inputs.
      b. Capable of controlling a valve (single pass option) that maintains constant delivery temperature to the storage tank.
      c. Optional gateway device which will allow integration with BACnet.
   9. Hot-Water Storage Tank: Connected with piping to circulating pump and water heater.

a. Construction: According to ASME Boiler and Pressure Vessel Code: Section IV, Part HLW steel with 125-psig working-pressure rating.
b. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
e. Jacket: Steel with enameled finish.
f. Anode Rods: Factory installed, magnesium.
g. Drain Valve: Corrosion-resistant metal complying with ASSE 1005, factory installed.
h. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

2.03 EXPANSION TANKS

A. Description: Steel, pressure-rated tank, ASME-code constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
1. Manufacturers:
a. AMTROL Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; Xylem Inc.
d. Taco, Inc.
e. Wessels Co.
2. Construction:
a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.
3. Capacity and Characteristics: Refer to Schedule on Drawings.

2.04 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
B. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch- high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1 pipe thread.
C. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
D. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
E. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
F. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that are capable of isolating each water heater and of providing balanced flow through each water heater.

G. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
H. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- maximum outlet pressure, unless otherwise indicated.
I. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

2.05 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
C. Prepare test reports.

PART 3 EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install water source heat pump water heaters on concrete bases.
    1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
    2. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
D. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 20 Section "Valves" for hose-end drain valves.
F. Install thermometer on outlet piping of water heaters. Refer to Division 20 Section "Meters and Gages" for thermometers.
G. Install thermometers on inlet and outlet piping of household, collector-to-tank, solar-electric water heaters. Refer to Division 20 Section "Meters and Gages" for thermometers.
H. Install pressure gage(s) on inlet and outlet of commercial electric water- heater piping. Refer to Division 20 Section "Meters and Gages" for pressure gages.
I. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 20 Section "Valves" for general-duty valves and to Division 20 Section "Meters and Gages" for thermometers.
J. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.
K. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
L. Fill water heaters with water.
M. Charge compression tanks with air.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
C. Ground equipment according to Division 26 Section "Grounding and Bonding."
D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
C. Remove water heaters that do not pass tests and inspections. Replace with water heaters meeting Contract requirements and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water source heat pump water heaters.

END OF SECTION 22 3313

SECTION 22 4200 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 10 Section "Toilet and Bath Accessories."
2. Division 20 Section “Mechanical General Requirements.”
3. Division 20 Section “Basic Mechanical Materials and Methods.”
4. Division 22 Section "Medical Plumbing Fixtures."
5. Division 22 Section "Drinking Fountains and Water Coolers."
6. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
7. Division 22 Section “Drainage Piping Specialties” for floor drains, and specialty fixtures not included in this Section.
8. Division 22 Section "Water Distribution" for exterior plumbing fixtures and hydrants.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
F. FRP: Fiberglass-reinforced plastic.
G. PMMA: Polymethyl methacrylate (acrylic) plastic.
H. PVC: Polyvinyl chloride plastic.
I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.
B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
E. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.
G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
H. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 PRODUCTS

2.01 WATER CLOSETS

A. Water Closets, WC-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard Companies, Inc.

b. Ferguson Enterprises, Inc..
c. Kohler Co.; Kingston K-4325-0.
d. Sloan Valve Company.
e. Zurn Plumbing Products Group.

2. Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
   a. Style: Flushometer valve.
      1) Bowl Type: Elongated with siphon-jet design.
      2) Supply Spud Location: Top.
      3) Design Consumption: 1.28 gal./flush.
      4) Color: White.
   b. Flushometer: FV-1.
   c. Toilet Seat: TS-1.
   d. Fixture Support: Water-closet support combination carrier.

2.02 MANUAL WATER CLOSET FLUSHOMETERS

A. Flushometers, FV-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Delany Products.
   c. Delta Faucet Company.
   d. Kohler Co.
   e. Sloan Valve Company; Royal 111.
   f. Zurn Plumbing Products Group.
2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
   a. Internal Design: Diaphragm or piston operation.
   b. Style: Exposed.
   c. Inlet Size: NPS 1.
   d. Trip Mechanism: Oscillating, low-force ADA compliant lever-handle actuator.
   e. Consumption: 1.28 gal./flush.
   f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.

2.03 TOILET SEATS

A. Toilet Seats, TS-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bemis Manufacturing Company; 1955SSC/1955SSCT.
   b. Centoco Manufacturing Corp.
   c. Church Seats.
   d. Comfort Seats; a Jones Stephens Brand.
   e. Ferguson Enterprises, Inc..
   f. Olsonite Seat Company.
   g. Plumbtech; Plumbing Technologies, LLC.
   h. Sanderson Plumbing Products, Inc.; Beneke Div.
   i. Zurn Plumbing Products Group.
2. Description: Toilet seat for water-closet-type fixture.
   a. Material: Molded, solid plastic.
   b. Configuration: Open front without cover.
   c. Size: Elongated.
   d. Hinge Type: SC, self-sustaining, check.
   e. Class: Standard commercial.
   f. Color: White.

2.04 LAVATORIES

A. Lavatories, LAV-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Ferguson Enterprises, Inc.
   c. Kohler Co.; K 2211-G Caxton.
   d. Sloan Valve Company.
   e. Zurn Plumbing Products Group.
2. Description: Accessible, under-counter mounting, vitreous-china fixture with unglazed rim, and concealed overflow.
   a. Oval Lavatory Size: 19 by 16 inches.
   b. Color: White.
   c. Faucet: LAVF-1.
   d. Water Temperature Limiting Device: Required.
   e. Drain: Grid
   f. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.

B. Lavatories, LAV-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Ferguson Enterprises, Inc.
   c. Kohler Co.; K 2005 Kingston.
   d. Sloan Valve Company.
   e. Zurn Plumbing Products Group.
2. Description: Accessible, wall-mounting, vitreous-china fixture.
   a. Type: With contoured back and side shields.
   b. Size: 20 by 18 inches rectangular.
   c. Faucet Hole Punching: Three holes, 2-inch centers.
   d. Color: White.
   e. Faucet: LAVF-1.
   f. Water Temperature Limiting Device: Required.
   g. Drain: Grid.
   h. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.
   i. Fixture Support: Lavatory with concealed arms.

2.05 LAVATORY FAUCETS

A. Lavatory Faucets, LAVF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Chicago Faucets.
   c. Delta Faucet Company; Model 523LF-HDF.
   d. Kohler Co.
   e. Moen Commercial.
   f. Speakman Company.
   g. T & S Brass and Bronze Works, Inc.
   h. Zurn Plumbing Products.
2. Description: Single handle mixing faucet, vandal resistant, 2 or 3 holes, with metal grid strainer, no lift rod hole, high temperature limit stop.
   a. Body Material: Commercial, all metal construction meeting NSF 61.
   b. Finish: Polished chrome plate.

c. Centers: 4 inches.
d. Mounting: Deck, concealed.
e. Inlet(s): NPS 1/2.
f. Spout Outlet:
1) Vandal resistant aerator.
2) Laminar flow or plain end for patient care areas.
g. Maximum Flow Rate:
1) 0.5 gpm for faucets in public restrooms.

2.06 SINKS

A. Sinks, SK-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.
b. Ferguson Enterprises, Inc.
c. Kohler Co.; K 2005 Kingston.
d. Sloan Valve Company.
e. Zurn Plumbing Products Group.
2. Description: Accessible, wall-mounting, vitreous-china fixture.
a. Type: With contoured back and side shields.
b. Size: 20 by 18 inches rectangular.
c. Faucet Hole Punching: Three holes, 2-inch centers.
d. Color: White.
e. Faucet: SKF-1.
f. Water Temperature Limiting Device: Required.
g. Drain: Grid.
h. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.
i. Fixture Support: Lavatory with concealed arms

B. Sinks, SK-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Elkay Manufacturing Co; Model ELUH1814PD.
b. Franke Consumer Products, Inc., Commercial Div.
c. Just Manufacturing Company.
d. Moen Commercial.
2. Description: Single-bowl, undermount stainless-steel sink.
a. Overall Dimensions: 20-1/2 inches left to right by 16-1/2 inches front to back.
b. Metal Thickness: 18 gage, with sound dampened underside.
c. Bowl:
1) Dimensions: 18 inches by 14 inches by 7-7/8 inches deep.
2) Drain: 3-1/2-inch grid.
d. Sink Faucet: SKF-2.
e. Water Temperature Limiting Device: Required.
f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).
g. Disposer: D-1.
h. Dishwasher Air-Gap Fitting: Required.
i. Hot-Water Dispenser: Not required.

C. Sinks, SK-3:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Elkay Manufacturing Co.
b. Franke Consumer Products, Inc., Commercial Div.

c. Just Manufacturing Company.

2. Description: One-compartment, freestanding, Type 304 stainless-steel commercial sink with backsplash.
   a. Overall Dimensions: Custom 7 feet long (refer to architectural enlarged plan #3/A4.11).
   b. Metal Thickness: 14 gage.
   c. Compartment:
      1) Dimensions: Custom (refer to architectural enlarged plan #3/A4.11).
      2) Drain: Grid with NPS 1-1/2 tailpiece.
         a) Location: Centered in compartment.
   d. Drainboard(s): Right side, (refer to architectural enlarged plan #3/A4.11).
   e. Supports: Tubular stainless steel legs with adjustable bullet shaped feet.
   f. Faucet(s): Sink SKF-3A & SKF-3B, and punched for emergency eyewash and water faucet.
      1) Mounting: On deck.
   g. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).

2.07 SERVICE SINKS

A. Service Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Engineering Company.
   b. Crane Plumbing, LLC; Fiat Products; an American Standard Brand.
   c. Florestone Products Co., Inc; Model 30 RH.
   d. Precast Terrazzo Enterprises, Inc.
   e. Stern-Williams Co., Inc.
   f. Crane Plumbing, LLC; Fiat Products; an American Standard Brand.
   g. Ferguson Enterprises, Inc.
   h. Florestone Products Co., Inc.
   i. Mustee, E. L. & Sons, Inc.
   j. Swan; American Bath Group.
   k. Zurn Plumbing Products Group; Light Commercial Operation.
2. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.
   a. Shape: Rectangular.
   b. Size: 36 by 24 inches.
   c. Height: 12 inches.
   d. Tiling Flange: On two sides.
   e. Rim Guard: On front top surfaces.
   f. Color: Not applicable.
   g. Faucet: SKF-4.
   h. Drain: Grid with NPS 3 outlet.

2.08 SINK FAUCETS

A. Sink Faucets, SKF-1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Chicago Faucets.
   c. Delta Faucet Company; Model 523LF-HDF.
   d. Kohler Co.
   e. Moen Commercial.
   f. Speakman Company.
   g. T & S Brass and Bronze Works, Inc.
   h. Zurn Plumbing Products.
2. Description: Single handle mixing faucet, vandal resistant, 2 or 3 holes, with metal grid strainer, no lift rod hole, high temperature limit stop.

a. Body Material: Commercial, all metal construction meeting NSF 61.
b. Finish: Polished chrome plate.
c. Centers: 4 inches.
d. Mounting: Deck, concealed.
e. Inlet(s): NPS 1/2.
f. Spout Outlet:
1) Vandal resistant aerator.
2) Laminar flow or plain end for patient care areas.
g. Maximum Flow Rate:
1) 0.5 gpm for faucets in public restrooms.

B. Sink Faucets, SKF-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.
b. Chicago Faucets; Model 434-ABBN.
c. Delta Faucet Company.
d. Kohler Co.
e. Moen Commercial.
f. Speakman Company.
g. T & S Brass and Bronze Works, Inc.
h. Zurn Plumbing Products Group.
2. Description: Kitchen sink style faucet. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
a. Body Material: Commercial, solid brass.
b. Finish: Brushed nickel.
c. Mixing Valve: Single handle.
d. Mounting: Deck.
e. Handle(s): Single handle, pull-down, ADA compliant.
f. Operation: Noncompression, manual.
g. Inlet(s): NPS 3/8.
h. Spout Type: 9-inch cast-brass.
i. Spout Outlet: Aerator.
j. Maximum Flow Rate:
1) 1.5 gpm.

C. Sink Faucets, SKF-3A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.
b. Chicago Faucets.
c. Delta Faucet Company.
d. Elkay Manufacturing.
e. Kohler Co.
f. Moen Commercial.
g. Speakman Company.
h. T & S Brass and Bronze Works, Inc.; Model B2187.
i. Zurn Plumbing Products Group.
2. Description: Commercial/Industrial sink faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Mixing Valve: Two handle.
d. Centers: 8 inches.
e. Mounting: Back/wall.

f. Handle(s): Lever, 4 inches.
g. Operation: Noncompression, manual.
h. Inlet(s): NPS 1/2.
i. Spout Type: 70 to 120-degree restricted swing gooseneck.
j. Spout Outlet: Aerator.
k. Maximum Flow Rate:
1) 1.5 gpm.

D. Sink Faucets, SKF-3B:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Haws Corp.; Model 7610.
b. Speakman Company.
2. Description: Eye/Face wash.
a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Eyewash Flow Rate: 0.4 gpm at 30 psi for 15 minutes.
d. Mixing Valve: ASSE 1071.
e. Mounting: Back/wall.
f. Handle(s): Pull-down.
g. Inlet(s): NPS 1/2.
h. Eyewash Activation: Pull-down.

E. Sink Faucets, SKF-4:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.
b. Chicago Faucets; Model 540-LD897SWXFXKCP.
c. Delta Faucet Company.
d. Ferguson Enterprises, Inc.
e. Kohler Co.
f. Moen Commercial.
g. Speakman Company.
h. Symmons Industries, Inc.
i. T & S Brass and Bronze Works, Inc.
j. Zurn Plumbing Products Group.
2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Include 5 foot rubber hose and wall mounted hose clamp.
a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
d. Mixing Valve: Two handle.
e. Centers: 8 inches.
f. Mounting: Back/wall.
g. Handle(s): Lever.
h. Inlet(s): NPS 1/2.
i. Spout Type: Rigid, solid brass with wall brace and pail hook.
j. Spout Outlet: Hose thread.
k. Vacuum Breaker: Required.
l. Operation: Non-compression, manual.

2.09 SHOWER FAUCETS

A. Shower Faucets SH-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Acorn Controls; Morris Group International.
    b. American Standard Companies, Inc.
    c. Bradley Corporation.
    d. Chicago Faucets.
    e. Delta Faucet Company.
    f. Kohler Co.
    g. Lawler Manufacturing Co., Inc.
    h. Leonard Valve Company.
    i. Moen Commercial.
    j. Powers; a Watts Water Technologies Co.
    k. Speakman Company.
    l. Symmons Industries, Inc.; Model 4700-X w/Speakman s-2252-e175 shower head & Speakman S-2520 shower arm and flange.
    m. Zurn Plumbing Products Group.
2. Description: Single-handle ASSE 1016 thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
    a. Body Material: Solid brass.
    b. Finish: Polished chrome plate.
    c. Maximum Flow Rate: 1.75 gpm, unless otherwise indicated.
    d. Diverter Valve: Integral with mixing valve.
    e. Mounting: Concealed.
    f. Backflow Protection Device for Hand-Held Shower: Not required.
    g. Operation: Manual.
    h. Antiscald Device: ASSE 1016, integral with mixing valve.
    i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
    j. Supply Connections: NPS 1/2.
    k. Shower Head Type: Ball joint.
    l. Shower Head Material: Metallic with chrome-plated finish.
    m. Spray Pattern: Adjustable.
    n. Temperature Indicator: Integral with faucet.

B. Shower Faucets SH-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Acorn Controls; Morris Group International.
    b. American Standard Companies, Inc.
    c. Bradley Corporation.
    d. Chicago Faucets.
    e. Delta Faucet Company.
    f. Kohler Co.
    g. Lawler Manufacturing Co., Inc.
    h. Leonard Valve Company.
    i. Moen Commercial.
    j. Powers; a Watts Water Technologies Co.
    k. Speakman Company.
    l. Symmons Industries, Inc.; Model 4700-X w/Symmons T736-1.5 Handshower.
    m. Zurn Plumbing Products Group.
2. Description: Single-handle ASSE 1016 thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.

a. Body Material: Solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
d. Diverter Valve: Integral with mixing valve.
e. Mounting: Concealed.
f. Backflow Protection Device for Hand-Held Shower: Required.
g. Operation: Manual.
h. Antiscald Device: ASSE 1016, integral with mixing valve.
i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
j. Supply Connections: NPS 1/2.
k. Shower Head Type: 36 inch slide/grab bar with ADA hand shower.
l. Shower Head Material: Metallic with polished chrome-plated finish.
m. Spray Pattern: Adjustable.
n. Temperature Indicator: Integral with faucet.

2.10 FIXTURE SUPPLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. BrassCraft; a Masco Company.
2. McGuire Mfg. Co., Inc.
3. Any of the approved plumbing fixture manufacturers.

B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers (PSG-1):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Engineered Brass Co.
b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
c. McGuire Manufacturing Co., Inc.
d. Oatey; Dearborn Safety Series.
e. Plumberex Specialty Products Inc.
f. TCI Products; SG-200BV.
g. TRUEBRO, Inc.
h. Zurn Plumbing Products Group; Z8946-3-NT.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.12 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Water-Closet Supports:
1. Description: Combination carrier designed for wall-mounting, water-closet-type fixture. Include:
a. Single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement.
b. Faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture.
c. Cast iron nipple and coupling kit.
d. Additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Lavatory Supports:

1. Description: Lavatory carrier with concealed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Sink Supports:
1. Description: For wall-mounting sink-type fixture. Include steel uprights with feet.
a. Type I, sink carrier with exposed arms and tie rods.
b. Type II, sink carrier with hanger plate, bear studs, and tie rod.
c. Type III, sink carrier with hanger plate and exposed arms.

2.13 DISHWASHER AIR-GAP FITTINGS

A. Dishwasher Air-Gap Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. B & K Industries, Inc.
b. Brass Craft Mfg. Co.; a Subsidiary of Masco Corporation.
c. Brasstech Inc.; Newport Brass Div.
d. Dearborn Brass; a div. of Moen, Inc.
e. Geberit Manufacturing, Inc.
f. JB Products; a Federal Process Corporation Company.
g. Sioux Chief Manufacturing Company, Inc.
h. Watts Brass & Tubular; a division of Watts Regulator Co.
2. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at a temperature of at least 140 deg F. Include 5/8-inch- ID inlet and 7/8-inch- ID outlet hose connections.
3. Hoses: Rubber and suitable for temperature of at least 140 deg F.
a. Inlet Hose: 5/8-inch ID and 48 inches long.
b. Outlet Hose: 7/8-inch ID and 48 inches long.

2.14 DISPOSERS

A. Disposers, D-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. In-Sink-Erator; a div. of Emerson Electric Co.; Badger 5XP.
2. Description: Continuous-feed, household type food-waste disposer. Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper. Include cord with grounded plug.
a. Motor: 115-V ac, 1725 rpm, 3/4 hp with overload protection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.
F. Install wall-mounting urinals with PVC-DWV piping from urinal outlet to first change in piping direction.
G. Install counter-mounting fixtures in and attached to casework.
H. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.
I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
    1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.
J. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 20 Section “Domestic Water Piping Specialties.”
K. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
L. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
M. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.
N. Install toilet seats on water closets.
O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
R. Install shower flow-control fittings with specified maximum flow rates in shower arms.
S. Install traps on fixture outlets.
    1. Exception: Omit trap on fixtures with integral traps.
    2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
T. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
U. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck. Connect inlet hose to dishwasher and outlet hose to disposer.
V. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
W. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
C. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.
D. Ground equipment according to Division 26 Section "Grounding and Bonding."
E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.05 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.
C. Adjust water pressure at faucets and flushometer valve to produce proper flow and stream.
D. Adjust flow at laboratory faucets having serrated nozzles to prevent splashing.
E. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.

3.06 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
    1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
    2. Remove sediment and debris from drains.
B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.
B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4200

SECTION 22 4700 - DRINKING FOUNTAINS, WATER COOLERS, AND CUSPIDORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

D. Fitting: Device that controls flow of water into or out of fixture.

E. Fixture: Drinking fountain or water cooler.

F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.

G. TDS: Total dissolved solids.

H. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.03 ACTION SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.
D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.
E. AHRI Standard: Comply with AHRI's "Directory of Certified Drinking Water Coolers" for style classifications.
F. AHRI Standard: Comply with AHRI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with AHRI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
G. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 PRODUCTS

2.01 PRESSURE (ELECTRIC) WATER COOLERS

A. Water Coolers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Elkay Manufacturing Co.; LZWS-EDFP217K.
b. Halsey Taylor.
c. Haws Corporation.
d. Murdock Manufacturing; A Member of Morris Group International.
e. Oasis Corporation.
f. Sunroc Corp.
2. Description: AHRI 1010, Type PB, pressure with bubbler, accessible, Style W, dual-height, architectural-style wall-mounting water cooler with bottle filling station.
a. Material: Stainless steel.
b. Receptor Shape: Round.
c. Back Panel: Stainless-steel behind receptors with ventilation grille located below receptors.
d. Bubblers: One for each receptor, flexible or elastomeric overmolded, with adjustable stream regulator, located on receptors.
e. Control: Push button.
f. Supply: NPS 3/8 with isolation valve.
g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
h. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
2) Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.
i. Bottle Filling Station: Recessed design constructed of 18 gage Type 300 series stainless steel and ABS plastic. Include:
1) Electronic sensor for no-touch activation.
2) Automatic 20-second shut-off timer.
3) 1.1 gpm flow rate
4) Anti-microbial protected plastic components.
j. Support: Refer to "Fixture Supports" Article.

2.02 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.; A Member of Morris Group International.
4. Tyler Pipe; Wade Div.

5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
B. Examine walls and floors for suitable conditions where fixtures are to be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
B. Use mounting frames for recessed water coolers, unless otherwise indicated.
C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.03 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."
E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
C. Ground equipment according to Division 26 Section "Grounding and Bonding."
D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.06 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.
B. Adjust water cooler temperature settings.

3.07 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 22 4700

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Testing, Adjusting, and Balancing.”

1.02 SUMMARY

A. This Section includes common requirements for fans and air moving equipment.

1.03 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

B. Fan Performance Data: AMCA Standard 210.

C. Sound Power Level Ratings:

1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 FAN SHAFTS

A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.03 MOTOR REQUIREMENTS

A. Furnish motors in accordance with Division 20 Section “Motors.”

2.04 FAN BEARINGS

A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L_{10} minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.

1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.
2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L_{10} life requirements.

2.05 IDENTIFICATION

A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.06 ACCESSORIES

A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

PART 3 EXECUTION

3.01 INSTALLATION

A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.
B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.
C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION 23 0500

SECTION 23 0523 - GENERAL-DUTY VALVES FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section "Mechanical Identification" for valve tags and charts.
2. Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
3. Division 22 Section “General-Duty Valves for Plumbing” for plumbing valves.
4. Division 23 Section "Temperature Controls" for control valves and actuators.

1.02 SUMMARY

A. This Section includes valves for general HVAC applications. Refer to piping Sections for specialty valve applications.

1.03 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. PTFE: Polytetrafluoroethylene plastic.
4. WOG: Water, oil, and gas.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.05 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 VALVES, GENERAL

A. Isolation valves are scheduled on the Drawings. For other general HVAC valve applications, use the following:
1. Throttling Service: Angle, ball, butterfly, or globe valves.
2. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:
1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

G. Extended Valve Stems: On insulated valves.

H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. Valve Grooved Ends: AWWA C606.

J. Solder Joint: With sockets according to ASME B16.18.
1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

K. Threaded: With threads according to ASME B1.20.1.

L. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Series 77C-A Series.
b. Crane Co.; Crane Valves.
c. Hammond Valve.
d. Kitz Corporation; Kitz Valves.

e. Milwaukee Valve Company.
f. NIBCO INC.; Models S-585-70-66 or T-585-70-66.
g. Watts Water Technologies, Inc.; Series B6080G2/B6081G2.

2.03 GENERAL SERVICE BUTTERFLY VALVES

A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:
1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.

B. Lug-Style (Single-Flange) Size NPS 2-1/2 CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD 145.
b. Bray International, Inc.
c. DeZurik.
d. Emerson Automation Solutions; Keystone.
e. Forum Energy Technologies; ABZ Valve.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.; LD-2000-3/5.
i. Tyco Flow Control; Grinnell Flow Control.
j. Watts Water Technologies.

C. Grooved-End Butterfly Valves with EPDM-Encapsulated, or Electroless Nickel Coated Ductile-Iron Disc: Ductile-iron body with grooved or shouldered ends and polyamide coating inside and outside; Type 416 stainless-steel stem, PTFE bronze sintered on steel bushing, and 300-psig CWP Rating for Valves NPS 2 through NPS 8. Valve design shall provide bi-directional, bubble tight seal from full vacuum to 300 psig.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ASC Engineered Solutions.
b. NIBCO INC.; Model GD-4765-3/5.
c. Victaulic Co. of America.

2.04 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 150, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 300 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.
b. Crane Co.; Crane Valves.
c. Crane Co.; Stockham Div.
d. Hammond Valve.
e. Milwaukee Valve Company; Model 515.
f. NIBCO INC.; Models S-433-B or T-433-B.
g. Watts Water Technologies.

2.05 BRONZE GLOBE VALVES

A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.

B. Class 150, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 300 psig CWP rating.
   1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
      a. Apollo Valves; by Conbraco Industries, Inc.
      b. Crane Co.; Crane Valves.
      c. Hammond Valve.
      d. Milwaukee Valve Company; Model 590.
      e. NIBCO INC.; Models S-235-Y or T-235-Y.
      f. Watts Water Technologies, Inc.

2.06 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
   1. Bronze ball valve as specified in this Section.
   2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
D. Examine threads on valve and mating pipe for form and cleanliness.
E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
C. Locate valves for easy access and provide separate support where necessary.
D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
E. Install valves in position to allow full stem movement.
F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

3.03 JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.04 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 23 0523

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:
   1. Division 20 Section “Mechanical General Requirements.”
   2. Division 20 Section “Basic Mechanical Materials and Methods.”
   3. Division 23 Section “Common Work Results for HVAC.”

1.02 SUMMARY

A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
   2. Hydronic Piping Systems:
      a. Constant-flow systems.
      b. Primary-secondary systems.
   3. HVAC equipment quantitative-performance settings.
   4. Kitchen hood airflow balancing.
   5. Space pressurization testing and adjusting.
   6. Verifying that automatic control devices are functioning properly.
   7. Reporting results of activities and procedures specified in this Section.

1.03 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
B. AHJ: Authority having jurisdiction.
C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
F. NC: Noise criteria.
G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
H. RC: Room criteria.
I. Report Forms: Test data sheets for recording test data in logical order.
J. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
M. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
N. TAB: Testing, adjusting, and balancing.
O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
P. Test: A procedure to determine quantitative performance of systems or equipment.
Q. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit copies of the Contract Documents review report as specified in Part 3.
C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
D. Sample Report Forms: Submit two sets of sample TAB report forms.

1.05 CLOSEOUT SUBMITTALS

A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
B. Warranties specified in this Section.

1.06 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
B. Smoke Control System Testing: Additional Qualifications: The TAB firm shall be a qualified special inspector for the smoke control systems. The TAB firm for the smoke control system shall have expertise in fire protection engineering, mechanical engineering, and certification as air balancers.
C. Approved Balancing Agencies.
    1. The TAB firm selected shall be from the following list:
        a. Airflow Testing Inc.; Lincoln Park, MI.
        b. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
        c. Ener-Tech Testing; Holly, MI.
        d. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.

e. International Test & Balance Inc.; Southfield, MI.
f. Pro-MEC Engineering Services, Inc.; Grand Ledge, MI.
g. Hi-Tech Test & Balance; Freeland, MI.

D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.

F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.07 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.08 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.09 WARRANTY

A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

B. Examine system and equipment test reports.

C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual

volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

E. Examine terminal units, to verify that they are accessible and their controls are connected and functioning.

F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

G. Examine strainers for clean screens and proper perforations.

H. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

I. Examine system pumps to ensure absence of entrained air in the suction piping.

J. Examine equipment for installation and for properly operating safety interlocks and controls.

K. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.

C. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.
C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
D. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
E. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.
F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
G. Verify that motor starters are equipped with properly sized thermal protection.
H. Check dampers for proper position to achieve desired airflow path.
I. Check for airflow blockages.
J. Check condensate drains for proper connections and functioning.
K. Check for proper sealing of air-handling unit components.
L. Check for proper sealing of air duct system.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
    1. Measure fan static pressures to determine actual static pressure as follows:
        a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
        b. Measure static pressure directly at the fan outlet.
        c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
        d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
    2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
        a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
    3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
    4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.
    5. When existing air handling systems require rebalancing, select required sheave sizes and advise Mechanical Contractor to change drive sheaves accordingly. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.
    6. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts, or use reduced scale contract documents with notations.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check expansion tank liquid level.
   3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at indicated flow.
   5. Set system controls so automatic valves are wide open to heat exchangers.
   6. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.07 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
   4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
    1. Determine the balancing station with the highest percentage over indicated flow.
    2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
    3. Record settings and mark balancing devices.
F. Equipment installed with pressure independent characterized control valves (PICCV) or auto-flow devices shall not require hydronic system balancing unless multiple coils are served from a single PICCV or auto-flow device (Example: AHU coil banks with multiple coils). Measure flow through each PICCV and auto-flow device and compare measured value to scheduled value to verify proper valve/device was installed and valve is functional. Verify flow for 100 percent of PICCV and auto-flow devices. Report discrepancies.
G. Chilled beams do not require individual hydronic balancing. Verify proper flow is achieved through balancing or control device serving chilled beam control zone. Report discrepancies.
H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
I. Measure the differential-pressure control valve settings existing at the conclusions of balancing, and record in report.

3.08 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance variable-flow hydronic systems by following the “Proportional Balancing Procedure” in accordance with NEBB.
B. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.09 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
C. Measure outside-air, wet- and dry-bulb temperatures.

3.10 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
B. After balancing is complete, do the following:
    1. Measure and record the static pressure at the hood exhaust-duct connection.
    2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
    3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
    1. Check duct slopes as required.
    2. Verify that duct access is installed as required.
    3. Verify that point of termination is as required.
    4. Verify that duct air velocity is within the range required.
    5. Verify that duct is within a fire-rated enclosure.
D. Report deficiencies.

3.11 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Air handling equipment and outlets: Plus or minus 5 percent.
    a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.
2. Heating-Water Flow Rate: 0 to minus 10 percent.
3. Cooling-Water Flow Rate: 0 to plus 5 percent.

3.12 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
    1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
    1. Pump curves.
    2. Fan curves.
    3. Manufacturers' test data.
    4. Field test reports prepared by system and equipment installers.
    5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
    1. Title page.
    2. Name and address of TAB firm.
    3. Project name.
    4. Project location.
    5. Architect's name and address.
    6. Engineer's name and address.
    7. Contractor's name and address.
    8. Report date.
    9. Signature of TAB firm who certifies the report.
    10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
    11. Summary of contents including the following:
        a. Indicated versus final performance.
        b. Notable characteristics of systems.
        c. Description of system operation sequence if it varies from the Contract Documents.
    12. Nomenclature sheets for each item of equipment.
    13. Notes to explain why certain final data in the body of reports varies from indicated values.
    14. Test conditions for fans and pump performance forms including the following:
        a. Settings for outside-, return-, and exhaust-air dampers.
        b. Conditions of filters.
        c. Cooling coil, wet- and dry-bulb conditions.
        d. Face and bypass damper settings at coils.

e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water flow rates.
3. Terminal units.
4. Balancing stations.

F. Apparatus-Coil Test Reports:
1. Coil Data:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btuh.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft.
j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
a. Heat output in Btuh.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.

f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
f. Ratings.
2. Steam Test Data (Indicated and Actual Values):
a. Inlet pressure in psig.
b. Condensate flow rate in lb/h.
3. Primary Water Test Data (Indicated and Actual Values):
a. Entering-water temperature in deg F.

b. Leaving-water temperature in deg F.
c. Entering-water pressure in feet of head or psig.
d. Water pressure differential in feet of head or psig.
e. Water flow rate in gpm.

4. Secondary Water Test Data (Indicated and Actual Values):
a. Entering-water temperature in deg F.
b. Leaving-water temperature in deg F.
c. Entering-water pressure in feet of head or psig.
d. Water pressure differential in feet of head or psig.
e. Water flow rate in gpm.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model and serial numbers.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):
a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

L. Air-to-Air Heat-Recovery Unit Reports:

1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.

2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full load amperage and service factor.

e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. If fans are an integral part of the unit, include the following for each fan:
   a. Make and type.
   b. Arrangement and size.
   c. Sheave make, size in inches, and bore.
   d. Sheave dimensions, center-to-center, and amount of adjustments in inches.
4. Test Data (Indicated and Actual Values):
   a. Total exhaust airflow rate in cfm.
   b. Purge exhaust airflow rate in cfm.
   c. Outside airflow rate in cfm.
   d. Total exhaust fan static pressure in inches wg.
   e. Total outside-air fan static pressure in inches wg.
   f. Pressure drop on each side of recovery wheel in inches wg.
   g. Exhaust air temperature entering in deg F.
   h. Exhaust air temperature leaving in deg F.
   i. Outside-air temperature entering in deg F.
   j. Outside-air temperature leaving in deg F.
   k. Calculate sensible and total heat capacity of each airstream in MBh.

3.14 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
   2. Randomly check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 5 percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
      d. Measure sound levels at two locations.
      e. Measure space pressure of at least 10 percent of locations.
      f. Verify that balancing devices are marked with final balance position.
      g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:
   1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
   2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
   3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
   4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
   5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
   6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
   7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 0593

SECTION 23 0933 - TEMPERATURE CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. Related Sections include the following:
   1. Division 20 Section “Mechanical General Requirements.”
   2. Division 20 Section “Basic Mechanical Materials and Methods.”
   3. Division 23 Section “Testing, Adjusting, and Balancing.”

1.02 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.03 DEFINITIONS

A. BACnet: Communications open protocol for building automation system networks and control (developed by ASHRAE and documented per ANSI/ASHRAE Standard 135-2012.
B. BAS: Building Automation System
C. CAD: Computer Aided Design.
D. DDC: Direct-digital controls.
E. LonWorks (aka LonTalk): Communications open protocol as developed by Echelon Corporation that is utilized with building automation system networks and control.
F. TC: Temperature Control.

1.04 SYSTEM DESCRIPTION

A. Temperature control building automation system consisting of direct digital control system controllers, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems.
B. BAS/DDC system programming, database generation. Graphic display generation accessible through Building Network Supervisory Controller or at the remote operator workstation (when applicable for project).
C. Electric thermostats, control valves, dampers, operators, control wiring, etc.
D. Gauges, indicating devices, electric and electronic control accessories, and other control system devices.

1.05 SEQUENCE OF OPERATION

A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.06 SUBMITTALS

A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.
B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valves and automated dampers shall be incorporated with the complete temperature controls submittal.
C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
   1. Each control device labeled with setting or adjustable range of control
D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
E. Shop Drawings:
   1. Shop drawings shall be done on CAD. Minimum size 11” x 17”.
   2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
   3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
   4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.
   5. Written sequence of operation for each controlled system.
   6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
   7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
   8. Complete bill of materials to identify and quantify all control components.
   9. Overall system schematic showing communication trunk cabling from Building Network Supervisory Controller(s) to BAS field level controllers including component locations and wire termination details.

10. DDC controller layouts showing connected data points and LAN connections. DDC controller terminations including power supply and remote control component termination details shall be provided.
11. Point list for each DDC controller including point descriptions and addresses. This information may be incorporated with DDC controller layouts.
12. List of system graphics to be provided with proposed tree diagram of graphics organization. Items to include: Each system, floor plan.

F. Graphic Displays: One month after TC Shop Drawing submittal, TC Contractor shall submit graphical display backgrounds for preliminary Engineer review. Concept for each floor plan, each system, each terminal unit template. Engineer understands that final representation of graphics may not be available until BAS database is established during course of construction. Thorough graphics review will be conducted by Engineer as part of the TC/BAS acceptance procedure.

G. Design Data: Provide indicated component selection and sizing criteria for the following component categories:
1. Control valves:
    a. Component tag.
    b. Equipment served/function.
    c. Media type.
    d. Design flow rate (GPM or lbs/hr).
    e. Design pressure drop (ft. head) or (psi), where applicable.
    f. Calculated valve Cv, where applicable.
    g. Selected valve Cv, where applicable.
    h. Resultant pressure drop (ft. head) or (psi) with selected valve.
    i. Valve size.
    j. Line size to valve connection (excluding reducers).
    k. Type (ball, butterfly, globe, etc.).
    l. Configuration (2-way, 3-way mixing, 3-way diverting).
    m. Normal position (normally open, normally closed, floating).
    n. Actuator spring range (where applicable).
    o. Actuator power requirement.
    p. Valve shut-off rating (ft. head) of (psi)
    q. Valve body pressure/temperature rating.
    r. Valve manufacturer/model number.
    s. Actuator manufacturer/model number.
2. Dampers:
    a. Component tag.
    b. Equipment served/function.
    c. Overall damper size (inch width x inch height).
    d. Quantity of damper sections with respective size(s):
    e. Material and gauge of thickness.
    f. Mounting orientation (horizontal or vertical).
    g. Blade configuration (parallel or opposed)
    h. Pressure drop (in. WG).
    i. Shut-off rating/differential pressure rating (in. wg).
    j. Leakage rating (CFM/sq.ft. at 4 in. wg).
    k. Normal position (normally open, normally closed, floating).
    l. Actuator spring range (where applicable).
    m. Actuator power requirement.
    n. Actuator torque requirement.
    o. Actuator quantity.
    p. Damper manufacturer/model number.
    q. Actuator manufacturer/model number.
3. Flow measuring probes - Air:

a. Component tag.
b. Equipment served/function.
c. Duct dimension (inch width x inch height) if applicable.
d. Fan inlet diameter (inch) if applicable)
e. Probe quantity.
f. Probe length (inch).
g. Flow rate (CFM).
h. Flow velocity (FPM).
i. Probe manufacturer/model number.
j. Transmitter manufacturer/model number.

4. Flow measuring probes - Water:
   a. Component tag.
   b. Equipment served/function.
   c. Pipe size/inside diameter (inch)
   d. Probe length.
   e. Flow rate (GPM).
   f. Flow velocity (FPS).
   g. Probe manufacturer/model number.
   h. Transmitter manufacturer/model number.
5. Flow measuring stations - Air:
   a. Component tag.
   b. Equipment served/function.
   c. Duct dimension (inch width x inch height).
   d. Station dimension (inch width x inch height).
   e. Flow rate (CFM).
   f. Flow velocity (FPM).
   g. Pressure drop (in. wg).
   h. Station manufacturer/model number.
   i. Transmitter manufacturer/model number.
6. Gauges:
   a. Component tag.
   b. Equipment served/function.
   c. Units/range of scale

H. Wall mounted temperature sensor, thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates – coordinate with electrical contractor. Provide samples of available temperature control device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.

I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

J. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.

K. Project Record Documents: Include the following:
   1. Revise Shop Drawings to reflect actual installation and operating sequences.
   2. Record actual locations of control components, including control units, thermostats, and sensors.
   3. Submit the electronic files for all as-built shop drawings in pdf format on USB Flash Drives (3 Total).

L. Software and Firmware Operational Documentation: Include the following:
   1. DDC controller keypad operating instructions and DDC controller override features, where applicable.
   2. Device address list.
   3. Program Software Backup: On a magnetic media or compact disc, complete with data files.
   4. Software license required by and installed for DDC workstations and control systems.

5. DDC workstation software operating instructions for scheduling equipment, trending data, displaying graphics, commanding points, adding/deleting/modifying points, changing setpoints, and setting up alarms.
6. Advanced DDC workstation operating instructions for graphics generation, control sequence programming and program modification.
7. Printout of software applications and graphic screens.

M. Maintenance Manuals: Include the following:
1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.
3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Calibration records and list of set points.

1.07 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
C. ANSI/ASTM B32 - Solder Metal.
D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
E. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
F. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.
G. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
H. ASTM E1 - Specification for ASTM Thermometers.
I. MMC – Michigan Mechanical Code, version applicable for project.
J. NEMA DC 3 - Low-Voltage Room Thermostats.
K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is a certified installer and an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
D. Comply with all applicable code requirements for project.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.
B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.
D. Ensure installation of components is complementary to installation of similar components in other systems.
E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
F. Coordinate equipment with Division 26 Section "Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
G. Coordinate equipment with Division 28 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.

H. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.

I. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

1.11 WARRANTY

A. Provide warranty per Division 20 Section "Mechanical General Requirements" and as supplemented in this section.

B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.

C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight hour service call every three months**.** Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.

D. Provide any software or firmware revisions which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

1.12 POSTED OPERATING INSTRUCTIONS

A. Provide DDC controller related as-built documents in protective binder or clear plastic display envelope for each control enclosure panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 SPECIAL TOOLS

A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, excluding PC laptop.

1.14 PROTECTION OF PROPRIETARY INFORMATION

A. Non-disclosure agreement(s) that may be subject to proprietary manuals and software shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 PRODUCTS

2.01 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)

A. The building automation system (BAS) shall be fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems. Microprocessor based BAS field level DDC controllers shall be directly connected to HVAC equipment sensors and actuators. A data communication network shall allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller. The Building Network Supervisory Controller shall be the primary operator BAS interface point for the building either through web-browser direct or through server application software (when applicable) or through local or remote Operator Workstation (when applicable to project).

B. Approved Manufacturer – System / Approved Installer (Locations) as listed:

1. Automated Logic Controls / by:

a. Automated Logic Contracting Services, Inc. (Southfield, MI).

2.02 BAS BUILDING NETWORK SUPERVISORY CONTROLLER (Proprietary platforms)

A. The Building Network Supervisory Controller shall provide the interface between the Owner's Ethernet and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC.

B. The network supervisory controller shall be sized appropriately per building to handle the required quantity of connected controllers and devices.

C. Manufacturers: As listed for Building Automation System.

2.03 DIRECT DIGITAL CONTROL (DDC) FIELD LEVEL CONTROLLERS

A. Modular in design and consisting of stand-alone microprocessor board with ROM and fully custom programmable RAM, EPROM, and/or EEPROM memory, integral interface equipment and power surge

protection. DDC controllers shall be connected directly to sensors, controlled devices and the communication network.

B. Powerfail Restart and Battery Backup: Minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger or 48 hour low voltage alarm warning. Upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.

C. Provide fully functional communication interface ports for communication between processor, other processors, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.

D. Panel enclosure for controller, associated power supply and other ancillary control components shall be finished steel or rigid plastic with hinged door and keyed lock. Electronics shall be removable for protection during mounting of panel.

2.04 DDC CONTROLLER SOFTWARE

A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC controller communications, scan inputs and outputs, and contain built-in diagnostics.

B. Input/output point processing shall include the following:

1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.
2. Assignment of proper engineering units and status condition identifiers to all points.
3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC input/output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.

C. Command control software shall manage the receipt of commands from control panels, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.

1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the BAS DDC network, not just within the DDC controller. Delays shall be assignable on an individual per point basis.
2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.
4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.

D. Provide self-test procedure. Notify remote Operator Workstation (when applicable for project) for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.

E. Alarm Processing

1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.
2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying values.

These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.

3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm shall be generated. Abnormal "on" shall cause an alarm, as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.
4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.
5. The capability of automatically initiating commands upon the occurrence of an alarm.

F. Totalization
1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC controller resident run time limits assignable through portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.
3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. DDC Controller Programming / Configuration
1. All DDC controllers shall be fully programmable or configurable per required controller application type. DDC controllers which require remote or factory programming or configuration are not acceptable. DDC controllers with custom programs which may not be modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.
2. DDC controllers shall be provided to meet the control strategies as called for in the sequences of operation on the drawings. If a configurable application specific DDC controller cannot meet this requirement, a DDC fully programmable controller shall be provided.
3. All DDC controller setpoints, gains, parameters, time constants, etc., associated with DDC controller programs shall be available to the operator for display and modification via portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
4. Each DDC controller shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:
    a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
    b. Logic: OR, AND, compare, negate.
    c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.
    d. Data Manipulation: Store, file and set.

e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/ software interlock.

H. Building Automation System program applications (as required for controllers)

1. Time of day scheduling: Allow the creation and maintenance of operating schedules for selected points based on time of day and holiday scheduling. At least two independent start and stop times per day for each system shall be allowed. Each point shall be allowed to have a unique time program, or points shall be able to be grouped and assigned to a common time program. Both digital and analog output points shall be able to be assigned to a time program. This software shall work in conjunction with the time of day scheduler software at the remote Operator Workstation (when applicable for project). This program shall also work in conjunction with the optimum start and optimum stop application software.
2. Optimum Start: Start equipment based on outdoor temperature, space temperature, and system response to minimize energy usage and to assure that comfort conditions are reached exactly at scheduled occupancy time (occupancy schedules are defined under "Time Of Day Scheduling"). This program shall operate in both the heating and cooling cycles. An adaptive algorithm shall be employed which automatically adjusts the start time according to previous performance and shall automatically assign longer lead times for weekend and holiday shutdowns.
3. Enthalpy Optimization: Using standard psychrometric calculations, automatically determine which air source, outdoor air or return air, presents the least total heat load, and automatically adjust mixed air damper position. When outside enthalpy exceeds return air enthalpy, the outside air damper shall go to its minimum position. Typically, the outside air damper must be in its minimum position before the cooling coil valve is allowed to open.
4. Duty Cycle: Periodically cycle electrical equipment to reduce energy consumption and/or energy demand. Each load shall be assigned a cycle interval and an off period. A load leveling algorithm shall be utilized to assure that cycle periods do not coincide.
5. Demand Limiting: Distributed power demand program shall be based on a sliding window instantaneous demand algorithm. The DDC controller(s) connected to the demand meter shall calculate the demand, forecast the demand trend, compare it to established demand limits, and initiate load shedding action or reestablishment of loads as required. Shedding shall be on a sequential basis with least important loads shed first and restored last. Restoration cycle shall add the most important loads first. DDC controllers on the network shall each have a four-tier shed table for assignment of sheddable loads. When a request is issued to the network to shed a specific number of kilowatts, each DDC controller shall shed Tier 1 loads, Tier 2 loads, etc. until the shed requirement is met. The program shall have the capability to sum the readings from multiple meters connected to multiple DDC controllers on the network, and to shed various loads from multiple DDC controllers on the network.
6. Warm-Up: Position the outside air dampers in an adjustable (minimum) position, and trigger a digital output(s) normally used to signal air terminal units to move to their maximum flow settings. When the desired space temperature is reached, as determined by feedback from space temperature sensor(s), the digital output shall return the air terminal units to their normal operation. When occupancy time is reached, the outside air dampers shall be controlled by the normal occupied mode control sequence. During the warm-up cycle, the outside air damper shall be set at the position which minimizes outside air intake while preventing over/under pressurizing of ductwork. This program shall work in conjunction with the time scheduling program and/or the optimum start program as required.
7. Night Cycle: Cycle HVAC equipment on and off as required to maintain an operator selectable unoccupied space temperature. During the equipment "on" time, the outside air damper shall be maintained in an adjustable position which minimizes outside air intake while preventing over/under pressurization of ductwork. The equipment shall be cycled such that energy reduction during unoccupied periods is uniform.

8. Night Purge: Night Purge program shall apply to cooling cycle only. Night Purge shall introduce 100% outdoor air any time the outdoor air is above 50 degrees F, the space temperature is above 75 degrees F, the outdoor air temperature is below space temperature and the outdoor air dew point is less than 60 deg F. Purging shall stop when outdoor air is below 50 deg F, or space temperature is below 75 deg F, or outdoor temperature is less than 5 deg F cooler than space temperature, or outdoor air dew point is greater than 60 deg F.
9. Reset Optimization: Adjust equipment discharge setpoints based on one of the following criteria:
    a. By sensing the worst case requirements (e.g., the zone requiring the most heating or cooling and providing only the minimum energy required to meet the load.
    b. Adjusting the setpoint in direct proportion to another sensed variable (e.g., reset supply water temperature based on outside temperature).

2.05 DDC INPUT/OUTPUT SENSORS

A. Air Static/Differential Pressure Transmitters:
1. Variable capacitance type with ranges not exceeding 150 percent of maximum expected input. Transmitter shall have zero and span adjustments.
2. Safe overpressure rating shall be minimum 5 times the range.
3. Temperature compensated with thermal error of not greater than 0.04 percent of full scale in temperature range of 40 to 100 deg F.
4. Accuracy: +/- 0.5% of full scale including calibration error, repeatability, hysteresis, and yearly drift.
5. Manufacturers:
    a. Air Monitor.
    b. Belimo.
    c. Dwyer.
    d. Modus
    e. Setra.

B. Carbon Dioxide Sensors:
1. Carbon dioxide sensing cell shall consist of a nondispersive infrared carbon dioxide gas cell that uses a pulsed source and has no free air optical path. Output shall be linearized 4-20 mA with the 24 VDC input. In addition, the unit shall be capable of providing SPDT switching of an external low voltage circuit at an adjustable setpoint. The unit shall be specifically designed for the wall or duct application specified. Return air aspiration boxes shall be designed by and approved by the manufacturer. Unit shall have single point setpoint and span adjustment. The unit shall have no moving parts.
2. Power for the sensor shall be extended from a transformer or adaptor installed adjacent to the DDC controller enclosure panel, and shall be run parallel to the 4-20 mA signal cable.
3. Minimum sensing range shall be 0-2,000ppm.
4. Overall Accuracy shall be 3% of full scale including calibration error, repeatability, hysteresis and yearly drift.
5. Minimum calibration interval shall be 5 years.
6. Contractor shall provide all necessary equipment and test gas for calibration and shall calibrate all CO_2 sensors in accordance with the manufacturer's recommendations.
7. Manufacturer:
    a. Specified BAS product where available that meets the requirements herein.
    b. Belimo.
    c. TelAire.
    d. Vaisala.
    e. Veris.

C. Current Sensors:
1. Split-core or donut type transformer for monitoring AC current, with analog output signal as indicated. Current sensors used on motor side of variable frequency drives shall have low frequency detection capability.
2. Analog sensors shall have accuracy of ±1% full scale.
3. Manufacturers:

a. ACI.
b. Johnson Controls.
c. Senva.
d. Veris Industries.

D. Current Switches:
1. Split-core or donut type transformer for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
2. For Electronically Commutated Motor (ECM) applications: Current switch shall be rated for ECM operation with amperage trip setting higher than trickle/idle/standby amperage with ECM off and amperage trip setting lower than minimum speed setting. Verify minimum amperage expectation for equipment with equipment suppliers to select appropriate current switch from list of approved manufacturers as their minimum trip settings vary from 0.15A to 0.5A.
3. For induction motor applications (as applicable): Current switch shall have adjustable trip setting to accommodate VFC minimum speed settings, to detect fan belt loss, or to detect pump coupling detachment. Set trip setting at approximately 90% of normal motor operating amperage.
4. Manufacturers:
a. ACI.
b. Johnson Controls.
c. Senva.
d. Veris Industries.

E. Differential Pressure Transmitters (Commercial Version):
1. Transmitters used for measuring differential pressure only:
a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches of water column (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.
c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.
d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
e. Span and zero shall be individually adjustable.
f. With LCD Display.
g. Manufacturers:
1) Belimo.
2) Dwyer.
3) Setra.
4) Veris Industries.

F. Differential Pressure Transmitters (Industrial Version):
1. Transmitters used for measuring flow rates:
a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 125% of the normal differential pressure and up to 150 psig line pressure. The calibration point shall be rounded upward to the nearest 10 inches of water column (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 0.25% of the span stated above throughout a 6:1 turndown.

c. The transmitter shall not be damaged by pressures of up to 1000 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene glycol in water.
d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
e. Span and zero shall be individually adjustable.
f. Manufacturers:
1) Tobar.
2) ITT Barton.
3) Yokogawa.
4) Taylor.
5) Rosemount.
6) Honeywell Industrial Division.
7) Foxboro.
8) SOR.

2. Transmitters used for measuring differential pressure only:
a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches W.C. (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.
c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.
d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
e. Span and zero shall be individually adjustable.
f. Manufacturers:
1) Tobar.
2) ITT Barton.
3) Yokogawa.
4) Taylor.
5) Rosemount.
6) Honeywell Industrial Division.
7) Foxboro.
8) SOR.

3. Indication Gauges for Differential Pressure Transmitters:
a. Each transmitter shall come with an indicating gauge which reads in gpm or inches of water (whichever is the final value desired). The gauge may be either an analog differential pressure gauge piped in parallel to the transmitter or a digital display wired directly to the output of the transmitter.
b. The analog pressure gauge shall be selected and calibrated for the same span as the transmitter it serves.
c. The accuracy, including linearity, hysteresis and repeatability, of the gauge for measuring differential pressure shall be better than 3% of the span stated above throughout its span. Calibration data shall be included on an embossed tag attached to each gauge.
d. The gauge shall not be damaged by pressures of up to 500 psig on either side of the gauge and all wetted parts shall be essentially inert in the presence of up to 40% concentration of ethylene or propylene glycol in water.

e. Scale shall be a minimum of 4.5" long. Furnish and install two bleed fittings for each gauge and mounting brackets appropriate for the installation location.

4. Three Valve Manifold:
   a. Provide a three-valve manifold for each transmitter. The manifold shall not be damaged by pressures of up to 500 psig and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene glycol in water.
   b. The manifold shall be designed for direct mounting on the transmitter it serves and utilize quarter-turn valves to provide zeroing, blocking and normal service modes.

G. Humidity Sensors:
1. Elements: Thin film or polymer capacitive type or bulk polymer resistance type with linear output, accurate within ± 2% RH throughout the range of 10-95% RH and drift to be less than +/-0.25%.
2. Humidity sensors shall be resistant to chlorine and other cleaning agents.
3. Room Sensors: With locking cover matching space temperature sensors used.
4. Duct Sensors: With duct probe and mounting plate.
5. Manufacturers:
   a. Specified BAS product where available that meets the requirements herein.
   b. Belimo.
   c. GE Industrial, Sensing (formerly General Eastern)
   d. Rotronic.
   e. Vaisala.
   f. Veris – HD/HO Series.

H. Outside Air Flow (low velocity) Differential Pressure Transmitters:
1. The transmitters shall be capable of receiving signals of static, velocity and reference pressures, amplifying and scaling the resulting differential pressure signal to produce a 4-20 mA output signal linear to differential pressure. The transmitters shall have manual zeroing capability.
2. The differential pressure transmitters shall not be affected by over-pressurization up to 1 psig, and shall be furnished with a factory calibrated span and automatic zeroing circuit. The transmitters shall be housed in an enclosure with integral terminal box and with power and output signal conduit connection ports and separate access plate.
3. Calibrated span: shall not exceed 150 percent of maximum expected input.
4. Reference Accuracy: ± 0.50% of span.
5. Hysteresis and dead band (combined): Less than 0.2% of span.
6. Repeatability: 0.15% of span.
7. Linearity: ± 0.25% of span.
8. Include LCD Display.
9. Manufacturers:
   a. Air Monitor-Veltron DPT 2500 Plus.
   b. Custom Electronics Systems.

I. Outside Air Temperature/Humidity Combination Transmitters:
1. Dual transmitters housed in a single hinged enclosure with integral probes configured for exterior wall mount application with PVC sun shield. Unit shall provide separate 4-20 mA signals for temperature and humidity measurement.
2. Temperature sensor: Refer to Temperature Sensors specifications. Range of operation shall be -25 degrees F to 125 degrees F.
3. Humidity sensor: Refer to Humidity Sensors specifications. Range of operation shall be 0-100% RH.
4. Manufacturer:
   a. Belimo.
   b. Vaisala.
   c. Veris.

J. Temperature Sensors:

1. Resistance temperature detectors (RTD) with 1000 ohm, thin-filmed platinum, nickel or balco element having 0.000385 temperature coefficient meeting the input requirements of the DDC controller.
2. Thermally sensitive resistors (thermistor) shall be 10k-type, epoxy or glass coated, having NTC characteristic, meeting the input requirements of the DDC controller.
3. Initial calibration accuracy shall be +/- 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.
4. Additional error such as repeatability, stability, tolerance, linearity and hysteresis shall not exceed an additional +/- 0.5 deg F additive (using RMS method) throughout the selected operating range for the application.
5. Temperature sensors shall be resistant to chlorine and other cleaning agents
6. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20 - 120°F.
7. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20 - 120°F.
8. Liquid immersion sensors shall have welded stainless steel thermowells for ferrous pipe and brass thermowells for copper pipe. Length of sensor and thermowell shall be selected based on the diameter of the pipe to provide accurate, reliable and homogeneous sensing of the liquid temperature. Thermowell pressure rating shall meet or exceed the system minimum pressure rating. Sensors for chilled water application shall have calibrated span of 20 - 120°F. Sensors for hot water applications shall have calibrated span of 40 - 240°F
9. Room sensors shall have locking cover and a minimum span of 40 - 90°F.
10. Outside air temperature (only) sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun and wind.
11. Manufacturers:
    a. Specified BAS product where available that meets the requirements herein.
    b. ACI – except PT1000 averaging sensor.
    c. BAPI – Basys Series.
    d. Belimo.
    e. MAMAC
    f. Minco.
    g. TCS.

K. Humidity, Temperature & Dew Point Sensor / Transmitters (HVAC High Performance Grade):
1. High performance Humidity, Temperature & Dew Point measurement with accuracy of +/- 0.8 % RH. Sensor range 0-160°F, 0-100%RH.
2. Removable probe for calibration purposes. Provide 1 extra probe for every 4 sensor/transmitter units required for project.
3. With two configurable and scalable outputs: 0-1V, 0-5V, 0-10V, 4-20mA for humidity, temperature and/or dew point readings.
4. Wall or duct mounted as indicated.
5. Provide display option where indicated.
6. Transmitter power supply options for 24VDC, 24VAC as required.
7. Provide weather shield for outdoor senor installations.
8. Provide guards for indoor installations as indicated on drawings.
9. Provide product software (where applicable) for transmitter configuration and probe calibration.
10. Manufacturers:
    a. Rotronic, HygroFlex5 transmitter with HC2-S probe and HW4 product software.
    b. Approved Equal.

L. Dew Point Sensor / Transmitters (Lab & Industrial High Performance Grade):
1. High performance chilled mirror technology with accuracy of +/- 1°F. Sensor range 0-160°F.
2. Wall or duct mounted as indicated.
3. Transmitter power supply options for 24VDC, 24VAC, 115VAC as required.
4. Provide weather shield for outdoor senor installations.

5. Provide guards for indoor installations as indicated on drawings.
6. Manufacturers:
    a. Omega RHCM Series.
    b. Approved Equal.

2.06 DDC DATA COMMUNICATIONS NETWORK

A. Data communication network shall be provided to allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller.

B. The BAS/DDC system-wide communication network shall consist of a primary peer-to-peer network, and at the Contractor's option, secondary sub-networks linked to the primary network. The primary network shall support peer-to-peer communications between primary network BAS field level DDC controllers. The Building Network Supervisory Controller shall be connected to the primary network. Secondary sub-networks when used shall interface with the primary network though the primary network BAS field level DDC controllers. At least one DDC controller connected to the primary peer-to-peer network shall be provided in each mechanical room, or as indicated on the drawings.

C. Data communications media shall be twisted pair wires.

D. The communications network shall allow shared point and control information between BAS field level DDC controllers. All required repeaters, hubs, active links, gateways, etc. and associated power supplies shall be provided as required to provide shared point and control information between BAS field level DDC controllers.

E. Failure of any individual BAS field level DDC controller shall not cause the loss of communications between peer BAS field level DDC controllers.

F. All data transmitted must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgments shall cause a retransmission of the data. Network connected devices must send a "functioning" message each network cycle. Lack of a "functioning" message after successive retries shall constitute a device failure and shall be recognized as such by the network.

G. Error recovery and communication initialization routines shall be resident in each network connected device.

2.07 CONTROL VALVES AND VALVE OPERATORS

A. Pressure Independent Control Valves (2-way):
    1. Up to 2 inches: Characterized ball valve or Globe valve style with integral pressure compensating cartridge which maintains a constant pressure drop across valve seat while providing equal percentage flow control. Ball valve construction shall include bronze or brass-nickel plated body with screwed ends, stainless steel or chrome plated brass ball, characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats. Globe valve construction shall include bronze or AMETAL (a dezincification alloy of TA), stainless steel or brass stem and EPDM type seats.
    2. Over 2 inches: Control valve with integral pressure compensating spring and diaphragm which maintains a constant pressure drop across the valve seat, iron body with flanged ends, stainless steel trim.
    3. Accuracy: Control valves shall accurately control flow from 0 to 100% of the full rated flow. Flow through the valve shall not vary more than +/- 5% due to system pressure fluctuations when the pressure drop across the valve is within the range of 5 psid to 35 psid.
    4. Manufacturers:
        a. Belimo.
        b. Bray / Delta Control Products.
        c. Danfoss Nexus Valve.
        d. Griswold.
        e. Honeywell.
        f. Johnson Controls.
        g. Siemens.
        h. Tour Anderson.

B. Globe Valves (2-way & 3-way):
    1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, single seated, screwed ends with backseating capability, repackable under pressure.

2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc, repackable under pressure.
3. Valve stem packing shall be tetrafluorethylene, spring loaded and self-adjusting. Packless construction is acceptable.
4. Manufacturers:
    a. Belimo.
    b. Bray / Delta Control Products.
    c. Dodge Engineering & Controls, Inc.
    d. Honeywell.
    e. Schneider Electric Controls.
    f. Johnson Controls.
    g. Siemens.

C. Butterfly Pattern: Refer to Division 20 Section "Valves" for valve body and trim requirements.

D. Electric Operators:
1. Operators shall be electronic type to accept signals from direct digital controller or modulating thermostat for proportional control.
2. Valves shall spring return to normal position as indicated. Terminal unit tempering coil control valve operators are not required to be spring return.
3. Select with sufficient shut-off power for system pressure and highest operating torque, and torque requirements of valves which may stick because of infrequent use.
4. Select to provide smooth proportioning control under operating conditions normal to the system.
5. Electric Butterfly Control Valve Actuators: Permanent split capacitor, reversible electric motor which drives a compound epicyclic gear, thermal overload protection, factory tested, factory lubricated, localized mechanical position indicator readable at 25 feet, 0-90 degree reversible operation, bolt directly to valve top plate. Housing shall be weatherproof and suitable for outdoor location. Provide thermostatically controlled heater for prevention of condensation at low temperatures, 120 VAC. Actuator ambient temperature range shall be -20 degrees F to +140 degrees F. Provide separate limit switches which close at the full open and full closed position, respectively. Actuator shall include a manually operated handwheel for manual override of the valve position.

E. Hydronic Systems:
1. Valve minimum pressure rating shall meet or exceed the system minimum pressure rating as noted for each system in Division 20 Section "Valves," and in Division 23 Section "Hydronic Piping."
2. Valve minimum temperature ratings shall be 250 deg F.
3. For globe valves: Replaceable plugs and seats of stainless steel or brass, selected for maximum lift under application conditions.
4. Two way and three way valves shall have equal percentage characteristics. Size two way valve operators to close valves against pump shut off head.
5. Pressure independent control valves shall be used for 2-way applications unless otherwise indicated. Select to achieve scheduled flow rate of the associated heat transfer device. If the scheduled flow rate is too high to achieve with one valve, provide multiple valves sized at flow divided equally of the scheduled flow rate and control all valves in unison - coordinate control valve quantity and the need for parallel piping of control valves with mechanical contractor.
6. Pressure Drop for pressure dependent characterized ball and globe valves: Select Control valves that result in a pressure drop at or as close as possible to scheduled information. If not scheduled, primary HVAC equipment and terminal equipment control valves shall be selected for a pressure drop close as possible to 11.5 feet of head. TC Contractor shall use control valves that meet the pressure drop requirements from manufacturers listed above.

2.08 DAMPERS - AUTOMATED

A. Performance: Test in accordance with AMCA 500.

B. Frames: Galvanized steel, minimum 16 gauge, minimum 2 inches in width, welded or riveted with corner reinforcement for 12 gage structural equivalence.

C. Blades: Galvanized steel, minimum 14 gauge, maximum blade size 8 inches wide, 60 inches long, attached to minimum 1/2 inch shafts. Dampers which are required to have a static pressure rating over 4 inch W.G. shall have minimum 3/4 inch solid shafts.
D. Blade Seals: Synthetic elastomeric or Neoprene, mechanically attached, field replaceable.
E. Jackshafts (where required): Minimum 1/2 inch galvanized steel.
F. Jamb Seals: Stainless steel.
G. Bearings: Oil impregnated sintered bronze or lubricant free, solid stainless steel. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
H. Linkages: Accessible for maintenance. Linkages may be located in airstream. Linkages located in damper frame shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be zinc-plated.
I. Leakage: Less than 8 CFM per square foot based on 4 inches W.G. pressure differential.
J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4" W.G.
K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
L. Temperature Limits: -40 to 200 deg F.
M. Manufacturers:
    1. American Warming & Ventilating.
    2. Arrow United Industries.
    3. Greenheck.
    4. Honeywell.
    5. Johnson Controls.
    6. Louvers & Dampers, Inc.
    7. Ruskin.
    8. Tamco.
    9. Vent Products.

2.09 DAMPERS, INSULATED OUTDOOR AIR / RELIEF AIR / EXHAUST AIR - AUTOMATED

A. Performance: AMCA certified for Air Performance and Air Leakage.
B. Frames: Extruded aluminum, .080-inch thickness minimum, 4 inches deep minimum, thermally broken, and insulated with polystyrene or polyurethane foam insulation.
C. Blades: Extruded aluminum, internally insulated, and thermally broken. Maximum blade size 8 inches wide, 60 inches long.
D. Shafts: Minimum 7/16 inch hexagonal or square corrosion resistant zinc plated steel.
E. Blade Seals: Extruded EPDM, silicone, or synthetic elastomeric, mechanically attached.
F. Jamb Seals: Silicone, or synthetic elastomeric, mechanically attached.
G. Bearings: Dual bearing assembly of durable synthetic polymer resulting in no metal-to-metal contact. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
H. Linkage: Linkage shall be installed in the frame side and shall be constructed of aluminum and/or corrosion resistant zinc plated steel.
I. Leakage: Less than 3 CFM per square foot at 1 inch W.G. pressure differential at minus 40 deg F.
J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4 inches W.G.
K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
L. Temperature Limits: Minus 40 to 155 deg F.
M. Manufacturers:
    1. Greenheck ICD-45.
    2. Ruskin TED50 Series.
    3. Tamco Series 9000 BF.

2.10 DAMPER OPERATORS - ELECTRIC

A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.

B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.

C. Manufacturers:
   1. Belimo.
   2. Delta Control Products.
   3. Honeywell.
   4. Schneider Electric Controls.
   5. Johnson Controls.
   6. Siemens.

2.11 DIFFERENTIAL PRESSURE SWITCHES

A. Shall provide electrical switching action upon a sensed pressure differential increase between two sensed points. Sensitivity shall be suitable for the application. Setpoint shall be adjustable over the full range of the device. Switching action shall open or close two independent single-pole, double-throw (SPDT) switches. Electrical switch rating shall be based on the application and circuit voltage

B. Pressure rating of switch/connecting tubing and reset type:
   1. Filter pressure drop - Rated for 2 inches w.g. Provide automatic reset type.
   2. Duct static pressure - Rated for 10 inches w.g. Provide manual reset type when used for high limit cutout safety.

2.12 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.

B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.

C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).

D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.

E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.

F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.

G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

H. TC Contractor shall provide 24V power supply transformers for TC Contractor provided controllers. Maximum Transformer circuit for controls shall be 100VA serving controllers within mechanical room control panels or for remote terminal unit controllers served from common 24V power supply circuit. Transformers shall be located within enclosures provided by TC Contractor.

2.13 INDICATING GAUGES - DUCT STATIC PRESSURE

A. 4" diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, scale as indicated on drawings or as appropriate for application, suitable for surface or flush mounting. Accuracy ± 2 % of full scale.

B. Where indicated on drawings, gauge shall incorporate high and low pressure switches. Switches shall be front adjustable over the full range of the gauge with pointers and with adjustable deadband to 1% of full scale. Separate electrical contacts shall close upon reaching the high or low pressure setpoints.

C. Manufacturer:
   1. Dwyer "Magnehelic" or "Photohelic."

2.14 LIMIT SWITCHES

A. Oil tight type with operator as required providing required function. Limit switches used on dampers should be set at approximately 75% of full stroke.

B. Manufacturers:
   1. Allen-Bradley.
   2. General Electric.
   3. Square D.

4. Westinghouse.
5. Micro-switch.

2.15 LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.

B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.

C. Panels shall be sized for a maximum fill of 50% capacity, and shall not be smaller than 24" X 24".

2.16 THERMOMETERS - AIRSTREAM

A. ASTM E1, 4 inch diameter dial in stainless steel or drawn steel with enamel finish case, vapor or liquid actuated with brass or copper bulb, copper or bronze braided capillary of sufficient length and with necessary bulb supports within airstream, white with black markings and black pointer, unbreakable lens, 1 percent scale accuracy. Maximum scale divisions shall be 2 deg F. Select scale ranges such that all expected temperatures are within the range but such that the range does not extend beyond the extremes more than 25 degrees.

B. Manufacturers:
1. Trerice.
2. Weksler.
3. Marsh.
4. Honeywell.
5. Schneider Electric Controls.
6. Johnson Controls.
7. Siemens.

2.17 THERMOSTATS – ELECTRONIC & ELECTRIC

A. Electronic Floating Control Room Thermostats: Microprocessor based tri-state (floating)proportional thermostat providing individual room control with setpoint adjustment, locking cover and range stops, output status LED's, night setback/setup feature with local override switch. Manufacturer: Honeywell, Model T6984 or similar.

B. Electronic Modulating Control Room Thermostats: Microprocessor based modulating 2-10V DC thermostat providing individual room control with setpoint adjustment, locking cover and range stops, output status LED's, night setback/setup feature with local override switch. Capable of single and dual modulating outputs to meet required control application. Manufacturer: Honeywell, Model T7984 or similar.

C. Line Voltage Room Thermostats: Adjustable single setpoint with exposed setpoint indicator and exposed thermometer for a range of 55 deg F to 85 deg F with maximum dead band of 1-1/2 degrees F, and locking cover. Contacts shall be rated for load, single-pole or two-pole as required. Provide with integral manual On/Off/Auto selector switch where indicated on control details. Power Requirement: 24 V, ac or 120 V, ac as required.

D. Room Thermostat Accessories:
1. Thermostat Covers: Manufacturers standard with finish as selected by Architect.
2. Insulating Bases: Provide one inch insulating base for thermostats located on exterior walls.
3. Adjusting Key: As required for device.

E. Electric Low Limit Duct Thermostat (freezestat): Snap acting which trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint, fixed 5 deg F differential, range 30 deg F to 60 deg F, requiring minimum 20 feet length of bulb. Manual-reset unless indicated on drawings to be auto-reset type. Provide one thermostat for every 20 sq ft of coil surface. Switch shall be UL listed and rated for 10 amps at 120 VAC. Provide additional switch or contacts for connection to monitoring system.

F. Electric High Limit Duct Thermostat: Snap acting, manual reset switch.

G. Electric; water-immersion type thermostat, for installation in hot-water circulation piping adjustable for control of water circulation pump. Operation of pump to be On or Off upon setpoint as required per control details. Contacts shall be rated for load. Provide transformer for 24 V, ac or 120 V, ac duty as required.

H. Electric; strap-on piping type thermostat for control of fans with hot water heating coils. Operation of fan to be Off when temperature is below setpoint as required per control details. Contacts shall be rated for load. Provide transformer for 24 V, ac or 120 V, ac duty as required

I. Manufacturers for listed Thermostat Types:
   1. Honeywell International, Inc.
   2. Johnson Controls, Inc.
   3. Schneider Electric USA, Inc.
   4. Siemens Industry, Inc.; Building Technologies Division.
   5. White-Rodgers Div.; Emerson Electric Co.

2.18 WATER FLOW SWITCHES

A. UL listed, suitable for all service application conditions. Body minimum working pressure rating shall equal or exceed system pressure rating as noted for each system in Division 22 and 23 piping sections.

B. Manufacturers:
   1. ITT.
   2. Honeywell.
   3. Johnson Controls.

2.19 GAS DETECTION MONITORING SENSORS/TRANSMITTERS (CO & NO2)

A. UL approved carbon monoxide sensor/transmitter shall be capable of detecting carbon monoxide (CO) at a radius of 50 ft. Each transmitter shall produce a 4 to 20 mA analog output over a detection range 0-500 ppm. Transmitter sensor shall be electrochemical with an accuracy of 3% and a 10-step led concentration display (LCD). Sensor must compensate for variations in humidity and temperature to maintain a high level of accuracy. Transmitter shall have a green LED for normal operation and local audible alarm (65 dBA at 3 ft) shall be provided on sensor/transmitter, activated upon 2nd high alarm level which shall be adjustable at control panel. Unit shall operate from 17-27 VAC, 24-38 VDC power. Signal shall be either a 2 or 3 wire. Sensor shall be capable of operating in environmental conditions of 5-90% relative humidity and 32 to 100 deg F temperatures.
   1. Manufacturer:
      a. Vulcain. Model VA-201T-Q1-CO (Michigan Wholesaler for Vulcain Products: Cochrane Supply & Engineering, Madison Heights, MI. (248-588-9260).
      b. Alternate systems subject to approval by engineer.

B. UL approved nitrogen dioxide sensor/transmitter shall be capable of detecting nitrogen dioxide (NO2) at a radius of 50 ft. Each transmitter shall produce a 4 to 20 mA analog output over a detection range of 0-10 ppm. Transmitter sensor shall be electrochemical with an accuracy of 3% and a 10-step led concentration display (LCD). Sensor must compensate for variations in humidity and temperature to maintain a high level of accuracy. Transmitter shall have a green LED for normal operation and local audible alarm (65 dBA at 3 ft.) shall be provided on sensor/transmitter, activated upon 2nd high alarm level which shall be adjustable at control panel. Unit shall operate from 17-27 VAC, or 24-38 VDC power. Signal shall be either 2- or 3-wire. Sensor shall be capable of operating in environmental conditions of 5-90% relative humidity and 32 to 100 deg F temperatures.
   1. Manufacturer:
      a. Vulcain. Model VA-201T-Q1-NO2. (Michigan Wholesaler for Vulcain Products: Cochrane Supply & Engineering, Madison Heights, MI. (248-588-9260).
      b. Alternate systems subject to approval by engineer.

C. Calibration Kit with carrying case shall be provided for carbon monoxide sensors. Two 100-liter tanks shall be provided.
   1. Manufacturer:
      a. Vulcain, Model SKCOQ1. (Michigan Wholesaler for Vulcain Products: Cochrane Supply & Engineering, Madison Heights, MI. (248-588-9260).
      b. Alternate systems subject to approval by engineer.

D. Calibration Kit with carrying case shall be provided for nitrogen oxide sensors. Two 50-liter tanks shall be provided.
   1. Manufacturer:
      A. Vulcain, Model SKNO2Q1. (Michigan Wholesaler for Vulcain Products: Cochrane Supply & Engineering, Madison Heights, MI. (248-588-9260).
      B. Alternate systems subject to approval by engineer.

PART 3 EXECUTION

3.01 INSTALLATION - CONTROL SYSTEMS

A. Install in accordance with manufacturer's instructions.
B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.
C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.
D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.
E. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC controller as the associated output signal.
F. Provide conduit and electrical wiring where required.
G. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize “wiremold” routing.
H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.
I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.
J. Coil and conceal excess capillary on remote element instruments.
K. Install thermometers in air duct systems on flanges.
L. Install all gauges and thermometers in locations where they are easily read from normal floor level. Provide tubing or wiring as required.
M. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.
N. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.
O. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.
P. Locate pressure sensing taps in liquid lines in straight runs of pipe with at least 10 pipe diameters of straight pipe both upstream and downstream of pressure tap. Provide a shut-off cock in sensing line at each pressure tap.
Q. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.
R. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.
S. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.
T. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.

U. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.

3.02 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS

A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor's option to schedule a meeting at the Engineer's Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request of Information (RFI) process.

B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.

C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include

1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
2. Graphics generation requirements including special Owner requirements and schedule for completion.
3. Owner training agenda and scheduling.
4. TC/BAS system acceptance procedures.

3.03 IDENTIFICATION AND MARKING

A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.

B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.

C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.

D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached on the front exterior with panel identification to match details of temperature control submittals and include system(s) served and area(s) served on the labeling. Include labeling near 120VAC terminations within panel identifying power source panel ID and specific circuit breaker used.

E. Temperature control conduit and junction box covers shall be painted green to signify that it is used for temperature controls. All junction box covers shall be painted green and the conduit shall be painted with a green mark (approximately 6 inches long) every 36" to 48", and on both sides of all penetrations.

3.04 GRAPHIC DISPLAY GENERATION

A. Provide the following graphic displays as a minimum at the operator interface, arranged in logical penetration paths:

1. Overall campus layout which shows all of the buildings on the Owner's campus.
2. Individual building layout or isometric for each building connected to the system.
3. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.
4. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
   a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
   b. System name.
   c. Area served.

d. Present value or status of all inputs, along with present setpoint.
e. Present percent open for each damper, valve, etc. based on commanded position.
f. Reset schedule parameters for all points, where applicable.
g. Present occupancy mode.
h. Present economizer mode, where applicable.
i. Present outside air temperature.
j. Associated space conditions and setpoints, where applicable.
k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
l. Color coding to indicate normal and abnormal values, alarms, etc.

5. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc) shall be provided. Graphic display of output point auto or manual override status shall be provided.
6. Sequence of operation in written (text) format for each HVAC system.
7. Overall BAS system schematic.
8. System management graphic for each network device and/or DDC controller.

3.05 OWNER INSTRUCTION AND TRAINING

A. Provide a minimum of forty (40) hours of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.
B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.
C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.
D. Provide computer training & tutorial material on USB Flash Drives 5 total describing operator's BAS graphical interface capabilities and functions.
E. Provide 5 sets of literature pertaining to the operation and maintenance of the DDC system components provided.

3.06 CALIBRATION AND START-UP

A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.
B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.07 ACCEPTANCE PROCEDURE

A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.
C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION 23 0933

SECTION 23 1123 - FUEL GAS PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 SUMMARY

A. This Section includes facility fuel gas piping.

1.03 DEFINITIONS

A. Fuel Gas Piping: Piping that conveys fuel gas from point of delivery to fuel gas utilization devices.

1.04 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: Performance requirements are scheduled on the Drawings.
2. Piping and Valves: 100 psig minimum unless otherwise indicated.

1.05 SYSTEMS DESCRIPTIONS

A. Fuel gas piping system materials are scheduled on the Drawing.

1.06 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   2. Pressure regulators. Include pressure rating, capacity, and settings of selected models.

1.07 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For fuel gas piping. Include plans and attachments to other work.
   1. Wiring Diagrams: Power, signal, and control wiring.
B. Coordination Drawings: Plans and details, drawn to scale, on which propane gas piping is shown and coordinated with other installations, using input from installers of the items involved.

1.08 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.
B. Operation and Maintenance Data: For propane gas specialties and accessories to include in operation and maintenance manuals.
   1. Lubricated Plug Valves: Installation, operation, lubrication, and leak testing procedures.

1.09 QUALITY ASSURANCE

A. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
B. NFPA Standard: Comply with NFPA 54, "National Fuel Gas Code."
C. NFPA Standard: Comply with NFPA 58, “Liquefied Petroleum Gas Code.”

1.10 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day.
B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.11 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 BLACK STEEL PIPE AND FITTINGS

A. Black Steel Pipe: ASTM A 53/A 53M or ASTM A 106; Type E or S; Grade B; Schedule 40. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
   2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
   3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
   4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
   5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
   6. Joint Compound and Tape: Suitable for propane gas.
   7. Steel Flanges and Flanged Fittings: ASME B16.5.

8. Gasket Material: Thickness, material, and type suitable for propane gas.

2.03 PIPING SPECIALTIES

A. Flexible Connectors: ANSI Z21.24, copper alloy.

B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

2.04 JOINING MATERIALS

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods."

2.05 SPECIALTY VALVES

A. Valves, NPS 3 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

B. Valves, NPS 4: Threaded ends according to ASME B1.20.1 for pipe threads; or flanged ends according to ASME B16.5 for steel flanges.

C. Valves, NPS 6 and Larger: Flanged ends according to ASME B16.5 for steel flanges.

D. Propane Gas Valves, NPS 4: Use any of the following:

1. Cast-Iron, Eccentric Plug Valves:
    a. Manufacturers:
        1) Homestead Valve; a division of Olson Technologies, Inc.; Keycentric Series 300.
        2) Milliken Valve Company; Mueller Water Products; Model 625.
    b. Approvals: UL approved.
    c. Body: Cast iron, complying with ASTM A 126, Class B.
    d. Plug: Bronze or nickel-plated cast iron.
    e. Stem Seal: Compatible with propane gas.
    f. Resilient Plug Seal: Compatible with propane gas.
    g. Operator: Square head or lug type with tamperproof feature where indicated.
    h. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
    i. Pressure Class: 125 psig.
2. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
    a. Manufacturers:
        1) Flowserve Nordstrom.
        2) Homestead Valve; a division of Olson Technologies, Inc.
        3) R&M Energy Systems, a Unit of Robbins & Myers, Inc.; Resun.
    b. Body: Cast iron, complying with ASTM A 126, Class B.
    c. Plug: Bronze or nickel-plated cast iron.
    d. Seat: Coated with thermoplastic.
    e. Stem Seal: Compatible with propane gas.
    f. Operator: Square head or lug type with tamperproof feature where indicated.
    g. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
    h. Pressure Class: 125 psig.

2.06 PRESSURE REGULATORS

A. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.

1. Manufacturers:
    a. Line Pressure Regulators:
        1) Elster Gas North America; Elster American Meter.
        2) Fisher Controls International, Inc.; Division of Emerson Process Management.
        3) Itron Gas.
    b. Appliance Pressure Regulators:
        1) Elster Gas North America; Elster American Meter.

2) Elster Gas North America; Elster Canadian Meter.
3) Fisher Controls International, Inc.; Division of Emerson Process Management.
4) Maxitrol Company; 325 Series.

2. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges.
3. Line Pressure Regulators: ANSI Z21.80/GCA 6.22 or ANSI B109.4/CGA 6.18, with inlet pressure rating as scheduled on the Drawings.
   a. Regulators for Generator Sets: Direct operated, fast acting type.

B. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for fuel gas piping system to verify actual locations of piping connections before equipment installation.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Close equipment shutoff valves before turning off propane gas to premises or piping section.
B. Inspect propane gas piping according to NFPA 54, the International Fuel Gas Code and NFPA 58 to determine that propane gas utilization devices are turned off in piping section affected.
C. Comply with NFPA 54, the International Fuel Gas Code and NFPA 58 requirements for prevention of accidental ignition.

3.03 PIPING SYSTEM INSTALLATION

A. Comply with NFPA 54, the International Fuel Gas Code and NFPA 58 for installation and purging of propane gas piping.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
   1. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
D. Drips and Sediment Traps: Install drips at points where condensate may collect. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
E. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
F. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
G. Connect branch piping from top or side of horizontal piping.
H. Install strainer on inlet of each automatic and electrically operated valve.
I. Install pressure gage upstream and downstream from each line pressure regulator. Pressure gages are specified in Division 20 Section "Meters and Gages."
J. Locate valves for easy access.
K. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
L. Install flanges when connecting to valves, specialties, and equipment having NPS 2-1/2 and larger connections.
M. Install gas valve or plug valve and strainer upstream from each line pressure regulator or appliance pressure regulator.
N. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

O. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.04 JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 20 Section "Basic Mechanical Materials and Methods."
B. Use materials suitable for fuel gas.
C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.05 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 20 Section "Hangers and Supports."

3.06 CONNECTIONS

A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.
B. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

3.07 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each pressure regulator, and specialty valve.
    1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
    2. Nameplates, pipe identification, and signs are specified in Division 20 Section "Mechanical Identification."
    3. Trace Wire: Yellow insulated, minimum 18 AWG wire, having copper or other approved conductor, with insulation suitable for direct burial, installed adjacent to underground nonmetallic piping, with aboveground access to tracer wire at each end of pipe.

3.08 PAINTING

A. Use materials and procedures in Division 09 painting Sections.
B. Paint exposed, exterior metal piping, valves, service regulators, and piping specialties, except components, with factory-applied paint or protective coating.
    1. Alkyd System: MPI EXT 5.1D.
        a. Prime Coat: Alkyd anticorrosive metal primer.
        b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
        c. Topcoat: Exterior alkyd enamel semigloss.
        d. Color: Gray.
C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Allow Owner access to field quality-control testing of fuel gas system. Notify Owner 7 days in advance of testing.
C. Tests and Inspections:
    1. Test, inspect, and purge propane gas according to NFPA 54, the International Fuel Gas Code, NFPA 58 and authorities having jurisdiction.
D. Additional Testing: Subject welded fuel gas piping installed within ceiling spaces used as plenums to test pressure of 150 psig for a minimum of 2 hours.
E. Propane gas piping will be considered defective if it does not pass tests and inspections.
F. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain lubricated plug valves.

END OF SECTION 23 1123

SECTION 23 2113 - HYDRONIC PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
2. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
3. Division 20 Section “Mechanical General Requirements.”
4. Division 20 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
5. Division 20 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
6. Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”
7. Division 20 Section "Meters and Gages" for thermometers, flow meters, flow measuring devices, and pressure gages.
8. Division 20 Section "Mechanical Identification" for labeling and identifying hydronic piping.

9. Division 23 Section "General-Duty Valves for HVAC" for general-duty gate, globe, ball, butterfly, and check valves.
10. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
11. Division 23 Section "Temperature Controls" for temperature-control valves and sensors.
12. Division 23 Section “Piping Systems Flushing and Chemical Cleaning.”
13. Division 23 HVAC water treatment sections.

1.02 DEFINITIONS

A. CPVC: Chlorinated polyvinyl chloride.
B. HDPE: High density polyethylene.
C. PTFE: Polytetrafluoroethylene.

1.03 PERFORMANCE REQUIREMENTS

A. Hydronic pressure and temperature performance requirements shall be as scheduled on the drawings.

1.04 SYSTEMS DESCRIPTIONS

A. Hydronic piping system materials are scheduled on the Drawings.
B. Refer to Application Schedule on the Drawings for valve types to be used.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of the following:
1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air control devices.
3. Chemical treatment.
4. Hydronic specialties.

1.06 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail, at minimum 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
B. Qualification Data: For Installer.
C. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.07 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.
B. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in operation and maintenance manuals.

1.08 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
B. Installer Qualifications:
1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

1.09 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.
B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Socket Fittings: ASME B16.22.
E. Wrought-Copper Unions: ASME B16.22.
F. Grooved Mechanical-Joint Fittings and Couplings:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. ASC Engineered Solutions; Gruvlok; CTS Copper System.
        b. Victaulic Company; Style 606 and Style 607.
    2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
    3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
G. Copper or Bronze Pressure-Seal Fittings:
    1. Manufacturers: Subject to compliance with requirements, provide products by the following:
        a. ASC Engineered Solutions; Anvil Press.
        b. Apollo Valves; by Conbraco Industries; ApolloXpress.
        c. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
        d. NIBCO Inc.; Press System.
        e. Viega North America; ProPress System.
    2. Housing: Copper.
    3. O-Rings and Pipe Stops: EPDM.
    4. Tools: Manufacturer's special tools.
    5. Minimum 200-psig working-pressure rating at 250 deg F.
H. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.
    1. Manufacturers: Subject to compliance with requirements, provide products by the following:
        a. T-DRILL Industries Inc.

2.02 STEEL PIPE AND FITTINGS

A. Schedule 40 Steel Pipe: ASTM A 53/A 53M or ASTM A 106, Type E or S, Grade A or B. Include ends matching joining method.
    1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
    2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
    3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
    4. Cast-Iron Flanges: ASME B16.1, Class 125.
    5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125.
    6. Fittings: ASTM A234 ANSI B16.9, steel butt weld to match pipe wall thickness, Class 300.
    7. Flanges: Class 300 forged steel welding neck to match pipe wall thickness and valve flanges, ANSI B16.5. Orifice plate flanges shall be raised face welding neck type with ring joint gaskets and flange taps. Coordinate orifice plate flanges with orifice plate flow elements.
B. Grooved Mechanical-Joint Fittings and Couplings:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. ASC Engineered Solutions; Gruvlok; Model 7401 Rigid, Model 74 SlideLOK, and Fig. 7400 Rigidlite.
        b. Victaulic Company; Style 107 QuickVic Rigid Coupling and W07 AGS Rigid Coupling.
    2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
    3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.

4. Couplings: Ductile-iron housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
    a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

2.03 JOINING MATERIALS

A. Refer to Division 20 Section “Basic Mechanical Materials and Methods.”

2.04 TRANSITION FITTINGS

A. HDPE Plastic-to-Grooved Steel Transition Fittings:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. ASC Engineered Solutions; Gruvlok Manufacturing; Fig. 7307.
        b. Victaulic Company; Style 997.
    2. Ductile iron coupling with integral rows of gripping teeth on the HDPE side of the coupling and conventional key section on grooved side designed to engage standard roll or cut grooved steel pipe.

B. HDPE Plastic-to-Metal Transition Fittings:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. ASC Engineered Solutions; Gruvlok Manufacturing; Fig. 7312.
        b. Victaulic Company; Style 994 Vic-Flange.
    2. Ductile iron flange adapter having integral gasket and designed to permit direct connection of ANSI Class 125 and 150 steel or bronze flanged components into HDPE systems.

2.05 VALVES

A. General Service Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC."

2.06 SPECIALTY VALVES

A. Balance Valves:
    1. Flow Measuring: Use Flow Measuring Devices as specified in Division 20 Section “Meters and Gages.”
    2. Balance Valves for Sizes Less than NPS 6: Combination balance valve and flow measuring device as specified in this Section.

B. Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Griswold Controls.
        b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
        c. IMI Flow Design; IMI Hydronic Engineering Inc.
        d. Jomar Hydronics.
        e. Macon Balancing; Tunstall Corporation.
        f. Nexus Valve.
        g. PRO Hydronic Specialties, LLC.
        h. ASC Engineered Solutions.
        i. Armstrong International, Inc.
        j. Armstrong Pumps, Inc.
        k. Bell & Gossett; Xylem Inc.
        l. Gerand Engineering Co.
        m. Taco, Inc.

C. Combination, Balancing Valves and Flow Measuring Devices NPS 2-1/2 through NSP 4:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Griswold Controls.
        b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
        c. IMI Flow Design; IMI Hydronic Engineering Inc.

d. Jomar Hydronics.
e. Macon Balancing; Tunstall Corporation.
f. Nexus Valve.
g. PRO Hydronic Specialties, LLC.
h. ASC Engineered Solutions.
i. Armstrong Pumps, Inc.
j. Bell & Gossett; Xylem Inc.
k. Gerand Engineering Co.
l. Taco, Inc.
m. Tour & Andersson; available through Victaulic Company of America.

D. Contractor Option for Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller: Preassembled coil hook up kits may be used.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Griswold Controls.
b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
c. IMI Flow Design; IMI Hydronic Engineering Inc.
d. Jomar Hydronics.
e. Macon Balancing; Tunstall Corporation.
f. Nexus Valve.
g. PRO Hydronic Specialties, LLC.
2. Manufacturers: Subject to compliance with requirements, use products by one of the following:
a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
b. ASC Engineered Solutions; Gruvlok.

E. Diaphragm-Operated Relief Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol, Inc.
b. Anderson Greenwood & Co.; Kunkle Valve Division.
c. Armstrong Pumps, Inc.
d. Bell & Gossett; Xylem Inc.; 3301 and 4100.
e. Conbraco Industries, Inc.; Apollo Valve.
f. Spence Engineering Company, Inc.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Cast iron.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: EPDM.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPDM.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Automatic Flow-Control Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Griswold Controls.
b. IMI Flow Design; IMI Hydronic Engineering Inc.
c. ASC Engineered Solutions; Gruvlok; ABV Series.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.

5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum Pressure Rating: 300 psig.
9. Maximum Operating Temperature: 250 deg F.

2.07 CONTROL VALVES

A. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Temperature Controls."

B. Calibrated orifice balancing valves shall not be required on devices where pressure independent characterized control valves (PICCV's) are installed.

2.08 AIR CONTROL DEVICES

A. Manual Air Vents: Use ball-valve-type hose-end drain valves, refer to Division 23 Section "General-Duty Valves for HVAC."

B. Automatic Air Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; Xylem Inc.
d. Spirotherm, Inc.
e. Taco, Inc.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4.
7. Maximum Operating Pressure: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

C. Expansion Tanks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; Xylem Inc.
d. Taco, Inc.
e. Wessels Co.
2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
5. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- diameter gage glass, and slotted-metal glass guard.

D. Diaphragm:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol, Inc.
b. Armstrong Pumps, Inc.

c. Bell & Gossett; Xylem Inc.
d. Taco, Inc.
e. Wessels Co.

2. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Combination Air and Dirt Separators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Spirotherm, Inc.; VDN Series.
2. Body: Fabricated steel; constructed for 150-psig maximum working pressure and 250 deg F maximum operating temperature. Separator shall have body extended below pipe connections for dirt separation and include removable lower head.
3. Air and Dirt Separation Mechanism: Internal copper core tube with continuous wound copper medium permanently attached followed by continuous wound copper wire permanently affixed .
4. Venting Chamber: With integral full port, float actuated brass venting mechanism. Include valved side tap to flush floating dirt or liquids and for quick bleeding of air during system fill.
5. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
6. Blowdown Connection: Threaded.
7. Size: Match system flow capacity.

2.09 HYDRONIC PIPING SPECIALTIES

A. Flexible connectors and expansion fittings are specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

2.10 HYDRONIC PIPING STRAINERS

A. Manufacturers:
1. Apollo Valves; Conbraco Industries, Inc.
2. Griswold Controls.
3. Keckley Company.
4. Metraflex Company.
5. Mueller Steam Specialty; a Watts Brand.
6. NIBCO, Inc.
7. Sure Flow Equipment Inc.
8. Titan Flow Control, Inc.
9. Watts.
10. Yarway; Emerson Automation Solutions.
11. ASC Engineered Solutions; Gruvlok Manufacturing (for grooved piping).
12. Victaulic Company (for grooved piping).

B. Y-Pattern Strainers, Bronze:
1. CWP: 200 psig minimum, unless otherwise indicated.
2. SWP: 125 psig minimum, unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller.
4. End Connections: Threaded or soldered.
5. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
6. Drain:
a. Pipe plug for sizes NPS 2 and smaller.
b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

C. Y-Pattern Strainers, Cast and Ductile Iron:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection; or ASTM A with coupled cover and drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger; grooved ends may be used on grooved piping.
3. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
4. CWP: 200 psig minimum, unless otherwise indicated.
5. SWP: 125 psig minimum, unless otherwise indicated.
6. Drain:
    a. Pipe plug for sizes NPS 2 and smaller.
    b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

2.11 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
    1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

PART 3 EXECUTION

3.01 PIPING SYSTEMS INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping to permit valve servicing.
F. Install piping at indicated slopes.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.
J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
M. Install piping, other than drain piping, at a uniform grade of 0.2 percent upward in direction of flow.
N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
P. Install valves according to Division 23 Section "General-Duty Valves for HVAC."
Q. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
R. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
S. Install check valves at each pump discharge and elsewhere as required to control flow direction.
T. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
U. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

V. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
W. Install flanges or grooved mechanical couplings in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
X. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and where indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
Y. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
Z. Identify piping as specified in Division 20 Section "Mechanical Identification."

3.02 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 20 Section "Hangers and Supports." Comply with the following requirements for maximum spacing of supports.
B. Install the following pipe attachments:
    1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
    2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
    3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
    4. Spring hangers to support vertical runs.
    5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
    6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
    1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
    2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
    3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
    4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
    5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
    1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
    2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
    3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
    4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
    5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.03 PIPE JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.04 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
D. Install combination air/dirt separator in pump suction. Install blowdown piping with ball valve; extend full size to nearest floor drain.
E. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
F. Install expansion tanks as indicated in piping diagrams. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
3. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.05 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
B. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 20 Section "Meters and Gages."

3.06 CHEMICAL TREATMENT

A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
   1. pH: 9.0 to 10.5.
   2. "P" Alkalinity: 100 to 500 ppm.
   3. Boron: 100 to 200 ppm.
   4. Chemical Oxygen Demand: Maximum 100 ppm. Modify this value if closed system contains glycol.
   5. Corrosion Inhibitor:
      a. Sodium Nitrate: 1000 to 1500 ppm.
      b. Molybdate: 200 to 300 ppm.
      c. Chromate: 200 to 300 ppm.
      d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
      e. Chromate Plus Molybdate: 50 to 100 ppm each.
   6. Soluble Copper: Maximum 0.20 ppm.
   7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum 10 ppm.
   8. Total Suspended Solids: Maximum 10 ppm.
   9. Ammonia: Maximum 20 ppm.
   10. Free Caustic Alkalinity: Maximum 20 ppm.
   11. Microbiological Limits:
      a. Total Aerobic Plate Count: Maximum 1000 organisms/ml.
      b. Total Anaerobic Plate Count: Maximum 100 organisms/ml.
      c. Nitrate Reducers: 100 organisms/ml.
      d. Sulfate Reducers: Maximum 0 organisms/ml.
      e. Iron Bacteria: Maximum 0 organisms/ml.
B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
C. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.07 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 2 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Remove disposal fine-mesh strainers in pump suction diffusers.
4. Set makeup pressure-reducing valves for required system pressure.
5. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
6. Set temperature controls so all coils are calling for full flow.
7. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
8. Verify lubrication of motors and bearings.

END OF SECTION 23 2113

SECTION 23 2114 - GROUND-LOOP, HEAT-PUMP PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Hydronic Piping.”
4. Division 23 Section “Water-Source Unitary Heat Pumps.”
5. Division 23 Section “Piping System Flushing and Chemical Cleaning.”

1.02 SUMMARY

A. This Section includes piping for horizontal vertical, direct-buried, ground-loop, heat-pump systems that operate between 23 and 104 deg F.

B. Work includes furnishing all labor, materials and equipment necessary to install a buried closed loop heat exchanger system as indicated on the Drawings and as specified in this Section.

1.03 DEFINITIONS

A. Certified technician: Person meeting International Ground Source Heat Pump Association Design and Installation Standards.

B. IGSHPA: International Ground Source Heat Pump Association.

C. PE: Polyethylene.

1.04 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Ground-Loop, Heat-Pump Piping: 200 psig.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:

1. Pipe and fittings.
2. Joining method and equipment.
3. Propylene glycol solution.

1.06 INFORMATIONAL SUBMITTALS

A. Certificates: The pipe manufacturer shall submit notarized document confirming compliance with specified requirements.

1.07 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:
1. Contractor's Qualifications: Firms regularly engaged in installation of closed-loop ground heat exchanger, or projects of similar scope of the type, material and size required; whose installations have been in satisfactory use in similar service for not less than five years.
2. Manufacturer's Qualifications: Firms regularly engaged in manufacture of closed-loop ground heat exchanger products and tools of the types, material and size required; whose products have been in satisfactory use in similar service for not less than three years.
3. Installer's Qualifications: The Drilling Contractor shall be licensed by the State of Michigan. Installers shall have at least five years of successful installation experience on projects with closed-loop ground heat exchanger work or projects of similar scope to that required for this project. Drilling Contractor must have experience at mixing and pumping bentonite grouting materials from the bottom of the borehole to the top.
4. Fabricator's Qualifications: Fabricators must have completed a certification training program offered by the International Ground Source Heat Pump Association (IGSHPA) or approved manufacturers' certification program and shall have at least two years of successful installation experience. The only acceptable method of joining buried plastic pipe systems is by heat fusion process. Each ground heat exchanger fabricator must have performed a fusion procedure under direct supervision of an IGSHPA Certified Heat Fusion Technician, an IGSHPA approved manufacturer's certification program or a DOT certified heat fusion technician. Each certified technician must attend a retraining school annually.
5. Design procedure must follow a recognized methodology such as presented in:
a. Closed Loop/Ground-Source Heat Pump Systems: Installation Guide, IGSHPA Publication, Oklahoma State University.
b. Data Design Manual for Closed Loop/Ground Coupled Heat Pump Systems, ASHRAE.

B. Borehole Backfill:
1. Grouting compound (bentonite-based and thermal enhancement compound) shall be certified and listed by NSF (National Sanitation Foundation International) to ANSI/NSF Standard 60, "Drinking Water Treatment Chemicals - Health Effects".

1.09 COORDINATION

A. Prior to installation, the loop contractor shall initiate a meeting with all other contractors and installers dealing with site related work to coordinate exact scheduling, depths and location of all intersecting work.

B. The manufacturer of ground source heat pump equipment must provide design standards for minimum ground heat exchanger lengths showing equipment efficiencies.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of ground-loop heat pump piping system that fail in materials or workmanship within specified period.
1. Piping System Warranty Period: Minimum 10 years from date of Substantial Completion. Warranty shall be transferable.

PART 2 PRODUCTS

2.01 PIPES AND FITTINGS

A. Design Requirements, Pipe: Pipe and heat-fused material shall be manufactured from virgin polyethylene extrusion compound material in accordance with ASTM D-2513, Sections 4.1 and 4.2. Pipe shall be manufactured to outside diameters, wall thickness and respective tolerances as specified in ASTM D-3035 or ASTM F-714.
   1. Tracer Wire:
      a. Factory installed on all PE pipe products NPS 2 and smaller.
      b. Field installed on all PE pipe products NPS 2-1/2 and larger.

B. Design Requirements, Fittings: Manufactured to diameters, wall thickness, and respective tolerances as specified in ASTM D-3261 for butt fusion fittings, ASTM D-2683 for socket fusion fittings, and ASTM F-1055 for electro-fusion fittings.

C. Material:
   1. Listed in PPI TR4 as a PE4710 piping formulation.
   2. High density extrusion compound having a cell classification of PE445574C or higher as specified in ASTM D-3350 with the following exceptions:
      a. Exhibit zero failure (F0) when tested for a minimum of 192 hours under ASTM D-1693, condition C, as required in ASTM D-3350.

D. Dimensions:
   1. Pipe NPS 2 or Less: Manufactured in accordance with ASTM D-3035 with a dimension ratio of 11.
   2. Pipe NPS 3 and Larger: Manufactured in accordance with ASTM D-3035 with a dimension ratio of 15.5.

E. Performance Requirements:
   1. Material shall maintain 1600 psig Hydrostatic Design Basis at 73.4 deg Fin accordance with ASTM D-2837.
   2. Water Pressure Rating at 73.4 deg F:
      a. Dimension Ratio 11: 202 psig.
      b. Dimension Ratio 15.5: 139 psig.

F. Markings: Information required by ASTM D-3035, including numerical markings every 24 inches, permanently marked on the pipe.

G. Pipe Joining Methods:
   1. Heat fusion process.
   2. Socket fusion, butt fusion, saddle fusion, or electro-fusion methods in accordance with pipe manufacturer's procedures.

H. U-Bend Assembly: Factory manufactured or shop fabricated in controlled environment, of same material as pipe and fittings and having embossed depth stamp every 24 inches from U-bend. After completion, both open ends shall be sealed with a cap, plug or tape. Reasonable care shall be taken not to crush, cut or kink pipe assembly during transportation to the job site. If damaged, the area of damage shall be removed and replaced, at no additional cost to the Owner.

2.02 GROUTING MATERIALS

A. Basis-of-Design Product: Subject to compliance with requirements, provide one of the Thermal Grout products and thermal enhancement compound by GeoPro, Inc., or a comparable pre-approved product by one of the following:
   1. Baroid Industrial Drilling Products.
   2. Cetco Drilling Products.

B. General: Thermally-enhanced bentonite grout shall be used to seal and backfill each geothermal bore of the closed-loop ground heat exchanger to ensure proper thermal contact with the earth and to ensure the environmental integrity of each vertical bore column.
   1. Grouting material shall remain in a plastic state (moldable) throughout the life of the system and shall not generate heat during the hydration process.
   2. Other types of grouting material are unacceptable.

C. Thermal Conductivity: 0.88 Btu/h x sq. ft. x deg For greater as determined when tested in accordance to ASTM D-5334, "Standard Test Method for Determination of Thermal Conductivity of Soils and Soft Rock

by Thermal Needle Probe Procedure" per International Ground Source Heat Pump Association (IGSHPA) Standard 2B.1.2.1. Upon request, supplier shall produce independent, third party verification of the grouting material's ability to achieve the specified thermal conductivity. The independent company verifying the thermal conductivity of the grouting material shall have a minimum of five years' experience in measuring thermal conductivity using the methods outlined in ASTM D-5334. Date of independent verification testing and reporting shall be no more than three years prior to the date of request from the engineer.

D. Permeability: Grout mixture shall have maximum permeability rate of 1.0×10^{-7} cm/s as determined by ASTM D-5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter, Method C - test with increasing tailwater level", per IGSHPA Standard 2B.1.2.2, with a 5 psig confinement pressure (to simulate an approximate sample depth of 5 feet.).
   1. Reported permeability shall be verified by an independent, lab certified by AMRL (American Association of State Highway & Transportation Officials, Materials Reference Laboratory) and validated by the US Army Corps of Engineers to perform ASTM D-5084 at the time of verification as per IGSHPA Standard 2B.1.2.3.
   2. A copy of the report shall be supplied upon request from the engineer.
   3. Credentials of the independent laboratory shall also be supplied upon request from the engineer.

E. Total Solids and Enhancement Compound Percentage: Thermally enhanced bentonite grout shall have a minimum manufacturer's recommended mixture of 63.1 percent solids. Thermal enhancement compound shall constitute a minimum of 50.5 percent by weight of the total aqueous slurry.

F. Installed Material Set: Within 4 hours of being pressure pumped in the bore annulus, the installed material shall have the consistency of moldable putty.

G. Packaging: Bentonite component and thermal enhancement compounds of the grouting mix shall be manufactured and packaged such that they are ready for use prior to delivery to the job site. Bulk materials that require on site handling such as grinding, sieving, or other processing prior to being mixable are not acceptable.

2.03 SOURCE QUALITY CONTROL

A. Shop Tests: Randomly test U-bend assemblies at maximum frequency of 1 per every 10 produced at 100 psig.

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

A. Subject to compliance with requirements, complete buried closed loop heat exchanger system shall be designed, furnished, and installed by one of the following:
   1. Frank Rewold and Son Inc. (248-651-7242).
   2. Midwest Geothermal (616-514-1101).
   3. SES Geothermal, LLC (248-399-1900).

3.02 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

B. Comply with Local and State laws and ordinances as they pertain to buried pipe systems including shoring of walls, stepping of walls, or the use of trench boxes. Each method shall be in accordance to OSHA trenching guidelines.

3.03 VERTICAL PIPING INSTALLATION

A. Borehole Drilling: Drill bore hole in accordance with local, State or Federal requirements. Borehole shall be clean (no casing) and of sufficient diameter to facilitate installation of the U-bend assembly and a tremie pipe.

B. Pre-Installation Testing of U-Bend Piping:
   1. Flow test U-bend assembly just prior to placement in the borehole to ensure no kinks, bends or pinches. Test shall consist of forcing clean water into one end of the assembly, and visually inspecting discharge. If an obstruction exists, obstructed section of pipe shall be removed and replaced with equal length section that is free of obstructions and re-attached by heat fusion.
   2. Pressure test loops before installation into the borehole. Pressurize U-bend assembly with water and air as needed to achieve a minimum of 100 psig. Assembly shall have no significant loss in

pressure for a minimum of 30 minutes. Allowances in pressure loss shall be made for expansion in accordance with pipe manufacturer's recommendations. At the conclusion of the test, the pipe ends shall be sealed with a cap, plug or tape.

C. U-Bend Piping Installation:
   1. Immediately after completion of the borehole and full removal of all drilling equipment, the pre-tested, water filled U-bend assembly shall be inserted into the borehole, U-bend first. A stiffener that does not present potential damage to the assembly may be used to straighten the leading section of the assembly and to add counter weight for easier insertion.
   2. Care shall be taken so sealed pipe ends do not drop into the open borehole below graded surface.
   3. When bore holes are drilled with a drilling fluid (mud), the U-bend shall be staked and tied to prevent the assembly from floating out of the bore prior to the setting of the bentonite grout.

D. Grout Installation:
   1. Mixing: Mix thermally enhanced bentonite grouting material according to manufacturer's written instructions.
   2. Installation: Pressure pump grout material through a minimum NPS 1 tremie pipe and placed in the bore column from the bottom to the top. Grouting process shall conform to the manufacturer's instructions and "Grouting for Vertical Geothermal Heat Pump Systems, Engineering Design and Field Procedures Manual", as published by the IGSHPA, Oklahoma State University, 2010 Edition. Terminate completed grouted surface at ground level to ensure complete fill of the bore column.
   3. Inspection:
      a. Settling may occur after initial placement of the grout material. Monitor each borehole and continue adding grout as required for a period not less than 30 minutes and not longer than two hours.
      b. Field inspect thermal conductivity. Grouting manufacturer shall provide testing of site mixed grouting material in accordance to ASTM D-5334 to verify thermal conductivity. Manufacturer shall provide a minimum of three, sample analyses for this project.
         1) At a minimum, sampling shall be taken once at the beginning of the project, once at a point approximately one-third to completion, and finally at a point approximately two-thirds to completion. Should analyses indicate a thermal conductivity value below the minimum specified value, take corrective action to increase thermal conductivity to the minimum specified requirement. Submit written report defining corrective action taken.

E. Header Piping Installation:
   1. Header pipes shall be installed and fusion connected to the vertical U-bend assembly. Join pipe and fittings using socket fusion, butt fusion, or electrofusion process. Other methods are acceptable. Keep the quantity of fusion joints in the system to an absolute minimum.
   2. Turns shall be made by bending the pipe according to manufacturer's specifications. Keep the use of directional fittings to an absolute minimum. Utilize reducer fittings at pipe size changes to eliminate trapped air.
   3. Avoid sharp bends in piping runs. Minimum bend radius shall be determined by the following formula: Minimum Radius = Pipe OD (actual) times 25
   4. Form bends using continuous lengths of pipe.

F. Identification:
   1. Install continuous detectable warning tape around perimeter of geo-exchange field and above individual header pipes. Locate tape a minimum of 24 inches below finished grade, directly over piping. Underground warning tapes are specified in Division 20 Section "Mechanical Identification."
   2. Provide surveyor's markers at all four corners of the loop field. Longitude and latitude readings, including minutes and seconds, shall be recorded and included in the project record drawings.
   3. Circuit headers in the vault shall contain a visible number that corresponds with circuit number. Like numbers shall be placed on the supply as well as the return.
   4. Copies of the loop field as-built shall be laminated and placed on the wall of the mechanical room and vault by the loop header. Position to be determined by Owner or Owner's representative.

5. Any and all deviations of the loop field as represented by these drawings and specifications shall be noted and revised in project record drawings.

3.04 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.05 FIELD QUALITY CONTROL

A. All horizontal components of the ground heat exchanger will be pressure tested at 80 psig prior to backfilling. Air pressure testing shall be done through fusion fitting connections. Barbed connections may not be used on tests using air as pressure fluid.

B. Piping Tests: Fill piping 24 hours before testing and apply test pressure to stabilize piping. Use potable water only.

C. Hydrostatic Tests: Test at not less than 1-1/2 times the pipe working-pressure rating allowing for static pressure of borehole depth.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 30 minutes. Slowly increase to next test pressure increment and hold for 30 minutes. After testing at maximum test pressure, reduce pressure to 30 psig. Hold for 90 minutes, and measure pressure at 30-minute intervals. Repair leaks and retest until no leaks exist.

D. A second pressure test shall be performed at risers in mechanical room. Each circuit shall have a hydrostatic test at 100 percent of system operating pressure. This test shall be a 24-hour test with pressure tolerances not to exceed 5 psig.

E. Header Tests: After headers have been laid in trenches and prior to backfill, heat exchangers shall be hydrostatically pressure tested.

1. Test Pressure: 100 psig.Duration: One hour.
    a. Allowable Pressure loss: Less than 10 psig or10 percent.
    b. Leakage is not allowed.
    c. Visually and physically inspect each joint using industry standards for cold joints.
    d. Joints failing the test shall be completely removed from the system and new joint or fitting installed. Repeat test procedure.
2. After conclusion of ground heat exchanger pressure test, ground heat exchanger shall be left filled with clean water and maintained under pressure until final connection to the building system.
    a. Testing results (i.e. pass/fail).
    b. Witness' signature (i.e. Owner or Owner's Representative).

F. Prepare reports of testing activity.

1. Record test results including the following information:
    a. Date, Time, Location.
    b. Testing duration.
    c. Testing results (i.e. pass/fail).
    d. Witness' signature (i.e. Owner or Owner's Representative)

3.06 CLEANING

A. Flushing and Purging:

1. Before backfilling the trenches, all systems shall be flushed and purged of air and flow tested to ensure all portions of the closed-loop ground heat exchanger are properly flowing.
2. Where new piping is connected to existing piping system, all existing and new piping shall be flushed and purged up to the furthest isolation valve in the existing system which remained closed throughout the construction process.
3. Utilize portable temporary purging unit consisting of the following:
    a. Purge pump - high volume and high head as required.
    b. Open fluid reservoir.
    c. Filter assembly.
    d. Flow meter.
    e. Pressure gages.
    f. Connecting piping.
    g. Connecting hoses.

h. Refer to Division 23 Section “Piping System Flushing and Chemical Cleaning” for additional requirements.

4. Water for Flushing: Chloride content shall be less than 25 ppm, sulfate less than 25 ppm, and hardness less than 100 ppm.
5. Waste Water Removal: Provide an adequate receptacle for the removal of the flushing liquid. Dumping of water used for flushing at any ground surface area will not be allowed unless prior approval is given by Owner or Owner’s Representative.
6. Flush and purge each supply and return circuit in the forward and reverse directions with water at a minimum velocity of 2 ft/sec through each piping section.
   a. Maintain flow for a minimum of 15 minutes in each direction to remove all debris and air.
   b. To verify that all air is removed from the system, return water valve to the tank shall be closed.
   c. Change in the level of fluid in purge pump tank during pressurization indicates air still trapped in the system.
   d. If debris or air removal is detected during the flushing process, the 15 minute timer shall be re-started.
   e. Each circuit shall be flushed until water runs clear and clean. A sample shall be collected for each circuit and given to Owner or Owner’s Representative.
7. During flushing, flow rates and pressure drops shall be compared to calculated values to assure that there is no blockage or kinking of any pipe. If actual flow rate or pressure drop values differ from calculated design values by more than 10 percent, the problem shall be identified and corrected. Submit proposed flow rates and anticipated (calculated) pressure drops to Engineer for review prior to the commencement of flushing.
8. If the flow test indicates blockage, locate blockage using manufacturer's recommended methods, remove blockage, then re-purge and conduct the pressure and flow test again until all portions of the system are flowing properly.
9. Flow test must be observed and approved by the Owner or his designate before the system will be considered completed.

END OF SECTION 23 2114

SECTION 23 2123 - HYDRONIC PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

C. PEI: Pump Energy Index as defined by the Department of Energy.

D. PEI_{CL}: Pump Energy Index – Constant Load, as defined by the Department of Energy.

E. PEI_{VL}: Pump Energy Index – Variable Load, as defined by the Department of Energy.

1.03 ACTION SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all pumps and accessories to include in Operation and Maintenance manuals.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Department of Energy Requirements: Pumps supplied that are regulated by the Department of Energy pump standards shall bear the acceptable PEI index.

1. Constant load pumps supplied shall bear the acceptable PEI_{CL} index.

2. Submittals for approval shall clearly identify the applicable PEI index and affirm that that index meets the DOE pump standards.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

PART 2 PRODUCTS

2.01 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Comply with requirements in Division 20 Section “Motors”.

C. Selection:

1. Base non-overloading characteristics for pumps upon nameplate horsepower, at any point on performance curve.
2. Shaft first critical speed shall not be less than 25 percent greater than operating speed.
3. Maximum impeller diameter shall not be greater than 90 percent of “cut water” diameter for a given casing and no smaller than the smallest published diameter for casing. Do not base acceptable maximum diameter calculation on percentage of impeller diameter range for a given casing.
4. Pump speed shall be limited to 1800 RPM except as scheduled.
5. Select at the point of maximum efficiency for a given impeller-casing combination. Deviations shall be within 3 percent of maximum efficiency on the increasing capacity side of the maximum efficiency point and 7 percent on the decreasing capacity side of the maximum efficiency point.
6. Select pump at a point no greater than 85 percent of end of curve flow.
7. Maximum pump suction velocity:
   a. In-line: 12 fps.
   b. End suction: 13 fps.
   c. Double suction: 15 fps.

2.02 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.03 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Pumps Inc.; Series 4360 and 4380.
2. Bell & Gossett; Xylem Inc.; Series e-80.
3. Grundfos Pumps Corporation.
4. Taco, Inc.; Series 1900 Series.

B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and companion-flange connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel with copper-alloy shaft sleeve, or stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N seal for all glycol systems and all water systems 225 deg F and below; EPT seals for water systems above 225 deg F. Include water slinger on shaft between motor and seal.

D. Motor: Single speed, with permanently or grease lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 20 Section "Motors"

E. Capacities and Characteristics: Refer to Schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Support in-line centrifugal pumps greater than 1/2 HP independent of piping. Use continuous-thread hanger rods and hangers of sufficient size to support pump weight. Do not support pump from motor housing plate.

E. Refer to Division 20 Section “Mechanical Vibration Controls” for vibration isolation devices.

F. Refer to Division 20 Section “Hangers and Supports” for hanger and support materials.

G. Automatic (Cooling Coil) Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.03 ALIGNMENT

A. Align pump and motor shafts and piping connections after, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

D. Install check valve and throttling valve on discharge side of pumps. Triple-duty valves are not allowed.

E. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps as indicated on drawings.

F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

G. Install pressure gages on pump suction and discharge or at integral pressure-gage tappings, or install single gage with multiple-input selector valve.

H. Install check valve and gate or ball valve on each condensate pump unit discharge.

I. Install electrical connections for power, controls, and devices.

J. Ground equipment according to Division 26 Section "Grounding and Bonding."

K. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service for each pump supplied. Written report of the start-up shall be provided to the Owner and Engineer upon completion of services.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   6. Start motor.
   7. Open discharge valve slowly.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 23 2123

SECTION 23 2513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:
   1. Division 20 Section "Mechanical General Requirements."
   2. Division 20 Section "Basic Mechanical Materials and Methods."
   3. Division 23 Section "Piping Systems Flushing and Chemical Cleaning."

1.02 DEFINITIONS

A. CPVC: Chlorinated Polyvinyl Chloride.

B. EEPROM: Electrically erasable, programmable read-only memory.

C. EPDM: Ethylene-propylene-diene monomer.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

E. RO: Reverse osmosis.

F. TDS: Total dissolved solids.

G. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

H. PTFE: Polytetrafluoroethylene.

I. UV: Ultraviolet.

1.03 PERFORMANCE REQUIREMENTS

A. Furnish the services of a firm specializing in hydronic piping system water treatment work.
   1. This firm shall furnish and administer glycol for systems using glycol/water mix.

B. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
C. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
D. Base chemical quantities on estimated system size.
E. Closed hydronic systems, including glycol cooling, shall have the following water qualities:
    1. pH: Maintain a value within 9.0 to 10.5.
    2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
    3. Boron: Maintain a value within 100 to 200 ppm.
    4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
    5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
    6. TDS: Maintain a maximum value of 5000 mmhos.
    7. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
    8. Scale Control: Provide sufficient scale inhibitors to prevent formation of scale and maintain all scale-forming material in solution.
    9. Microbiological Limits:
        a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
        b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
        c. Ammonia: Maintain a maximum value of 20 ppm.
        d. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
        e. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
        f. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.
        g. Total Hardness: Maintain a value less than ?.? ppm.

1.04 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
    1. Bypass feeders.
    2. Water meters.
    3. Inhibitor injection timers.
    4. pH controllers.
    5. TDS controllers.
    6. TSS controllers.
    7. Chemical solution tanks.
    8. Injection pumps.
    9. UV-irradiation units.
    10. Chemical test equipment.
    11. Chemical material safety data sheets.
    12. Water softeners.
    13. RO units.

1.05 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
    1. Wiring Diagrams: Power and control wiring.
B. Other Informational Submittals:
    1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
    2. A step-by-step procedure to be followed by the Contractor during flushing, purging, disinfecting, draining, disposal, pretreatment and treatment operations. The intent of the step-by-step procedure is two-fold.

a. To assure that all essential permanent provisions to accomplish the above work are included during the course of construction.
b. To allow the Owner to accomplish the source procedures as subsequent maintenance operations.

C. Provide OSHA equivalent materials form for hazardous substances.

1.06 CLOSEOUT SUBMITTALS

A. Field quality-control test reports including final water quality test reports:
1. Boiler water samples taken at one-week intervals after boiler startup for a period of five weeks, and test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristics
2. Samples taken at four -week intervals following Substantial Completion, on hydronic systems to show that systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

B. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in operation and maintenance manuals.
1. Submit under provisions of Division 20 Section “Mechanical General Requirements” and as supplemented in this Section.
2. Submit following operation and maintenance data as minimum for purified water system.
a. Furnish complete instruction manuals for installation, operation, maintenance, and lubrication requirements for each component of mechanical and electrical equipment or system.
b. Each instruction manual shall include, but not be limited to, the following:
1) Diagrams and illustrations.
2) Detailed description of the function of each principal component of the system.
3) Performance and nameplate data.
4) Installation instructions.
5) Procedures for starting.
6) Proper adjustment.
7) Test procedures and recording of operation data.
8) Procedures for operating.
9) Shutdown and restart instructions.
10) Emergency operating instructions and trouble-shooting guide.
11) Safety precautions.
12) Maintenance and overhaul instructions which shall include detailed assembly drawings with part numbers, recommended spare parts list, instructions for ordering spare parts (including suppliers names), and complete preventive maintenance instructions required to ensure satisfactory performance and longevity of the equipment.
13) Lubrication instructions, which shall list points to be greased or oiled, shall recommend type, grade, and temperature range of lubricants, and shall recommend frequency of lubrication.
14) List of electrical relay settings and control and alarm contact settings.
15) Electrical interconnection wiring diagram for equipment furnished, including all control.
c. Manual shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances.
d. Each O&M Manual shall be transmitted to the Owner's representative and Architect prior to installation of the equipment and all equipment shall be serviced by the manufacturer in accordance with the manufacturer's recommendations prior to operation. A service record shall be maintained on each item of equipment and shall be delivered to the Owner's representative and Architect prior to final acceptance of the project.

1.07 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Conform to applicable codes for addition of non-potable chemicals to building mechanical systems, and for delivery to public sewage systems.

1.08 OWNER'S INSTRUCTIONS

A. Provide a coordinated water treatment training program oriented to the needs common to operating personnel and maintenance personnel and to the needs of maintenance personnel only, sufficiently prior to acceptance of the work, upon mutually satisfactory arrangement with the Architect.

B. Provide a total of not less than eight "field" hours encompassing mechanical, electrical, chemical, pollution and safety aspects, sufficient for personnel to operate and maintain systems and consistently achieve specified objectives, with subsequently scheduled guidance by the water treatment laboratory.

C. Water treatment laboratory chemical engineer, complemented by instrument engineer, supplemented by Contractor's staff, shall comprise the training staff.

D. Training materials shall include "survey," limits control program, shop drawings, operating and maintenance manuals, safe handling of chemicals, chemical testing, use of log sheets and demonstrations of installed and functioning systems.

E. On completion of the installation of the entire purified water system, conduct a thorough check and test of all components in the system. During this period, instruct the Owner's personnel in the theory, operation, and maintenance of the system. When this work is finished, start up the system and operate it for as long as necessary to complete two consecutive days of operation at the specified performance levels. During this period, continue to instruct the Owner's personnel.

1.09 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for heat pump loop water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:

1. Provide piping/plumbing recommendation to optimize chemical program results.
2. Initial water analysis and HVAC water-treatment recommendations.
3. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
4. Quarterly field service and consultation.
5. Customer report charts and log sheets.
6. Laboratory technical analysis.
7. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

B. Glycol manufacturer shall provide testing services every six months of samples submitted by the Owner. Fluid shall be tested at no charge for: glycol percent, pH, reserve alkalinity, dissolved metals, magnesium, calcium, chlorides, acidity, and inhibitor components. Testing service shall be for the life of the fluid.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers/Suppliers: Unless otherwise specified, and subject to compliance with requirements, provide products by one of the following:

1. Ashland Specialty Chemical Company; Drew Industrial Div.
2. Enerco Corporation.
3. SUEZ Water Technologies & Solutions
4. DuBois Chemicals.
5. NALCO Water, an Ecolab Company.
6. H-O-H Chemicals, Inc.

2.02 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
   1. Capacity: 2 gal.
   2. Minimum Working Pressure: 125 psig.

2.03 MAKE-UP WATER METERS

A. Water Meter:
   1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
   2. Body: Bronze.
   3. Minimum Working-Pressure Rating: 150 psig.
   4. Maximum Pressure Loss at Design Flow: 3 psig.
   5. Registration: Gallons or cubic feet.
   6. End Connections: Threaded.
   7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.

2.04 CHEMICAL FEED PIPE AND FITTINGS

A. CPVC Piping:
   1. CPVC Schedule 80 Pipe: ASTM F 441/ F 441M.
   2. CPVC Schedule 80 Fittings: ASTM F 439, socket type or ASTM F 437, threaded type.
   3. Isolation Valves: Three-piece true union style ball valve constructed of CPVC with TFE seats, and FPM or EPDM o-ring seals.

2.05 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

B. Corrosion Test-Coupon Assembly (Corrosion Racks): Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
   1. Two-station rack for closed-loop systems.
   2. Include three feet per second flow control valve.

2.06 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 EXECUTION

3.01 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.02 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install meters and equipment requiring service at a maximum 60 inches above finished floor.

D. Install interconnecting control wiring for chemical treatment controls and sensors.

E. Mount sensors and injectors in piping circuits.

F. Install glycol feed system in accordance with manufacturer’s instructions.

3.03 CHEMICAL INSTALLATION

A. Utilize softened or reverse osmosis water for initial system fill

B. Add specified chemicals to meet performance requirement specified in Part 1 of this Section.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to equipment to allow service and maintenance.
C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."
D. Install make-up water meters where indicated on the drawings.
E. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 20 Section "Valves."
F. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.
G. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
H. Ground equipment according to Division 26 Section "Grounding and Bonding."
I. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
B. Perform tests and inspections and prepare test reports.
    1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
C. Tests and Inspections:
    1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
    2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
    3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
    4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
    5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
    6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
    7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
    8. Repair leaks and defects with new materials and retest piping until no leaks exist.
D. Equipment will be considered defective if it does not pass tests and inspections.
E. Remove and replace malfunctioning units and retest as specified above.
F. At eight -week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.
G. Comply with ASTM D 3370 and with the following standards:
    1. Silica: ASTM D 859.
    2. Steam System: ASTM D 1066.
    3. Acidity and Alkalinity: ASTM D 1067.
    4. Iron: ASTM D 1068.

5. Water Hardness: ASTM D 1126.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 23 2513

SECTION 23 3113 - METAL DUCTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section "Mechanical General Requirements."
2. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
3. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 SUMMARY

A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.

B. Products Installed but Not Furnished Under This Section:

1. Receive, handle, and install terminal boxes furnished by the Laboratory Airflow Controls Contractor. Refer to Division 23 Section “Laboratory Airflow Controls.”

1.03 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.

C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm.
D. PVC: Polyvinyl Chloride.

1.04 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.05 ACTION SUBMITTALS

A. Shop Drawings: Drawn to scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Elevations of top and bottom of ducts.
   4. Dimensions of main duct runs from building grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated and other partitions.
   9. Equipment installation based on equipment being used on Project.
   10. Duct accessories, including access doors and panels.
   11. Hangers and supports, including methods for duct and building attachment, vibration isolation.

1.06 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

1.07 QUALITY ASSURANCE

A. NFPA Compliance:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
B. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

1.08 COORDINATION

A. Sheet metal trades shall cooperate fully with the Laboratory Airflow Controls Trades and shall attend all field installation training sessions.
B. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."
   1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
C. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
E. Reinforcement Shapes and Plates:
   1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
   2. Compatible materials for aluminum and stainless-steel ducts.
F. Tie Rods:
   1. Galvanized Steel Duct: Galvanized steel, 3/8-inch minimum diameter.
   2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches.

2.03 DUCT LINER

A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
   1. Manufacturers:
      a. CertainTeed Corp.; Insulation Group.
      b. Johns Manville International, Inc.
      c. Knauf Fiber Glass GmbH.
   2. Materials: ASTM C 1071, Type I, flexible; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
      a. Thickness: 1 inch.
      b. Density: 1-1/2 pounds per cubic foot.
      c. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
      d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
      e. Maximum Operating Temperature: 250 deg F when tested according to ASTM C 411.
      f. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      g. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
         1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
         2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
         3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
   3. Noise reduction coefficient (NRC): Sound absorption coefficients shall not be less than those in the table below as tested by ASTM C423 using an ASTM E795 Type A mounting.

	Sound absorption coefficients at octave band center frequencies, Hz						
Thickness Inches	125	250	500	1000	2000	4000	NRC
1	.08	.31	.59	.84	.91	.90	.70

2.04 SEALANTS AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.
   1. Manufacturers:
      a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.
C. Water-Based Joint and Seam Sealant:

1. Manufacturers:
    a. Design Polymerics; DP1010 Water Based Duct Sealant.
    b. Hardcast; Flex-Grip 550 and Versa-Grip 181.
    c. Polymer Adhesives; No. 11.
    d. United McGill.
2. Application Method: Brush on.
3. Solids Content: Minimum 63 percent.
4. Shore A Hardness: Minimum 20.
5. Water resistant.
6. Mold and mildew resistant.
7. VOC: Maximum 75 g/L (less water).
8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

2.05 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
4. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

E. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
    a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
    b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
4. Manufacturers:
    a. B-Line by Eaton; KwikWire.
    b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.

c. Duro Dyne Corp.; Dyna-Tite System.
d. Gripple Inc.; Hang-Fast System.

F. Stainless Steel Load Rated Cable Suspension System for Corrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality stainless steel 7 x 7 and 7 x 19 wire rope.
a. Stainless steel complying with ASTM A 492.
2. Fastener: One-piece, stainless steel housing with Type 302 S26 stainless steel hardened and tempered springs, and ceramic locking wedges.
3. End Fixings:
a. Loop End: Type 316L/A4 stainless steel.
b. Stud or Toggle End: Type 304L/A2 stainless steel.
c. Plain end suitable for stainless steel wire rope beam clamp.
4. Manufacturers:
a. B-Line by Eaton; KwikWire.
b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
c. Duro Dyne Corp.; Dyna-Tite System.
d. Gripple Inc.; Hang-Fast System.

2.06 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
3. Internal Tie Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
1. Manufacturers:
a. Ductmate Industries, Inc.
b. Nexus Inc.
c. Ward Industries, Inc.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.07 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
C. Butt transverse joints without gaps and coat joint with adhesive.
D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
1. Fan discharges.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

2.08 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA “Industrial Duct Construction Standards” as required based on pressure class.
   1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA “Industrial Duct Construction Standards” as required based on pressure class.
   1. Flat-oval fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

D. Duct Joints:
   1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
   2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
   3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
   4. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
   5. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
   6. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

E. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)
   1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
   2. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

F. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

G. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
   1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
   2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
      a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
   3. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
   4. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

5. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
6. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

PART 3 EXECUTION

3.01 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
C. Install ducts with fewest possible joints.
D. Install fabricated fittings for changes in directions, size, and shape and for connections.
E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
    1. Where ducts not having fire dampers, smoke dampers, or combination fire and smoke dampers pass through fire-rated partitions, maintain indicated fire rating. Seal penetrations with firestop materials. Refer to Division 07 Specification Sections for materials and UL classified firestop systems.
O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
P. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
    1. Intermediate level.

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 EQUIPMENT INSTALLATION

A. Install venturi terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance. Refer to details for additional requirements.

3.04 DUCT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer's instructions.
   1. Seal Class: Refer to Application Schedule on the Drawings.
   2. Seal ducts before external insulation is applied.
   3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at maximum intervals of 16 feet.

D. Install concrete inserts before placing concrete.

E. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.

F. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

G. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.

H. Use load rated cable suspension system for round duct in exposed locations.

3.06 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.08 FIELD QUALITY CONTROL

A. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.

B. Duct system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.09 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23 3113

SECTION 23 3300 - DUCT ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section “Testing, Adjusting, and Balancing” for duct test holes.
3. Division 23 Section “Temperature Controls” for motorized control dampers.
4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.02 DEFINITIONS

A. NVLAP: National Voluntary Laboratory Accreditation Program.

B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.

C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.

D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. For turning vanes, include data for pressure loss generated sound power levels.
2. For duct silencers, include pressure drop and dynamic insertion loss data.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      b. Manual volume damper installations.
      c. Control damper installations.
      d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
      e. Wiring Diagrams: Power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
B. Comply with AMCA 500-D testing for damper rating.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.
D. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.
E. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.

2.03 BACKDRAFT DAMPERS

A. Manufacturers:
   1. American Warming and Ventilating; Mestek, Inc.
   2. Greenheck Fan Corporation.
   3. Ruskin Company.
B. Description: Multiple-blade, parallel action counterbalanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
C. Performance: Based on tests in accordance with AMCA Standard 500:
   1. Pressure drop not to exceed 0.15 inch wg at face velocity of 2500 fpm.
   2. Leakage not to exceed 9.2 cfm per square foot at 1 inch wg differential and temperature of 70 deg F.
D. Frame: 0.052-inch- thick, galvanized sheet steel or 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.
E. Blades: 0.025-inch- thick, roll-formed aluminum or 0.050-inch- thick aluminum sheet.
F. Blade Seals: Manufacturer’s standard seal material.

G. Blade Axles: Nonferrous or galvanized steel.
H. Tie Bars and Brackets: Aluminum or galvanized steel.

2.04 LOW PRESSURE MANUAL VOLUME DAMPERS

A. Manufacturers:
1. American Warming and Ventilating; Mestek, Inc.
2. Arrow United Industries; Mestek, Inc.
3. Greenheck Fan Corporation.
4. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
5. Louvers and Dampers, Inc.; Mestek, Inc.
6. Nailor Industries Inc.
7. Ruskin Company.
8. Vent Products Co., Inc.
9. Young Regulator Co.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.

C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

F. Damper Materials:
1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
3. Blade Axles: Galvanized steel.
4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
5. Tie Bars and Brackets: Galvanized steel.

G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

I. Positive-Locking Damper Hardware:
1. Manufacturers:
a. Duro Dyne Corporation; Dyna-Click.
b. Rossi Hardware; Everlock.
c. Windgate Products Co., Inc.; Sure-Loc & Sure-Loc HD.
2. Quadrant Material: 18 gage galvanized steel with 11 to 15 locking positions.
3. Handle material: Die-cast aluminum or flame-retardant high-strength polymer.
4. Include center hole to suit damper operating-rod size.
5. Include elevated platform for insulated duct mounting on either round or rectangular duct.

2.05 MOTORIZED CONTROL DAMPERS

A. Refer to Division 23 Section “Temperature Controls.”

2.06 FIRE DAMPERS (CURTAIN STYLE)

A. Manufacturers:
1. Air Balance, Inc.; Mestek, Inc

2. Greenheck Fan Corporation.
3. NCA; a brand of Metal Industries Inc.
4. Nailor Industries Inc.
5. Ruskin Company.

B. Dynamic fire dampers with curtain style blades, and labeled according to UL 555, maximum velocity 2000 fpm, maximum static pressure 4 inches w.g.

C. Fire Rating:
1. 1-1/2 hours for 2 hour rated walls.
2. 3 hours for 4 hour rated walls.

D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Fusible Links: Replaceable, 165 deg F rated.

2.07 FIRE DAMPERS (MULTIPLE BLADE TYPE)

A. Manufacturers:
1. Greenheck Fan Corporation.
2. NCA; a brand of Metal Industries Inc.
3. Nailor Industries Inc.
4. Ruskin Company.

B. Dynamic fire dampers with multiple blades, and labeled according to UL 555, maximum velocity of 2000 fpm, maximum static pressure 4 inches w.g.

C. Fire Rating:
1. 1-1/2 hours for 2 hour rated walls.
2. 3 hours for 4 hour rated walls.

D. Frame: Fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Parallel operation, single-piece airfoil type construction with 0.078 inch equivalent thickness, or 0.064 inch thick, roll-formed, triple v-groove.

H. Axles: 1/2 inch plated steel hex.

I. Bearings: Stainless steel, or oil-impregnated bronze sleeve type, pressed into frame.

J. Linkage: Concealed in frame.

K. Fusible Links: Replaceable, 165 deg F rated.

2.08 TURNING VANES

A. Manufactured Turning Vanes:
1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.
3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.

4. Manufacturers:
    a. Aero-Dyne Sound Control; H-E-P Turning Vanes & Rail.
    b. Ductmate Industries, Inc.
    c. Duro Dyne Corporation.
    d. Ward Industries, Inc.; a JCI Company.

B. Manufactured Acoustic Turning Vanes:
1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.
3. Manufacturers:
    a. Ductmate Industries, Inc.
    b. Ward Industries, Inc.; a JCI Company.

2.09 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pottorff.
2. Ventfabrics, Inc.
3. Young Regulator Co.

B. Description: Cable system designed for remote manual damper adjustment.
C. Tubing: Brass.
D. Cable: Stainless steel.
E. Wall-Box Mounting: Recessed, 2 inches deep.
F. Wall-Box Cover-Plate Material: Steel

2.10 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class. Doors may be field fabricated in accordance with SMACNA Standards, or commercially produced.
B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
1. Manufacturers:
    a. Air Balance, Inc.; Mestek, Inc.
    b. Greenheck Gan Corporation.
    c. Nailor Industries Inc.
    d. Ruskin Company.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:
    a. Less Than 12 Inches Square: Secure with two sash locks.
    b. Up to 18 Inches Square: Two hinges and two compression locks.
    c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
    d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
1. Manufacturers:
    a. Ductmate Industries, Inc.
    b. Flexmaster U.S.A.; a Masterduct Company.
2. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
E. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers:
1. ADSCO Manufacturing LLC.
2. Duro Dyne Corp.

3. Senior Flexonics Pathway.
4. Ventfabrics, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 20 to plus 200 deg F.

2.12 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE

A. Manufacturers:
1. Flexmaster U.S.A.; a Masterduct Company; Type 1M Acoustical.
2. Hart & Cooley.
3. Thermaflex; part of the Flexible Technologies Group.

B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.

C. Insulated Flexible Ducts: UL 181, Class 1, flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F.

D. Acoustical performance tested in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties* shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self-generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.

F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.13 FLEXIBLE DUCT ELBOW SUPPORTS

A. Manufacturer:
   1. Titus; Air Distribution Technologies, Inc.; a JCI Company; FlexRight.
   2. Thermaflex; part of the Flexible Technologies Group; FlexFlow Elbow.
   3. Hart and Cooley, Inc.; Smart Flow Elbow.
B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.
C. Elbow supports shall be UL listed for use in return air plenum spaces.

2.14 DUCT ACCESSORY HARDWARE

A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.15 FINISHES

A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

PART 3 EXECUTION

3.01 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts and PVC coated ducts; and aluminum accessories in aluminum ducts.
C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install stainless steel volume dampers in stainless steel ducts.
   3. Install aluminum volume dampers in aluminum ducts.
E. Set dampers to fully open position before testing, adjusting, and balancing.
F. Install fire dampers according to UL listing.
G. Install duct access doors on ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. Upstream from duct filters.
   2. At outdoor-air intakes and mixed-air plenums.
   3. At drain pans.
   4. Downstream from control dampers, backdraft dampers, and duct mounted equipment.
   5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
   6. Control devices requiring inspection, including airflow measuring devices. Size access doors appropriately to facilitate service of each device.
   7. Elsewhere as indicated.
H. Install access doors with swing against duct static pressure.
I. Label access doors according to Division 20 Section "Mechanical Identification."
J. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
K. Connect flexible ducts to metal ducts with plenum-rated draw bands.
L. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.
M. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
   1. Use manufactured double-vane turning vanes unless otherwise specified.
   2. Seat outboard-most vane in heal of duct elbow.
   3. Provide vanes for all runner punchings. Practice of eliminating every other vane is prohibited.
   4. Use single-vane turning vanes in low pressure square elbows.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

3.03 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire dampers, combination fire and smoke dampers, and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23 3300

SECTION 23 3423 - POWER VENTILATORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Motors.”
3. Division 20 Section “Variable Frequency Controllers.”
4. Division 23 Section “Common Work Results for HVAC” for common mechanical drive requirements for fans and air moving equipment.

1.02 PERFORMANCE REQUIREMENTS

A. Classify according to AMCA 99.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.
B. Operation and Maintenance Data: For power ventilators to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
D. UL Standard: Power ventilators shall comply with UL 705.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
C. Lift and support units with manufacturer's designated lifting or supporting points.

1.08 COORDINATION

A. Coordinate size and location of structural-steel support members.
B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
C. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Manufacturing; Acme Fan Group; Models PRN and PV.
2. Aerovent; a Twin City Fan Company.
3. Greenheck Fan Corporation; Models G and GB.
4. Loren Cook Company; Models ACED and ACES.
5. Moffitt Corporation.
6. PennBarry; Division of Air System Components; Domex.
B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
E. Accessories:
1. Variable Frequency Controller: Refer to Division 20 Section “Variable Frequency Controllers.”
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops. Refer to temperature controls.
F. Provide prefabricated roof curbs for each fan.
G. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.02 UPBLAST CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing; Acme Fan Group.
2. Aerovent; a Twin City Fan Company.
3. Greenheck Fan Corporation; CUBE Series.
4. Loren Cook Company.
5. Moffitt Corporation.
6. PennBarry; Division of Air System Components; Fumex.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Spun-aluminum construction with square, one-piece, aluminum base with venturi inlet cone. Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Accessories:
1. Variable Frequency Controller: Refer to Division 20 Section "Variable Frequency Controllers."
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops. Refer to temperature controls.

F. Provide prefabricated roof curbs for each fan.

G. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.03 KITCHEN HOOD EXHAUST FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Manufacturing; Acme Fan Group; Models PDURG and PNURG.
2. Aerovent; a Twin City Fan Company.
3. Greenheck Fan Corporation; CUBE Series.
4. JencoFan; Soler & Palau Ventilation Group.
5. Loren Cook Company.
6. Moffitt Corporation.
7. PennBarry; Division of Air System Components; Fumex with Fatrap.

B. Description: UL 762 labeled belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, heat baffle, curb base, and accessories.

C. Housing: Spun-aluminum construction with square, one-piece, aluminum base with venturi inlet cone. Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains, grease collector, and drain connection.
1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Sheaves: Cast-iron, adjustable-pitch motor sheave.
4. Fan and motor isolated from exhaust airstream.
5. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.

F. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.

G. Provide prefabricated roof curbs for each fan. Provide vented curb extension as required to locate fan discharge at a minimum of 40 inches above the roof.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.04 ROOF CURBS AND ACCESSORIES

A. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
    a. Creative Metals.
    b. The Pate Company.
    c. Roof Products & Systems.
    d. Thybar Corporation.
    e. Any of the approved roof mounted exhaust fan manufacturers.
2. Configuration: Self-flashing without a cant strip, with mounting flange, and suitable for flat roofs with tapered insulation.
3. Height: Curb shall extend a minimum 12 inches above top surface of roof insulation.
4. Sound Curb: Curb with sound-absorbing insulation matrix.
5. Metal Liner: Galvanized steel.

2.05 MOTORS

A. Comply with requirements in Division 20 Section "Motors."

2.06 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.01 INSTALLATION

A. Install power ventilators level and plumb.
B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
C. Install units with clearances for service and maintenance.
D. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
B. Install ducts adjacent to power ventilators to allow service and maintenance.
C. Ground equipment according to Division 26 Section "Grounding and Bonding."
D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
    1. Verify that shipping, blocking, and bracing are removed.
    2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
    3. Verify that cleaning and adjusting are complete.
    4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
    5. Adjust damper linkages for proper damper operation.
    6. Verify lubrication for bearings and other moving parts.
    7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
    8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
    9. Shut unit down and reconnect automatic temperature-control operators.
    10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

C. Lubricate bearings.

END OF SECTION 23 3423

SECTION 23 3500 - SPECIAL EXHAUST SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Motors.”
3. Division 23 Section “Common Work Results for HVAC” for common mechanical drive requirements for fans and air moving equipment.

1.02 PERFORMANCE REQUIREMENTS

A. Operating Limits: Classify according to AMCA 99.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

B. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.08 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 TAILPIPE EXHAUST SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Plymovent AB.

B. Flexible Exhaust Tubing: Diameter and length indicated on Drawings.

1. Abrasion resistant, 2-ply, fire retardant fabric, heat resistant cloth base, capable of withstanding 650 deg F.

2. Tubing shall have bonded exterior scuff strip to provide abrasion resistance, and exterior steel-spring wire reinforcing spiral encased within fabric laminations to prevent collapsing.

3. Terminate tubing with tailpipe clamp/quick release adaptor.

C. Exhaust Fan: Direct drive, single inlet, single width, backward inclined, non-overloading centrifugal fan with single thickness blades and cast iron hub.

1. Fan statically and dynamically balanced with machined keyway to match motor shaft.

2. Housing: Constructed of heavy gage cold rolled steel, welded construction, with inlet cone and Heresite coating.

3. Fan Motor: Industrial grade, C-face type bolted directly to housing.

4. Average reading over 3 mils deflection will not be accepted.

5. Capacities and Characteristics: Refer to Schedule(s) on Drawings.

2.02 MOTORS

A. Comply with requirements in Division 20 Section "Motors."

B. Enclosure Type: Totally enclosed, fan cooled.

2.03 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.01 INSTALLATION

A. Install packaged exhausters and collectors level and plumb.

B. Support units using spring isolators having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."

1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.

C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."

B. Install ducts adjacent to packaged exhausters to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain special exhaust systems and equipment.

END OF SECTION 23 3500

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.02 ACTION SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

PART 2 PRODUCTS

2.01 AIR DIFFUSION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
2. Nailor Industries, Inc.
3. Price Industries.
4. Titus; Air Distribution Technologies, Inc.; a JCI Company.
5. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.

B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.

C. Provide plaster frames for units installed in plaster ceilings.
D. Provide gaskets for supply terminal air devices mounted in finished surfaces.
E. Finish:
    1. Device Face and Visible Trim: Standard off white baked enamel finish unless noted otherwise.
    2. Device Interior Surfaces, Including Blank-Offs and Boots: Black matte finish.
F. Air pattern adjustments shall be made from the face of the device.
G. Refer to drawings and schedules for quantities, types, and finishes.
H. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.02 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, “Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.”

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.
B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
C. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.
D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 3713

SECTION 23 3723 - AIR INTAKE AND RELIEF HOODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 08 Section "Louvers and Vents" for ventilator assemblies provided as part of the general construction.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 23 Section "Power Ventilators" for roof-mounting exhaust fans.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads, and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For intake and relief ventilators. Include plans, elevations, sections, details, and ventilator attachments to curbs and curb attachments to roof structure.

B. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which roof curbs and ventilators will be attached.
2. Sizes and locations of roof openings.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.06 COORDINATION

A. Coordinate installation of roof curbs and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
   1. Use types and sizes to suit unit installation conditions.
   2. Use Phillips flat, hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.

2.03 FABRICATION, GENERAL

A. Factory or shop fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
D. Fabricate supports, anchorages, and accessories required for complete assembly.
E. Perform shop welding by AWS-certified procedures and personnel.

2.04 GRAVITY INTAKE AND RELIEF HOODS (RECTANGULAR)

A. Manufacturers:
   1. Acme Engineering & Manufacturing.
   2. Greenheck Fan Corporation; Fabra-Hood.
   3. Loren Cook Company.
   4. Moffitt Corporation.
   5. PennBarry; Division of Air System Components.
B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.
C. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch- thick hood; suitably reinforced.
D. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire.
E. Galvanized-Steel Sheet Finish:
   1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
   2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.

3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
    a. Color and Gloss: As indicated by manufacturer's designations. As selected by Architect from manufacturer's full range.

2.05 ACCESSORIES

A. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and hood base.
    1. Manufacturers: Roof curbs shall be provided by the hood manufacturer, or one of the following:
        a. Creative Metals.
        b. Pate.
        c. Roof Products & Systems.
        d. ThyCurb.
        e. Any of the listed hood manufacturers.
    2. Configuration: Self-flashing without a cant strip, with mounting flange, and suitable for flat roofs with tapered insulation.
    3. Height: Curb shall extend a minimum 12 inches above top surface of roof insulation.
    4. Metal Liner: Galvanized steel.
    5. Burglar Bars: Minimum 1/2-inch- thick steel bars welded in place to form 6-inch squares.
B. Backdraft Damper:
    1. Manufacturer’s standard, with multiple-blade, parallel action counterbalanced backdraft dampers, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
C. Motorized Backdraft Damper: Refer to DAMPERS – AUTOMATED in Division 23 Section “Temperature Controls.”

PART 3 EXECUTION

3.01 INSTALLATION

A. Install intake and relief hoods level, plumb, and at indicated alignment with adjacent work.
B. Secure intake and relief hoods to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible.
C. Install goosenecks on curb base where throat size exceeds 9 by 9 inches.
D. Install intake and relief hoods with clearances for service and maintenance.
E. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
F. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.
G. Label intake and relief hoods according to requirements specified in Division 20 Section "Mechanical Identification."
H. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
I. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.03 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION 23 3723

SECTION 23 3813 - COMMERCIAL KITCHEN HOODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section "Power Ventilators" for exhaust fans.
3. Division 23 Section "Temperature Controls" for automatic controls for exhaust fans, makeup air units, and fire alarm systems.

1.02 DEFINITIONS

A. Listed Hood: A hood tested according to UL 710 by an NRTL acceptable to authorities having jurisdiction.

B. Standard Hood: A hood that complies with design, construction, and performance criteria of applicable national and local codes.

C. Type I Hood: A hood designed for grease exhaust applications.

D. Type II Hood: A hood designed for heat and steam removal and other nongrease applications.

1.03 ACTION SUBMITTALS

A. Product Data: For the following:

1. Hoods.
2. Grease removal devices.
3. Fire-suppression systems.
4. Lighting fixtures.

1.04 CLOSEOUT SUBMITTALS

A. Field test reports.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance: Fabricate hoods according to NSF 2, "Food Equipment."

C. SMACNA Compliance:

1.06 COORDINATION

A. Coordinate equipment layout and installation with other Work, including light fixtures, HVAC equipment, and fire-suppression system components.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish one complete set of grease removal devices.

PART 2 PRODUCTS

2.01 HOOD MATERIALS

A. Stainless-Steel Sheet: 300 series.
   1. Minimum Thickness: 0.03 inch.
   2. General: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
   3. Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. Sealant: Elastomeric sealant shall be NSF certified for commercial kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR, Section 177.2600, for use in areas that come in contact with food.

C. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and passes testing according to UL 710.

2.02 COMMERCIAL ENVIRONMENT DOMESTIC STYLE HOOD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Domestic style hoods for use in commercial environments
      a. Greenheck; GRRS

B. Hood Configuration: Exhaust only

C. Hood Style: Wall-mounted canopy

D. Grease Removal Devices: Removable, stainless-steel or aluminum filter/baffle grease filters

E. Light Fixtures: UL-listed, recessed fixtures and lamps with lenses sealed vaportight. Wiring shall be installed in stainless-steel conduit on hood exterior. Number and location of fixtures shall provide a minimum of 50 fc on cooking surface below hood.
   1. Switches shall be mounted on front panel of hood canopy.

F. Wet-Chemical Fire-Suppression System: Meeting requirements of UL 300. Pre-engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator
   1. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood Furnish manual pull station for wall mounting adjacent to hood. Exposed piping shall be covered with stainless-steel sleeves. Exposed fittings shall be chrome plated.
   2. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
   3. Furnish an electric-operated, gas shutoff valve with clearly marked open and closed indicator for field installation.
   4. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
   5. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters.

G. Hood Controls: Single, hood mounting control cabinet shall control groups of adjacent hoods and shall be fabricated of stainless steel.
   1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Motor starters shall comply with Division 26 Section "Enclosed Controllers."
   2. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation.
B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install hoods level and plumb.
B. Complete field assembly of hoods where required.
   1. Make closed butt and contact joints that do not require filler.
   2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in Part 2 "General Hood Fabrication" Article.
C. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, grease removal devices, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
D. Make cutouts in hoods where required to run service lines and to make final connections.
E. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.
F. Install hoods to operate free from vibration.
G. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
H. Install lamps, with maximum recommended wattage, in equipment with integral lighting.

3.03 CONNECTIONS

A. Duct Connections: Comply with applicable requirements in Division 23 Section "Duct Accessories" for flexible connectors on makeup air supply duct. Weld exhaust-duct connections.
B. Fire-Suppression Piping: Install piping connections for remote-mounted suppression systems according to NFPA 17, "Wet Chemical Extinguishing Systems."
C. Ground equipment.
D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
C. Tests and Inspections:
   1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Test water, drain, gas, and liquid-carrying components for leaks. Repair or replace leaking components.
4. Perform hood performance tests required by authorities having jurisdiction.
5. Perform fire-suppression system performance tests required by authorities having jurisdiction.

D. Prepare test and inspection reports.

3.05 CLEANING

A. Remove protective coverings and clean and sanitize hoods and associated services, both inside and out, according to manufacturer's written instructions.

B. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hoods.

END OF SECTION 23 3813

SECTION 23 7200 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 07 Section "Roof Accessories" for roof curb installation.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 23 Section "Temperature Controls" for control wiring and control devices connected to energy recovery units.

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

1.03 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain air-to-air energy recovery units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-to-air energy recovery units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

D. AHRI Compliance: Ratings for energy recovery devices shall comply with AHRI 1060, “Rating Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.”

E. ASHRAE Compliance:

1. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

F. UL Compliance:

1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."
2. Electric coils shall comply with requirements in UL 1995, "Heating and Cooling Equipment."

1.05 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchangers, Fans and components that fail in materials or workmanship within specified warranty period.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Furnish one set of each type of filter specified.
2. Fan Belts: Furnish one set of belts for each belt-driven fan in energy recovery units.
3. Wheel Belts: Furnish one set of belts for each heat wheel (not required for units with minimum 5-year wheel drive warranty).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PACKAGED ENERGY RECOVERY UNITS

A. Manufacturers:

1. Greenheck Fan Corporation.
2. Innovent Air Handling Equipment.
3. Modine Manufacturing Company.
4. Munters Corporation; Des Champs Products Division.
5. Nortek Air Solutions: Governaire.
6. Nortek Air Solutions; Venmar CES Inc.
7. Spinnaker Industries Inc.
8. XeteX Inc.

B. General: Construct unit as specified. Single wall and 1-inch double wall casing are unacceptable. Fans and coils must be removable without dismantling the structural framing of the unit. Unit shall be suitable for indoor or outdoor installation as detailed on the plan drawings.

C. Base: Construct base of minimum 10 gage welded structural steel with cross supports integral lifting lugs. Base shall be insulated and provided with a minimum 22 gage galvanized G90 steel subfloor. Coat base with 2-part epoxy primer and urethane modified enamel top coat.

D. Flooring: Provide double wall floor construction. Walk on floor material shall be a minimum of 18 gage galvanized G90 steel. Flooring sheets shall be sealed with a closed-cell neoprene gasket material to minimize sound transmission to spaces located below the unit. Subfloor shall be welded to the base frame.

E. Framing: Frame is constructed of formed galvanized members designed to support flush-mounted double-wall panels. Framing must have gasketing between support members and panels. Casing must be thermal break construction.

F. Panels: Unit shall have non-load bearing heavy gage 2-inch double-wall panels. 22 gage galvanized perforated lining will be provided in the fan sections for additional sound attenuation.

G. Casing Ratings: Maximum casing panel deflection shall not exceed L/250 at 8 inches w.c. TSP (where L is the longest panel span on the unit). Casing shall meet a SMANCA duct class leakage rating of 5 at 8 inches w.c. TSP. The panel insertion loss, per octave band, shall not be less than the following:

Frequency:	100	125	250	500	1000	2000	4000	8000
Insertion loss, dB:	24	16	30	32	33	34	63	60

H. Insulation: Walls, floor, and roof shall be double wall and insulated. Walls and roof shall be insulated with either glass fiber or polyurethane foam insulation having minimum R-value of 8. Floors shall be insulated with polyurethane foam insulation to achieve minimum R-13. Insulation shall not be exposed to the air stream.

INSULATION OPTIONS

Wall thickness	R-Value	Cabinet Insulation Options	Thermal Break Options
2"	8.3	Fiberglass	None or Gasket thermal break
2"	13.2	Injected Foam	None or Gasket thermal break
4"	16.7	Fiberglass	None or Gasket
4"	26.4	Injected Foam	None or Gasket or Poly-block No Thru Metal
3"	20	Injected Foam	3” Walls used on Temtrol and Venmar units

I. Glass Fiber Housing Insulation: Comply with NFPA 90A or NFPA 90B.
   1. Materials: Glass-fiber, ASTM C 1071.
   2. Thickness: 2 inches.
   3. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
   4. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.
   5. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C 916.
   6. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment without damaging liner when applied as recommended by manufacturer and without causing leakage in housing.
   7. Location and Application: Encased between outside and inside casing.

J. Injected Foam Housing Insulation: Comply with NFPA 90A or NFPA 90B.
   1. Rated UL94 HF-1.
   2. Thickness: 2 inches.
   3. Polyurethane Injected Foam: 2.5 pounds per cubic foot density with an effective thermal conductivity (C) of 0.154 BTU in/hr sq.ft°F).
   4. Ozone depletion potential of 0.
   5. Global warming potential of 0.
   6. VOC exempt.

K. Coatings: Exterior casing shall be coated with 2 part epoxy primer with urethane modified enamel top coat. Interior casing shall be galvanized G90 steel and coated with air-dried phenolic where specified for corrosive environment.

L. Access Doors: Full height. Same materials and finishes as housing, complete with stainless steel piano hinges, latches, handles, and gaskets. Doors shall be sized and located to allow periodic maintenance and inspections. Allegis corrosion resistant compression latches (tool lockable in fan sections), and minimum 24-inch clear opening width at all walk-in sections. Supply and exhaust air streams shall not be covered by a single door. Provide doors for access to areas requiring routine maintenance. Access panels in lieu of access door are unacceptable.

M. Door Accessories:
   1. Access doors shall be provided with stainless steel door tie backs.
   2. Door shall be thermal break design.

N. Heat Recovery Device: Fixed-plate heat exchanger.

O. Supply and Exhaust Blower: 12 blade aluminum airfoil plenum fan with minimum L10 200,000 hour rated bearings. Plenum fans with less than 12 blades are not acceptable due to increased noise levels. Non-airfoil blades are not acceptable due to decreased efficiency of the fan. Hi-Pro Polyester urethane powder coating or equivalent air-dried Heresite coating for corrosive environments.

P. Refer to Division 20 Section "Motors" for general requirements.
Q. Belt-Drives: Adjustable pitch sheaves for 10 hp motors and smaller, fixed pitch sheaves for 15 hp motors and larger. Belt-drives shall be minimum 2-groove with 2 belts and minimum 1.2 service factor. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.
R. Isolation: Refer to Division 20 Section “Mechanical Vibration Controls.”
S. Accessories:
    1. Belt guards / fan outlet safety cages for plenum fans / inlet screens shall be provided.
    2. Variable Frequency Controllers: Provide variable frequency controllers for supply and exhaust fan(s) where indicated. VFCs shall be factory provided and installed.
T. Dampers: Motorized dampers shall be low leakage type with aluminum construction, airfoil blades, vinyl edge seals, metal jamb seals, and synthetic bearings. Gravity dampers shall have aluminum frame, aluminum blades, extruded vinyl edge seals, and synthetic bearings.
    1. Provide the following dampers:
        a. Outside air heat exchanger face sequencing dampers, parallel blade type, two-position actuators. A minimum of 5 dampers shall be provided across the face of the HX to allow defrost operation without affecting performance.
        b. Outside air heat exchanger bypass damper, parallel blade type, 2-position actuator.
        c. Exhaust gravity damper.
U. Filters:
    1. Mixed Air Filter: Provide 2-inch thick, MERV 8 filter bank downstream of the heat exchanger. Mount in galvanized steel side access slide rack and size for 500 fpm maximum face velocity.
    2. Aluminum Outside Air Filter: Provide 2-inch thick, washable aluminum filter bank in the location shown on unit drawing. Mount in galvanized steel front access rack and size for 650 fpm maximum face velocity.
V. Electric Duct Heater: Provide UL listed open coil heater with, fusing, air proving switch, and high temperature cut-out. Provide power to heater from main electrical panel (factory wired).
W. Electrical:
    1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection.
    2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
    3. Wiring shall be numbered and color-coded to match wiring diagram.
    4. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
    5. Minimum SCCR according to UL 508 shall be as indicated on the Drawings or 5,000 A, whichever is greater.
    6. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
        a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
        b. NEMA KS 1, heavy-duty, nonfusible switch.
        c. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    7. Each motor shall have overcurrent protection.
    8. Factory test wiring and controls before shipment.
    9. A phase/voltage protection relay shall be provided for each unit. Upon sensing a loss of phase or voltage the unit shall be de-energized.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is from exhaust side to purge section to supply side.
    1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.

2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
3. Access doors and panels are specified in Division 23 Section "Duct Accessories."
4. For outdoor units: Provide waterproof roof with standing seam construction and positive slope to ensure water drainage.

B. Install fixed-plate heat exchangers so supply and exhaust airstreams flow in opposite directions.
1. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to heat exchanger. Access doors and panels are specified in Division 23 Section "Duct Accessories."

C. Install floor-mounted units on 4-inch- high concrete base.
D. Install units with clearances for service and maintenance.
E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
F. Pipe condensate drains from heat exchanger units and drain pans to nearest floor drain or roof drain. Use same size piping as condensate drain connection. For equipment located outdoors, insulate and provide electrical heat trace for condensate drains.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Units shall be provided complete for single point connection to hydronic piping system.
B. Install piping adjacent to machine to allow service and maintenance.
C. Duct and fan installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts, fittings, and specialties.
D. Ground equipment according to Division 26 Section "Grounding and Bonding."
E. Connect wiring according to Division 26 Section "Conductors and Cables."
F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set initial temperature and humidity set points.
5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.
C. Remove malfunctioning units, replace with new units, and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 7200

SECTION 23 8146 - WATER-TO-AIR HEAT PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section "Mechanical Vibration Controls" for isolation pads, and spring isolators.
3. Division 23 Section "Temperature Controls" for control devices not packaged with units.

1.02 DEFINITIONS

A. EVA: Ethylene-vinyl acetate.

B. MS/TP: Master slave/token passing data link protocol.

C. PVC: Polyvinyl chloride.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each model.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which heat pumps will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.

5. Items penetrating finished ceiling, including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

C. Product Certificates: For each type of water-source heat pump, signed by product manufacturer.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For water-source heat pumps to include in operation and maintenance manuals.

C. Warranty: Special warranty specified in this Section.

1.06 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-source heat pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance:

1. ASHRAE 15.

D. Comply with minimum COP/efficiency levels according to ASHRAE/IESNA 90.1.

E. Comply with NFPA 70.

F. Comply with safety requirements in UL 484 for assembly of free-delivery water-source heat pumps.

G. Comply with safety requirements in UL 1995 for duct-system connections.

1.07 COORDINATION

A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, refrigeration components.
2. Warranty Period: Five years from date of Substantial Completion.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. One set of matched fan belts for each belt-driven fan.
2. One set of filters for each unit.
3. Spare Cooling Components: Furnish three spare compressors, evaporator coils and condenser coil fans for each unit size and voltage listed in the capacity schedule.
4. Spare Fan Assemblies: Furnish three spare supply and condenser/exhaust fan assemblies for each unit size listed in the capacity schedule.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 CONCEALED WATER-SOURCE HEAT PUMPS, 6 TONS AND SMALLER

A. Manufacturers:
   1. Carrier; a United Technologies Company.
   2. ClimateMaster, Inc.
   3. Daikin Applied; a member of Daikin Industries, Ltd.
   4. FHP Manufacturing; Bosch Thermotechnology.
   5. Nortek Global HVAC; Mammoth Inc.
   6. Trane; a Trane Technologies Brand.
   7. WaterFurnace International, Inc.

B. Description: Packaged water-source heat pump; factory assembled, tested, and rated according to ASHRAE/AHRI/ISO-13256-1.

C. Cabinet and Chassis: Galvanized-steel casing with the following features:
   1. Access panel for access and maintenance of internal components.
   2. Knockouts for electrical and piping connections.
   3. Flanged duct connections.
   4. Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181.
   5. Units field convertible for various discharge configurations.
   6. Condensate Drainage: High-density polyethylene plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet.
      a. Condensate Overflow Protection Switch: Solid state electronic; mechanical float switch not permitted.
   7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
   8. Sound Attenuation Package:
      a. Minimum 0.598-inch- thick compressor enclosure and front panel. Minimum 0.0937-inch-thick foam gasket around the compressor and perimeter of end panel.
      b. Sound attenuating blanket over compressor.
      c. Hot-gas muffler.

D. Fan: Direct driven, centrifugal, with multispeed motor resiliently mounted in fan inlet.
   1. General requirements for motors are specified in Division 20 Section "Motors."
   2. Motor: Multispeed, permanently lubricated, ECM motor.

E. Water Circuit:
   1. Refrigerant-to-Water Heat Exchangers:
      a. Coaxial heat exchangers with copper or cupronickel water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.
   2. Water Regulating Valves: Limit water flow through refrigerant-to-water heat exchanger, and control head pressure on compressor during cooling and heating. Valves shall close when heat-pump compressor is not running.
   3. Motorized Water Valve: Stop water flow through the unit when compressor is off and modulate for head pressure control.

F. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.

G. Refrigerant Circuit Components:
   1. Sealed Refrigerant Circuit: Charge with R-407C or R-410A refrigerant.
   2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.
   3. Charging Connections: Service fittings on suction and liquid for charging and testing.

4. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.
5. Compressor: Hermetic scroll compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties as follows:
    a. Antirecycle timer.
    b. High-pressure cutout.
    c. Low-pressure cutout or loss of charge switch.
    d. Internal thermal-overload protection.
    e. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F.
    f. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.
6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.
7. Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes according to ASTM E 84.
8. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 25 to 125 deg F.
9. Hot-Gas Reheat Valve: Pilot-operated sliding-type valve with replaceable magnetic coil.

H. Control equipment is specified in Division 23 Section "Temperature Controls."

I. Sequence of operation is indicated on the Drawings.

J. Controls:
1. Basic Unit Controls:
    a. Low- and high-voltage protection.
    b. Overcurrent protection for compressor and fan motor.
    c. Random time delay, three to ten seconds, start on power up.
    d. Time delay override for servicing.
    e. Control voltage transformer.
2. Thermostat:
    a. Wall-Mounted Thermostat:
        1) Heat-cool-off switch.
        2) Fan on-auto switch.
        3) Automatic changeover.
        4) Exposed temperature set point.
        5) Exposed temperature indication.
        6) Deg F indication.
    b. Unoccupied period override push button.
    c. LED to indicate fault condition at heat pump.
    d. Data entry and access port.
        1) Input data include room temperature and humidity set points for occupied and unoccupied periods.
        2) Output data include room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.
3. BAS interface requirements as further described in Division 23 Section "Temperature Controls."
    a. Interface relay for scheduled operation.
    b. Interface relay to provide indication of fault at central workstation.
    c. Provide BACnet interface for central BAS workstation for the following functions:
        1) Set-point adjustment for set points identified in this Section.
        2) Start/stop and operating status of heat-pump unit.
        3) Data inquiry to include supply air, room air temperature and humidity, and entering-water temperature.
        4) Occupied and unoccupied schedules.

K. Electrical Connection: Single electrical connection with fused disconnect.
   1. Power Factor Correction: Unit power factor of 0.90 or better at single point of connection.
L. Capacities and Characteristics: Refer to Schedule on Drawings.

2.03 HOSE KIT ASSEMBLIES

A. Supply and return hoses having ball valve with pressure temperature port.
B. Supply hose having ball valve with pressure temperature port; return hose having automatic flow regulator valve with pressure temperature ports, and ball valve.
C. Supply hose having "Y" strainer with blowdown valve, and ball valve with pressure temperature port; return hose having automatic flow regulator with PT ports, and ball valve.
D. Supply hose having "Y" strainer with blowdown valve, and ball valve with pressure temperature port.
E. Return hose having ball valve with pressure temperature port.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.
B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Concrete Bases: Install floor mounting units on 4-inch- high concrete bases. See Division 20 Section "Basic Mechanical Materials and Methods" for concrete base materials and fabrication requirements.
B. Suspend water-source heat pumps from structure with threaded steel rods.
   1. Vibration isolators are specified in Division 20 Section "Mechanical Vibration Controls."]
C. Install wall-mounting thermostats, humidistats, and switch controls in electrical outlet boxes at heights to match lighting controls or as required in Division 23 Section "Temperature Controls."

3.03 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
   1. Connect supply and return hydronic piping to heat pump with hose kits.
   2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:
   1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Division 23 Section "Duct Accessories."
   2. Install ducts to termination in roof curb.
   3. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   4. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2-inch- thick, acoustic duct liner.
C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.
D. Install piping adjacent to machine to allow service and maintenance.
E. Ground equipment according to Division 26 Section "Grounding and Bonding."
F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Heat pumps will be considered defective if they do not pass tests and inspections.

C. Remove and replace malfunctioning units and retest as specified above.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Adjust vibration isolators.
9. Inspect operation of barometric dampers.
10. Verify bearing lubrication on fan.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Adjust fan belts to proper alignment and tension.
13. Start unit according to manufacturer's written instructions.
14. Complete startup sheets and attach copy with Contractor's startup report.
15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Verify thermostat and humidistat calibration.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. Start refrigeration system and measure and record the following:
    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

3.06 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.07 CLEANING

A. Replace filters used during construction prior to air balance or substantial completion.

B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps.

END OF SECTION 23 8146

SECTION 23 8241 - PROPELLER FAN UNIT HEATERS – ELECTRIC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 SUMMARY

A. This Section includes propeller fan unit heaters with electric-resistance coils.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Submit the following for each unit type and configuration:

1. Plans, elevations, sections, and details.
2. Details of anchorages and attachments to structure and to supported equipment.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Coordination Drawings: Plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Other items, including the following:
   a. Lighting fixtures.

b. Sprinklers.
c. Ductwork.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.
B. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Electric Unit Heaters:
a. Berko Electric Heating; a division of Marley Engineered Products.
b. Brasch Manufacturing Company, Inc.
c. Chromalox Advanced Thermal Technologies; Spirax-Sarco Engineering plc.
d. Indeeco Heating Solutions; ASPEQ Heating Group.
e. Markel Products; a division of TPI Corporation.
f. Sterling Radiator; a Mestek Company.
g. Trane Inc.; a Trane Technologies Brand.

2.02 UNIT HEATERS

A. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
B. Comply with UL 2021.
C. Comply with UL 823.

2.03 CASING

A. Cabinet: Removable panels for maintenance access to controls.
B. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
C. Discharge Louver: Four-way adjustable louvers for horizontal units and adjustable pattern diffuser for projection units.

2.04 COILS

A. Test and rate propeller unit-heater coils according to ASHRAE 33.

2.05 ELECTRIC-RESISTANCE HEATING ELEMENTS

A. Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.06 FAN

A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.07 FAN MOTORS

A. Comply with requirements in Division 20 Section "Motors."
B. Motor Type: Permanently lubricated.

2.08 CONTROLS

A. Control Devices:

1. Unit-mounted thermostat.

2.09 CAPACITIES AND CHARACTERISTICS

A. Refer to Schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before propeller unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install propeller unit heaters level and plumb.

B. Install propeller unit heaters to comply with NFPA 90A.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers.

1. Hanger rods and attachments to structure are specified in Division 20 Section "Hangers and Supports."

2. Vibration hangers are specified in Division 20 Section "Mechanical Vibration Controls."

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.

3.03 CONNECTIONS

A. Comply with safety requirements in UL 1995.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing and report results in writing:

1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safeties.

B. Remove and replace malfunctioning units and retest as specified above.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller fan unit heaters. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION 23 8241

SECTION 23 8244 - CENTRIFUGAL FAN CABINET UNIT HEATERS (ELECTRIC)

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

1.03 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For cabinet unit heaters to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

1.05 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Unit Heater Filters: Furnish spare filter for each filter installed.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berko Electric Heating; a division of Marley Engineered Products.
2. Brasch Manufacturing Company, Inc.
3. Chromalox Advanced Thermal Technologies; Spirax-Sarco Engineering plc.
4. Daikin Applied; a member of Daikin Industries, Ltd.
5. Indeeco Heating Solutions; ASPEQ Heating Group.
6. Markel Products; a division of TPI Corporation.

7. QMark Electric Heating; a division of Marley Engineered Products.

B. Description: A factory-assembled and -tested unit complying with AHRI 440.
   1. Comply with UL 2021.

C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall have erosion-resistant coating to prevent erosion of glass fibers.
   1. Thickness: Minimum 1/2 inch.
   2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
   3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
   5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
   1. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
   2. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
   3. Recessing Flanges for Units That Are Semirecessed or Fully Recessed: Steel, finished to match cabinet.
   4. Control Access Door: Key operated.
   5. Base for Surface, Vertical, Wall-Mounting Units: Minimum 0.0528-inch- thick steel, finished to match cabinet, 6 inches high with leveling bolts.

E. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Glass Fiber Treated with Adhesive: Throw-away type 80 percent arrestance and 5 MERV.

F. Electric-Resistance Heating Coil: Non-glowing type. Steel fins brazed to high temperature resistance wire enclosed in incoloy sheath; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

G. Fan and Motor Board: Removable.
   1. Fan: Forward curved, double-width centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
   2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 20 Section "Motors."
   3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

H. Electrical Connection: Factory wire motors and controls for a single field connection.

I. Capacities and Characteristics: Refer to Schedule on Drawings.

2.02 UNIT CONTROLS

A. Control devices are specified in Division 23 Section "Temperature Controls," and operational sequences are indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before cabinet unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install cabinet unit heaters to comply with NFPA 90A.

B. Suspend cabinet unit heaters from structure with elastomeric hangers.
   1. Vibration isolators are specified in Division 20 Section "Mechanical Vibration Controls."

C. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.03 CONNECTIONS

A. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Duct Accessories."
B. Comply with safety requirements in UL 1995.
C. Ground equipment according to Division 26 Section "Grounding and Bonding."
D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:
    1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
    2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
    3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
C. Remove and replace malfunctioning units and retest as specified above.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 23 8244

SECTION 26 0010 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.02 SUMMARY

A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.03 REFERENCES

A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. ANSI - American National Standards Institute; www.ansi.org.
2. ASTM - ASTM International; www.astm.org.
3. CSI - Construction Specifications Institute (The); www.csiresources.org.

4. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
6. NEC - National Electrical Code
7. NECA - National Electrical Contractors Association; www.necanet.org.
   a. NECA 1-2000, "Practices for Good Workmanship in Electrical Contracting (ANSI)."
8. NEMA - National Electrical Manufacturers Association; www.nema.org.
9. NETA - InterNational Electrical Testing Association; www.netaworld.org.
10. UL - Underwriters Laboratories Inc.; www.ul.com.

1.04 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test, and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
   1. Contract Documents are complementary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
   2. The Contractor understands that the work herein described shall be complete in every detail.
B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State, and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
   1. Notify the Architect/Engineer if revisions to the Drawings or Specifications are required to conform to applicable ordinances, codes, or regulations. Identify the cost associated with these revisions in the bid.
C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.
D. Tests and Inspections: Perform all tests required by state, city, county, and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
F. Sequence and Schedule: Avoid interference with the work of other trades. Remove and relocate any work which in the opinion of the Owner's Representatives causes interference.

1.05 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals, and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules, and regulations.
B. Comply with rules of local utility companies. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets, and meters which will be required and include the cost of all such items and all utilities costs in proposal.
C. All work shall be executed in accordance with the rules and regulations outlined in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction that exceed code requirements, the Drawings and/or Specifications shall govern.

1.06 DRAWINGS

A. The Drawings show the location and general arrangement of equipment, electrical systems, and related items. They shall be followed as closely as elements of the construction will permit.
B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes, and accessories as may be required to meet such conditions.
C. Deviations from the Drawings, apart from minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades, and electrical Drawings in

all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.07 MATERIAL AND EQUIPMENT MANUFACTURERS

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new, be standard products of manufacturers regularly engaged in the production of electrical equipment and be of the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

C. Where existing equipment is modified to include new switches, circuit breakers, metering, or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third-party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.08 INSPECTION OF SITE

A. Visit the site, examine, and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.09 ITEMS REQUIRING PRIOR APPROVAL

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information, and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

A. Submit project-specific submittals for review in compliance with Division 1.

B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.

C. If deviations (not substitutions) from the Contract Documents are deemed necessary by the Contractor, the details of such deviations, the reason for the deviation, and the resulting changes shall be included with the submittal for approval.

E. Submit for approval shop drawings for electrical systems or equipment indicated in other sections of electrical specs. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures).

1.11 COORDINATION DRAWINGS

A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.

B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manual shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:

1. Routine maintenance procedures.
2. Trouble-shooting procedures.
3. Contractor's telephone numbers for warranty repair service.
4. Submittals.
5. Recommended spare parts list.
6. Names and telephone numbers of major material suppliers and subcontractors.
7. System schematic drawings on 8-1/2" x 11" sheets.

1.13 RECORD DRAWINGS

A. Submit record drawings in compliance with Division 01.

B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be marked with a contrasting color so the marks are readily apparent.

C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer, and Owner at their request during construction.

1.14 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.

D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 WARRANTY

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship, or failure to follow the contract documents.

B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.

C. File with the Owner all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.17 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions; and to maintain the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 DEMOLITION WORK

A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items related to the existing systems that are being removed such as, but not limited to, electrical equipment, cabinets, devices, lighting fixtures, conduit, fittings, boxes, wiring, and supports. No abandoned components of the electrical systems indicated to be removed shall remain.

1. Where electrically powered equipment is included in the demolition scope of other trades, disconnect electrical wiring connections and remove circuit wiring complete.

B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.

C. Unless specifically noted otherwise, removed materials shall not be reused in the work.

1. Materials indicated to be salvaged shall be carefully removed, stored, and protected from damage.
2. Salvaged materials intended to be re-used shall be thoroughly cleaned, refurbished if necessary, and determined to be fully functional prior to placing back into service.

3. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items that the Owner has waived ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

D. Where equipment or fixtures are removed, outlet boxes that remain recessed in walls shall be properly blanked off, and conduits capped. After alterations are complete, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical systems remaining in service shall not be changed unless specifically indicated as part of the project scope.

E. Reroute signal wires, lighting, and power wiring as required to maintain services that are to remain and/or unaffected by the renovations. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or the panels.

F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.

G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where specifically indicated on the drawings or approved by the Architect/Engineer.

H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, re-lamped, and reconditioned suitable for satisfactory operation and appearance.

3.03 INSTALLATION OF EQUIPMENT

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.

B. Device Location:

1. Allow for wiring devices, control devices, and fire alarm devices to be relocated within a 10’ radius to accommodate final coordination with furnishings and other finish elements. Devices relocated prior to installation shall be done without additional cost to the project.

3.04 TEMPORARY SERVICES

A. Provide and remove upon completion of the project, following the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.

3.05 CHASES AND RECESSES

A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.06 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

A. Refer to General Conditions for requirements..

B. All cutting, patching, and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.07 EXCAVATION AND BACKFILLING

A. Provide all excavation, trenching, tunneling, dewatering, and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.

B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.

C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

D. Backfill all excavations inside building, under drives, and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen excavated material in such a way as to prevent settling.

3.08 EQUIPMENT CONNECTIONS

A. Make connections to equipment and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.09 CLEANING

A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.

B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.10 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Equipment and materials shall be protected from theft, injury, or damage.

B. Protect conduit openings with temporary plugs or caps.

C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.11 EXTRA WORK

A. For additional electrical work which may be proposed or requested, furnish an itemized cost breakdown of material and labor required to complete the work. Proceed only after receiving a written authorization.

B. Before providing an itemized break-down for additional electrical work, submit unit prices for the following items: 1/2", 3/4", 1", 1-1/2" EMT conduit; #12, #10, #8, #6, #2 building wire; duplex receptacles, GFCI receptacles, data box and raceway, fire alarm audible/visual notification appliance and visual notification appliance, clocks and speakers, and other common electrical work which may be anticipated for any future revisions. These unit costs, once agreed to, shall be applied to additions and deducts for all project change orders.

3.12 DRAWINGS AND MEASUREMENTS

A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor’s responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION 26 0010

SECTION 26 0519 - CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:
   1. Building wires and cables rated 600V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:
   1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
   2. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.03 SUBMITTALS

A. Field Quality-Control Test Reports

B. Submit letter of compliance (intent) for general building wire and cable. Provide product data for the following:
   1. Metal-Clad Cable, Type MC
   2. Photovoltaic Cable, Type PV
   3. 2- Hour Fire Rated Mc Power Cable
   4. Power Cable for Variable Frequency Controlled Motors

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:

1. Type THHN/THWN-2: Comply with UL 83.
2. Type THW/THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
3. Type XHHW-2: Comply with UL 44.

2.02 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

1. Allowed only for conductors used in feeders 100A and larger.

B. Manufacturers:

1. General Cable
2. Southwire

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.

E. Conductor Insulation:

1. Type XHHW-2: Comply with UL 44.

2.03 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers:

1. AFC Cable Systems
2. Alpha Wire Company
3. American Bare Conductor
4. Belden
5. Encore
6. General Cable
7. Okonite
8. Service Wire Co.
9. Southwire Company

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multi-circuit with color-coded conductors for branch circuit distribution.

2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors:
1. Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
2. Aluminum, complying with ASTM B 800 and ASTM B 801 for conductors #1 AWG and larger.

F. Ground Conductor: Insulated. Ground conductor sized as indicated on drawings (reduced ground conductor is not acceptable).

G. Conductor Insulation:
1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Steel OR Aluminum, interlocked.

2.04 PHOTOVOLTAIC CABLE, TYPE PV

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600V.

B. Manufacturers:
1. Encore
2. General Cable
3. Service Wire Co,
4. Southwire Company

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation: Comply with UL 44 and UL 4703.

2.05 2-HOUR FIRE RATED MINERAL INSULATED CABLE, TYPE MI

A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V.

B. Manufacturers:
1. KME America
2. Pentair
3. Watlow Electric Manufacturing

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. UL 2196 for fire resistance.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:
1. Single circuit and multi-circuit with color-coded conductors.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper.

F. Insulation: Compressed magnesium oxide.

G. Sheath: Copper.

2.06 2-HOUR FIRE RATED RHW-2, 600 VOLT

A. Description: RHW-2 cable listed by UL as a 2-hour fire rated when installed in accordance with installation procedures complying with the product listing.

B. Manufacturers:
1. Prysmian Group/Draka – Lifeline.

C. Standards:

1. Listed and labeled as defined in NFPA 70 Article 728.4, by UL, and marked for intended location and use.
2. UL 44 listed for NEC compliance.
3. UL 2196 listed for fire resistance.
4. Electrical Circuit Integrity Systems (FHIT) – System No. 25B or System No. 25C, of the UL Fire Resistance Directory.
5. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide", and NFPA 70, Article 728.120.

D. Conductors: Annealed Copper, Class B strand complying with ASTM B-3 and B-8.
E. Insulation: Thermoset, low smoke zero halogen ceramifiable silicone rubber.
F. Jacket: Low smoke, zero halogen, cross-linked polyolefin.

2.07 2-HOUR FIRE RATED MC POWER CABLE

A. Description: MC Power cable listed by UL as a 2 hour Fire Rated when installed in accordance with installation procedures complying with the product listing.
B. Manufacturers:
1. OMNI Cable – Vita Link
2. Prysmian GroupDraka – Lifeline MC.
C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. UL 1569
3. UL 2196 for fire resistance.
4. Electrical Circuit Integrity Systems (FHIT) – System No. 120 or System No. 50, of the UL Fire Resistance Directory
5. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide," and NFPA 70, Article 728.120 and Article 310.120.
D. Conductors: Annealed Copper, Class B strand complying with ASTM B-3 and B-8.
E. Insulation: Thermoset, low smoke zero halogen silicone rubber.
F. Armor: Continuously welded and corrugated copper exceeding the NEC requirement for equipment grounding conductor
G. Outer Jacket (if required): Black low smoke zero halogen polyolefin.

2.08 POWER CABLE FOR VARIABLE FREQUENCY CONTROLLED MOTORS

A. Description: A factory assembly of three conductor cable with three symmetrical ground conductors, a continuous shield, an overall PVC jacket and a product specific connector and termination kit.
B. Manufacturers:
1. Service Wire Co.
C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1277
3. Comply with ICEA S-95-658/NEMA WC 70 for Type TC-ER Power Cable (for VFD application)
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
D. Circuits:
1. Single circuit feeder.
E. Phase Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
F. Ground Conductor: Bare copper.
G. Phase Conductor Insulation: Moisture resistant, flame retardant, cross linked polyethylene (2KV RHW-2) suitable for 90degC conductor temperature operation inf dry, damp and wet locations
H. Shield: Helically applied minimum 5 mils thick bare copper with minimum 50% overlap.
I. Armor: Steel OR Aluminum, interlocked.
J. Jacket: Oil resistant PVC

K. Connector: Water-tight and UL listed for installation on supplied TC cable (tray cable) assembly.
   1. Body material: nickel clad aluminum
   2. Connector shall provide a 360-degree electrical bonding of the copper tape shield to the connector body.
   3. Connection of the copper tape shield to the connector body shall be accomplished by an integral and self-retaining grounding collar that automatically provides a 360-degree connection as the connector is tightened.
   4. The connector assembly shall be designed to ensure against loosening of threads due to vibration.
   5. A UL listed chrome plated grounding and bonding locknut with a 360-degree knurled teeth connection shall be provided with each connector to secure and bond the connector to the inverter cabinet / motor termination box.
   6. Tinned copper braids (minimum ¾ inches wide) with installation hardware to connect the copper tape shield to the inverter enclosure / back-panel and to the motor frame shall be provided as part of the cable system.

L. Termination Kit: Tinned copper braids (minimum ¾ inches wide) with installation hardware to connect the copper tape shield to cable core, to the inverter enclosure/back-panel, and to the motor frame shall be provided as part of the cable system.
   1. Braid width shall be determined by cable core diameter size and shall be placed at a separation of 180 degrees.

2.09 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Refer to application schedule on the drawings
B. If providing aluminum feeders, contractor is responsible for providing correct feeder, equipment ground and conduit size based on voltage drop and any de-rating required.
C. Feeders and Branch Circuits: Solid or stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
D. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).
E. Use conductor not smaller than 14 AWG for control circuits,
F. Where equipment is listed for use with copper conductors only, use copper conductors for the entire length of feeder.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Refer to application schedule on the drawings
B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.
C. Fire Alarm Circuits: Type THHN/THWN-2, in raceway.
D. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.
E. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.
F. Connection between Variable Frequency Controllers and Motors: Use power cable for variable frequency-controlled motors. Install and terminate according to cable manufacturer’s recommendations.
G. Isolated Power System Circuits: Use Type XLP in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.
H. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
I. Neatly train and lace wiring inside boxes, equipment, and panelboards.
J. Provide a separate neutral conductor for each circuit unless multi-wire branch circuits are specifically indicated on the drawings.
K. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable. Neutral conductors shall be considered current carrying conductors.
L. Type MC cable shall be supported and secured at intervals not exceeding 4'-0" in new construction
M. AC/MC cable shall not be used for home runs to receptacle or distribution panels.
N. Where AC/MC cable is permitted by the specifications, AC/MC cable shall not be bundled.
O. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.
P. Do not route conductors across roof without prior approval from engineer.
Q. Install and terminate power cable for variable frequency- controlled motors according to cable manufacturer’s recommendations.
R. Install fire resistive cable assemblies (Type MI cable and/or fire rated MC cable) in accordance with the manufacturer’s instructions and the product UL listing.
    1. Do not paint fire resistive cable assemblies.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
    1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
    2. Use compression type terminations for aluminum conductors.
C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
D. Clean conductor surfaces before installing lugs and connectors.
E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
G. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.
H. Use insulated spring wire connectors with plastic caps (wire nuts) for copper conductor splices and taps, 10 AWG and smaller. Push-in style connectors are not permitted.
I. Provide lugs suitable for bussing and conductor material used.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260533 "Raceways and Boxes."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping”.

3.08 FIELD QUALITY CONTROL

A. Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”
   1. Description: Test all feeders rated 100 A and above.
   2. Visual and Mechanical Inspection
      a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
      b. Test cable mechanical connections with an infrared survey.
      c. Check cable color-coding against project Specifications and N.E.C. requirements.
   3. Electrical Tests
      a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
      b. Perform continuity test to insure proper cable connection.
   4. Test Values
      a. Minimum insulation resistance values shall be not less than fifty mega-ohms.

B. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 0519

SECTION 26 0526 - GROUNDING AND BONDING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements”.
2. Division 26 Section “Conductors and Cables”.

1.03 REFERENCES

A. ASTM B 3: Specification for Soft or Annealed Copper Wire.

B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.

C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.

E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

F. IEEE 142: Grounding of Industrial and Commercial Power Systems.

G. IEEE 837: Qualifying Permanent Connections Used in Substation Grounding.

H. IEEE 1100 – 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.

I. IEEE C2: National Electrical Safety Code.

J. NETA MTS – 2001: Maintenance Testing Specifications.

K. NFPA 70: National Electrical Code.

L. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.

M. NFPA 99: Health Care Facilities.

N. NFPA 780: Lightning Protection Code.

O. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.

P. UL 96: Lightning Protection Components.

Q. UL 467: Grounding and Bonding Equipment.
R. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
S. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.04 SUBMITTALS

A. Product Data: For the following:
   1. Ground rods.
   2. Compression-type connectors.
B. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
C. Field Test Reports: Submit written test reports to include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
   4. Indicate overall system resistance to ground.
   5. Indicate overall Telecommunications system resistance to ground.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 26 “Electrical General Requirements”.
B. Accurately record actual locations of grounding electrodes and connections to building steel.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Refer to specification section “Electrical Testing.”
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   1. Comply with UL 467.
C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
E. Comply with ANSI/TIA/EIA-607 “Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications”.
F. Comply with ANSI/IEEE 1100 -1992 “Powering and Grounding Sensitive Electronic Equipment”.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grounding Conductors and Cables:
      a. Refer to Division 26 Section “Conductors and Cables”.
   2. Grounding Rods:
      a. American Electric-Blackburn.
      b. Apache Grounding/Erico Inc.
      c. Chance/Hubbell.
   3. Mechanical Connectors:
      a. American Electric-Blackburn.
      b. Burndy.
      c. Chance/Hubbell.
   4. Exothermic Connections:
      a. Cadweld.
   5. Compression-type Connectors:
      a. Burndy HyGround
      b. Blackburn EZ Ground.
      c. Panduit.

2.02 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."
B. Material: Aluminum, copper-clad aluminum, and copper.
C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
E. Grounding Electrode Conductors: Stranded cable.
F. Underground Conductors: Bare, stranded, copper unless otherwise indicated.
G. Bare Copper Conductors: Comply with the following:
    1. Solid Conductors: ASTM B 3.
    2. Assembly of Stranded Conductors: ASTM B 8.
    3. Tinned Conductors: ASTM B 33.
H. Copper Bonding Conductors: As follows:
    1. Bonding Conductor: Stranded copper conductor; size per the NEC.
    2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.
    3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.
I. Ground Conductor and Conductor Protector for Wood Poles: As follows:
    1. No. 4 AWG minimum, soft-drawn copper conductor.
    2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.
J. Electrical Grounding Busbar
    1. 24" (min) x 2" x ¼" tin plated, copper busbar with two rows of ¼" x 20 tapped holes 1" on center.
K. Telecommunications Main Grounding Busbar (TMGB)
    1. 48" (min) x 4" x ¼" tin plated, copper busbar with three rows of ¼ x 20 tapped holes 1" on center.
L. Telecommunications Grounding Busbar (TGB)
    1. 12" (min) x 2" x ¼" tin plated, copper busbar with two rows of ¼ x 20 tapped holes 3" on center.
M. Telecommunications Bonding Backbone (TBB)
    1. Minimum No. 2 AWG insulated stranded copper.
N. Telecommunications Bonding Conductors
    1. Minimum No. 6 AWG insulated stranded copper.

2.03 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.
D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
    1. Size: 5/8 in diameter.
    2. Length: 120 inches.

PART 3 EXECUTION

3.01 EQUIPMENT GROUNDING

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
C. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.
D. In raceways, use insulated equipment grounding conductors. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.

1. Where existing branch circuits are using conduit as equipment grounding conductor and are extended, provide grounding bushing on existing conduit and provide new equipment grounding conductor with new branch circuit.

E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.

F. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

G. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

H. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

I. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at the isolated equipment ground bus of the source panelboard unless otherwise indicated.

J. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at the isolated ground bus in the circuit's overcurrent device enclosure unless otherwise indicated.

K. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

L. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

M. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

N. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a separate equipment grounding conductor with supply branch-circuit conductors. Bond pole and foundation reinforcing steel to equipment ground conductor.

O. Verify specific equipment grounding requirements with the manufacturer's recommendations.

3.02 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations

1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A or UL 486B as applicable.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Connections shall be non-reversible. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.03 INSTALLATION

A. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system Grounding electrodes to be interconnected include:
   1. Ground rods.
   2. Metal water service pipe.
   3. Geothermal System

B. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
   1. Verify that final backfill and compaction has been complete before driving ground rods.
   2. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
   3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds or non-reversing compression-type connectors, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.
   1. Aluminum and copper-clad aluminum conductors shall not be used in direct contact with masonry, within 18 inches of the earth, or where subject to corrosive conditions.

D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors or non-reversing compression-type connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

E. Metal Water Service Pipes in direct contact with the earth for 10 feet: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to all metal water service entrances to building including fire protection water service entrance. Connect grounding conductors to metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

H. Bond interior metal piping systems, including any portions of metal piping systems separated by non-metal piping, and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

I. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers to grounding electrodes per NFPA 70.

J. Packaged Engine Generator: Solidly ground the packaged engine generator neutral to the normal power source neutral. Do not ground the generator neutral to a separate grounding electrode.

K. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

L. Grounding Bus:
   1. Install grounding bus in the locations listed below and elsewhere as indicated:
      a. Electrical equipment rooms.
      b. Telephone equipment rooms.
      c. Rooms housing service equipment.
   2. Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.

M. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.

N. Bond together metal building elements not attached to grounded structure; bond to ground.

O. Provide a flexible braid bonding jumper at each set of columns at expansion joints.

3.04 TELECOMMUNICATIONS GROUNDING

A. Telecommunications Grounding System: The telecommunications grounding system shall consist of:
   1. Telecommunications Main Grounding Busbar (TMGB) located in the main telecommunications room near the telecommunications service entrance. Bond to the main building electrical grounding electrode system via a No. 3/0 AWG copper ground conductor.
   2. A Telecommunications Grounding Busbar (TGB) in each telecommunications room, cabinets, etc.
   3. A Telecommunications Bonding Backbone (TBB) tying together the TMGB and each TGB.
   4. Bonding of all equipment racks, raceways, non-current carrying metallic equipment and surge protection devices within the telecommunications room to the TGB's or TMGB using approved bonding conductors. Each piece of equipment shall be bonded individually directly to the ground bus.

B. All bonding connections shall be installed at an accessible location for inspection and maintenance.

C. All telecommunications bonding connections shall be of an approved mechanical type connection. Do not use exothermic welds unless specifically indicated on the Drawings.

D. The physical routing shall, in general, follow the same path as the backbone cable system.

E. Bond each TGB directly to the building steel with a No. 6 AWG conductor.

F. Do not use TGB's as a power system ground connection unless specifically noted on the Drawings.

G. All bonding connectors and conductors shall be UL listed for the purpose intended.

H. TMGB and TGB installation: Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.

I. Individually bond each piece of non-current carrying metallic equipment in the Telecommunications Room to the TGB.

J. Install continuous cable from the TMGB to the furthest TGB. Bond all TGB's to TBB with bare No. 3/0 AWG copper ground conductor and T-tap grounding hardware.

3.05 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
   1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.
   2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
      a. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.

b. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

c. Perform tests, by the fall-of-potential method according to IEEE 81. Instrumentation utilized shall be as defined in Section 12 of IEEE 81 and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that curves flatten in the 62% area of the distance between the item under test and the current electrode.

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
   a. Equipment Rated 500 kVA and Less: 10 ohms.
   b. Equipment Rated 500 to 1000 kVA: 5 ohms.
   c. Equipment Rated More Than 1000 kVA: 3 ohms.
   d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
   e. Manhole Grounds: 10 ohms.
   f. The telecommunications grounding system shall have a maximum resistance of 1 ohm as measured from the TMGB ground to earth ground.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.06 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 26 0526

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Allied Tube & Conduit; a part of Atkore International.
    b. B-Line, by Eaton.
    c. GS Metals Corp.
    d. Pentair Electrical & Fastening Solutions.
    e. Thomas & Betts Corporation.
    f. Unistrut; a part of Atkore International.
    g. Wesanco, Inc.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Allied Tube & Conduit; a part of Atkore International.
    b. B-Line by Eaton.
    c. Fabco Plastics Wholesale Limited.
    d. Seasafe, Inc.
2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1) Hilti Inc.
    2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
    3) MKT Fastening, LLC.
    4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) B-Line by Eaton.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.03 ROOF MOUNTED CONDUIT AND EQUIPMENT SUPPORTS

A. General: Shop- or field- fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted conduit and equipment.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. B-Line by Eaton; Dura-Blok.
    2. MIRO Industries.
    3. Pentair Electrical & Fastening Solutions; Caddy Pyramid.
    4. Pipe Pier Support Systems; Pipe Piers.

C. Adjustable Compact Stand: Recycled rubber base unit with integral threaded coupling capable of accepting 3/8-16 threaded rod, or 1-5/8 inch by 1-5/8 inch metal strut and various supporting elements.

D. Multiple-Conduit and Equipment Stand: Assembly of bases, vertical and horizontal members, and conduit supports, for roof installation without membrane penetration.
    1. Bases: One or more adjustable compact stand bases.
    2. Vertical Members: Two or more protective-coated-steel channels.
    3. Horizontal Member: Protective-coated-steel channel.
    4. Supports: Standard strut clamps, hangers, and accessories.

2.04 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry." Plywood sheets shall be free of all voids. Plywood shall have a minimum of two coats of fire-resistant, non-conducting paint applied to all sides of all sheets. Provide flush hardware and supports to mount plywood to wall. The provided hardware shall have sufficient strength to carry all anticipated loads including, but not limited to cabling, cable management and equipment racks.

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70 or as scheduled in NECA 1. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with:
    a. Two-bolt conduit clamps
    b. Single-bolt conduit clamps
    c. Single-bolt conduit clamps using spring friction action for retention in support channel.

D. Support single runs of MC cable using spring-steel clamps from suspended ceiling hangers, hanger wire or building structure at intervals not to exceed three feet. Do not support MC cable from ceiling grid.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel:
    a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
    b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
    c. Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel support systems attached to substrate.

E. Slotted support systems applications:

1. Indoor dry and damp Locations: Painted Steel
2. Outdoors and interior wet locations: Galvanized Steel
3. Corrosive Environments, including pool equipment rooms: Nonmetallic

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

G. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

H. Obtain permission from Architect/Engineer before using powder-actuated anchors.

I. Obtain permission from Architect/Engineer before drilling or cutting structural members.

J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

K. Install surface-mounted cabinets and panelboards with minimum of four anchors.

L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
M. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
N. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 INSTALLATION OF ROOF MOUNTED SUPPORTS

A. Install in accordance with manufacturer's instructions.
B. If gravel top roof, gravel must be removed around and under support.
C. Consult roofing manufacturer for roof membrane compression capacities. If required, a compatible sheet of roofing material (rubber pad) may be required under rooftop support to disperse concentrated loads and add further membrane protection.
D. Utilize properly sized clamps and accessories to suit conduit sizes.
E. Provide vertical steel channel members as required for elevated conduit supports where required for clearances, coordination with other roof mounted systems or derating.

3.05 CONCRETE BASES

A. Provide concrete bases for all floor mounted electrical equipment.
B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.
C. Base/Pad Construction:
    1. Construct per manufacturer's recommendations for particular equipment, including suggested piers and dowel rods.
    2. Interior concrete bases shall have a minimum depth of 4" unless other indicated or recommended by the manufacturer.
    3. Exterior concrete bases shall have a minimum depth of 8" unless other indicated or recommended by the manufacturer.
    4. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.
D. Anchor equipment to base per both supports and equipment manufacturer's instructions.
E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.

3.06 BACKBOARDS

A. A minimum of two walls (or as indicated on drawings) shall be covered with plywood backboards to a minimum 8'-6" above finished floor in all Telecommunication Rooms and similar spaces and as indicated on Drawings.
B. Securely fasten backboard to wall using appropriate hardware and mount at all four corners, minimum. Securely fasten backboard to wall-framing members (studs).
C. Provide adequate backboard space to allow a clean and workable arrangement for telephone and data connections.

3.07 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
    1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 0529

SECTION 26 0533 - RACEWAYS AND BOXES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section, “Underground Ducts and Raceways for Electrical Systems” for exterior duct banks, manholes and underground utility construction.
2. Division 07 Section, “Penetration Firestopping” for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
4. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.
E. LFMC: Liquidtight flexible metal conduit.
F. LFNC: Liquidtight flexible nonmetallic conduit.
G. RNC: Rigid nonmetallic conduit.
H. PVC: Polyvinyl Chloride.
I. HDPE: High Density Polyethylene.
J. RTRC: Reinforced Thermosetting Resin Conduit

1.04 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
   1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

1.06 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Allied Tube Triangle Century.
   4. Anamet Electrical, Inc.; Anaconda Metal Hose.
   5. International Metal Hose.
   6. Electri-Flex Co
   7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
   8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.
   9. Maverick.
   10. O-Z Gedney; unit of General Signal.
   11. Wheatland.
B. Rigid Steel Conduit: ANSI C80.1.
C. Aluminum Rigid Conduit: ANSI C80.5.
D. IMC: ANSI C80.6.
E. PVC-Coated Steel Conduit: PVC-coated IMC.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch, minimum.
F. EMT: ANSI C80.3.
G. FMC: Zinc-coated steel or Aluminum.
H. LFMC: Flexible steel conduit with PVC jacket.
I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
   2. Fittings for EMT: Steel, compression type.
   3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

2.02 FIRE ALARM EMT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allied Tube Triangle Century.
B. EMT conduit with bright red topcoat; Fire Alarm EMT.
C. EMT and Fittings: ANSI C80.3.

2.03 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American International.
   2. Anamet Electrical, Inc.; Anaconda Metal Hose.
   3. Arnco Corp.
   4. Cantex Inc.
   5. Certainteed Corp.; Pipe and Plastics Group.
   6. Condux International.
   7. ElecSys, Inc.
   8. Electri-Flex Co.
   9. Integral.
   10. Kor-Kap.
   11. Lamson and Sessions: Carlon Electrical Products.
   12. Manhattan/CDT/Cole-Flex.
   13. RACO; Division of Hubbell, Inc.
   14. Scepter.
   15. Spiralduct, Inc./AFC Cable Systems, Inc.
   16. Thomas & Betts Corporation.
B. ENT: NEMA TC 13.
C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
E. LFNC: UL 1660.
F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.
G. RTRC: Comply with UL 2515A and NEMA TC 14.

2.04 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hoffman.
   2. Square D.
B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.
C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
E. Wireway Covers: Hinged type.
F. Finish: Manufacturer's standard enamel finish.

2.05 NONMETALLIC WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hoffman.
   2. Lamson & Sessions; Carlon Electrical Products.
B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

2.06 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
      b. Thomas & Betts Corporation.
      c. Walker Systems, Inc.; Wiremold Company (The).
      d. Wiremold Company (The); Electrical Sales Division.
      e. Mono-Systems, Inc.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell, Inc.; Wiring Device Division.
      b. Carlon Electric Products.
      c. Panduit Corporation.
      d. Walker Systems, Inc.; Wiremold Company (The).
      e. Wiremold Company (The); Electrical Sales Division.
      f. Mono-Systems, Inc.

C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.07 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2. Shall be used in corrosive areas.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Floor Boxes: Nonmetallic, nonadjustable, round.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.

H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

I. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.08 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with ANSI/SCTE 77.
   1. Color of Frame and Cover: Gray if in paved area, Green if in landscape area.
   2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering, "ELECTRIC", “COMMUNICATIONS” or as indicated for each system service.
   6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
   7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell: Quazite
      b. Armorcast Products Company.
      c. Carson Industries LLC.
      d. CDR Systems Corporation.
      e. NewBasis.
      f. Christy Concrete Products.

2.09 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.10 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.
   3. Metraflex Co.
   4. Pipeline Seal and Insulator, Inc.
B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
   1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   2. Pressure Plates: Plastic. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.11 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.12 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Tests of materials shall be performed by an independent testing agency.
   2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Provide raceways in interior and exterior locations in accordance with the “Raceway Application Matrix” included on the drawings.
B. Boxes and Enclosures, Exterior Aboveground: NEMA 250, Type 3R.
C. Boxes, Enclosures, and Handholes:

1. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
2. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.

D. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
E. Minimum Raceway Size: 3/4-inch trade size.
F. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
3. EMT: Use compression, cast-metal fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

G. Do not install aluminum conduits in contact with concrete.
H. Install surface raceways only where indicated on Drawings.
I. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F .

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
C. Complete raceway installation before starting conductor installation.
D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
E. Install temporary closures to prevent foreign matter from entering raceways.
F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

J. Support conduit within 12 inches of enclosures to which attached.
K. Raceways Embedded in Slabs:
1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.
2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
4. Space raceways laterally to prevent voids in concrete.
5. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
7. Conduits shall run flat. Do not allow conduits to cross.
8. Change from non-metallic raceway to EMT before turning up out of the concrete and rising above the floor.

L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

U. Provide pull string and 25% spare capacity in every branch circuit conduit.

V. Communications and Signal Cabling Systems Raceways: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
1. Electrical condulet (LB's) are not permitted.
2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
3. Conduits shall contain no continuous sections longer than 150 ft. without a pull point/box.
4. Conduit for fiber cabling shall have a bend radius of at least 10 times the internal diameter.
5. Conduit for copper cabling less than 2" shall have a bend radius of at least 6 times the internal diameter. Conduit for copper cabling 2" and larger shall have a bend radius of at least 10 times the internal diameter.
6. All conduit ends shall have an insulated bushing.

W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

X. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide

expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Y. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

Z. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Provide cover clips to cover space between connecting pieces.

AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

CC. Locate boxes so that cover or plate will not span different building finishes.

DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.

GG. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

HH. Do not route feeders across roof unless approved in writing by Engineer.

II. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
D. Install handholes and boxes with bottom below the frost line, 42” below grade.
E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."
B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
D. Rectangular Sleeve Minimum Metal Thickness:
    1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
    2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
F. Cut sleeves to length for mounting flush with both surfaces of walls.
G. Extend sleeves installed in floors 2 inches above finished floor level.
H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."
L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.
B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Through-Penetration Firestop Systems."

3.08 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.09 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 0533

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Identification for raceway and metal-clad cable.
   2. Identification for conductors and communication and control cable.
   3. Underground-line warning tape.
   4. Warning labels and signs.
   5. Instruction signs.
   6. Equipment identification labels.
   7. Miscellaneous identification products.

1.03 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.
B. Comply with NFPA 70.
C. Comply with 29 CFR 1910.145.

1.04 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
C. Coordinate installation of identifying devices with location of access panels and doors.
D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
B. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.
2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.03 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.04 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.05 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.06 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch.

B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.07 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb, minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.01 APPLICATION

A. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with self-adhesive vinyl labels. Repeat legend at 10-foot maximum intervals.

B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders More Than 400 A: Identify with orange self-adhesive vinyl label.

C. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
   1. Fire Alarm System: Red.
   2. Security System: Blue and yellow.
   3. Telecommunication System: Green and yellow.
   4. Control Wiring: Green and red.

D. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

E. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.

F. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.

G. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.
   2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

K. Instruction Signs:
   1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
   2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.

b. Outdoor Equipment: Stenciled.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled: If included on project. All items may not be on project.
   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Transformers.
   e. Electrical substations.
   f. Emergency system boxes and enclosures.
   g. Motor-control centers.
   h. Disconnect switches.
   i. Enclosed circuit breakers.
   j. Motor starters.
   k. Push-button stations.
   l. Power transfer equipment.
   m. Contactors.
   n. Remote-controlled switches, dimmer modules, and control devices.
   o. Battery inverter units.
   p. Battery racks.
   q. Power-generating units.
   r. Voice and data cable terminal equipment.
   s. Intercommunication and call system master and staff stations.
   t. Television/audio components, racks, and controls.
   u. Fire-alarm control panel and annunciators.
   v. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
   w. Monitoring and control equipment.
   x. Uninterruptible power supply equipment.
   y. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
   z. Breakers or switches at distribution panels.

3.02 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location:
   1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
   2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.

C. Apply identification devices to surfaces after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
   1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
   2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Grounded Conductor (Neutral): White.

3. Colors for 480/277-V Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Ground Conductor (Neutral): Grey.
4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

I. Label information arrangement for 3 lines of text.
1. Line one shall describe the panel or equipment. Line one example: “DP-XX,” RP-XX,” “T-XX,” “EF-XX,” etc.
2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: “Fed from DP-XX,” “Fed from RP-XX,” etc.
3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: “First Floor Elect. Rm #XXX.”
4. Line four shall include “Via T-XX” when panel or equipment is fed from a transformer.

J. Examples:

RP-1A FED FROM DP-1A ELECTRICAL ROOM A100 VIA T-1A	EF-1 FED FROM MCC-1A MECHANICAL ROOM F101	LP-1A LOCATED IN ELECTRICAL ROOM A100

K. Fusible Enclosed Switches and Distribution Equipment: Install self-adhesive vinyl label indicating fuse rating and type on the outside of door on each fused switch.

L. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

M. Degrease and clean surface to receive nameplates.

N. Install nameplate and labels parallel to equipment lines.

O. Secure nameplate to equipment front using screws.

P. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

Q. Identify conduit using field painting where required.

R. Paint red colored band on each fire alarm conduit and junction box.

S. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION 26 0553

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following lighting control devices:
   1. Time controllers.
   2. Outdoor and indoor photoelectric control.
   3. Occupancy sensors.
   4. Outdoor motion sensors.
   5. Wall digital time switches.

B. Related Sections include the following:
   1. Division 26 Section “Electrical General Requirements”.
   2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.
   3. Division 26 Section "Lighting Control Systems" for programmable lighting systems.

1.03 REFERENCES

A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.

B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.

C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.

D. NFPA 70: National Electrical Code.

E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

F. UL 486B: Wire Connectors for Use with Aluminum Conductors.
G. UL 773: Plug-in, Locking Photocontrols for Use with Area Lighting.
H. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.
I. UL 917: Clock Operated Switches.
J. UL 1449: Surge Protective Devices.
K. UL 1598: Luminaires.
L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.04 DEFINITIONS

A. LED: Light-emitting diode.
B. PIR: Passive infrared.
C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.
D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.
E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated including physical data and electrical performance.
B. Shop Drawings: Show installation details for occupancy and light-level sensors.
   1. Lighting plan showing location, orientation, and coverage area of each sensor.
   2. Interconnection diagrams showing field-installed wiring.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:
   1. Description of operation and servicing procedures.
   2. List of major components.
   3. Recommended spare parts.
   4. Programming instructions and system operation procedures.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.07 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
B. Coordinate interface of lighting control devices with temperature controls specified in Division 23.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Division 26 Section “Electrical General Requirements”.
B. Store and protect products under provisions of Division 26 Section “Electrical General Requirements”.

PART 2 PRODUCTS

2.01 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.02 TIME CONTROLLERS

A. Manufacturers:
   1. Intermatic, Inc.
   2. TORK.
B. General
   1. Provide NEMA Type 1-general purpose steel enclosure with corrosion-resistant primer and baked enamel finish in manufacturer’s standard color.
   2. Provide enclosure suitable for surface mounting with hinged front; padlock hasp; and side, bottom, and back knockouts for conduit connections.
   3. Provide heavy-duty pressure terminals suitable for wire sizes up to no. 8 AWG.

C. Digital Time Controller: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.
   1. Contact Configuration: SPDT.
   2. Contact Rating Normally Open: (20-A inductive or resistive, 120-277-V ac, 20-A ballast load, 120-277 V ac.) (10-A inductive or resistive, 120-277-V ac, 10-A ballast load, 120 277 V ac.)
   3. Contact Rating Normally Closed: 10-A inductive or resistive, 120-277-V ac, 10-A ballast load, 120-277 V ac.
   4. Input Voltage:120 volts.
   5. Programs: 1-channels.
      a. For each channel, 7 day or full year load control, minimum 1,000 on/off operations with one-minute programming resolution; minimum 99 holiday event scheduling; automatic adjustment for daylight savings (with disable); automatic leap year compensation; manual override ON and OFF to the next scheduled event; LCD display.
   6. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program.
   7. Astronomical Time: Provide astronomic feature adjustable from 10° to 60° Northern and Southern latitudes with 1-99 minute adjustable offset from sunrise to sunset for All channels.
   8. Battery Backup: Field replaceable lithium battery with minimum 8 year life for schedules and time clock.

D. Electromechanical-Dial Time Controller: Type complying with UL 917.
   1. Contact Configuration: SPST.
   2. Contact Rating: 40 amperes tungsten, 120-277 V ac.
   3. Input Voltage:120 volts.
   4. Program: 24 hour dial, which can perform a minimum of 10 On/Off operations within a 24-hour period. Provide a minimum of 1 hour setting for ON or OFF operations and maximum ON time of 20 hours.
      a. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program.
   5. Program: Astronomical time dial which turns load on at sunset and turns load off at sunrise or can be set per owners direction. Provide dial suitable for Project location.

2.03 OUTDOOR PHOTOELECTRIC CONTROL

A. Manufacturers:
   1. Intermatic, Inc.
   2. Square D.
   3. TORK.

B. General
   1. Provide fully-gasketed, weathertight enclosure constructed of die cast zinc, with one-half inch conduit nipple for mounting purposes, and with positioning lug to permit full 360-degree adjustable orientation of photocell.
   2. Provide hermetically-sealed, one-inch-diameter, cadmium sulphide photoelectric cell with manual, light level selector.
   3. Provide photoelectric control suitable for an operating temperature range of minus 40 degrees F to plus 140 degrees F.

C. Description: Solid state, with dry contacts rated for 1800 VA load, to operate connected load, relay, contactor coils, or microprocessor input, and complying with UL 773A.
   1. Light-Level Monitoring Range: Adjustable turn-on range of 1 to 5 footcandle and adjustable turn-off range of 3 to 15 footcandle, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
   2. Time Delay: Adjustable delay up to two minutes to prevent false operation.
   3. Contacts: Normally closed, fail on.
   4. Electrical: Provide photocell with operating voltage rated to switch the load directly unless otherwise indicated.
   5. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.

6. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.
7. Provide hermatically-sealed, one inch diameter, cadmium sulphide photoelectric cell with manual, 2 to 50 footcandle, light level selector.

2.04 INDOOR PHOTOELECTRIC CONTROL

A. Manufacturers:
1. Wattstopper LS-101.
2. Sensorswitch CM-PC.

B. Photoelectric Sensor: Solid-state, light-level sensor unit utilizing an internal photoconductive cell to detect changes in lighting levels and capable of controlling any lighting source.
1. Housing: White, thermoplastic, tamper resistant, ceiling mount.
2. Sensor shall operate on 24V DC power through a control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
3. Light-Level Monitoring Range: 10 to 200 footcandle, with an adjustment for turn-on and turn-off levels within that range.
4. Deadband: Adjustable range of 10 to 300%.
5. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
6. Indicator: Two LEDs to indicate the beginning of on and off cycles.
7. Manual override function.
8. Provide indoor photoelectric switches and control units from single manufacturer.
9. Provide indoor photoelectric switches from same manufacturer as occupancy sensors.
10. Provide all control units and relays required to interface with occupancy sensors as required.

C. Indoor Photoelectric Sensor Control Units:
1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
a. Control units shall be provided as required to power indoor photoelectric sensor, control lighting loads and provide a minimum of one auxiliary contact.
b. Sensor control units shall mount external to 4” sq junction box in the ceiling space. Wiring between control unit and photoelectric switch shall be plenum rated.
c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
e. It is acceptable to provide controls and auxiliary contacts as required integral to the sensor, provided all required contacts are provided.
f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

2.05 OCCUPANCY SENSORS

A. General
1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer’s recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
3. Provide occupancy sensors with a bypass switch to override the “ON” function in the event of sensor failure.
4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.

B. Wall Switch Passive Infrared Occupancy Sensor
1. Manufacturers:
a. Perfect Sense – PS-PWS

b. Wattstopper PW-100.
c. Hubbell Building Automation SOM 101.
d. Greengate OSW-P-0451-W.
e. Sensorswitch WSD.
f. Philips LRS2210.
g. Leviton ODS10-IDW.

2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.
   a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
   b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
   c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes. Ambient light sensing shall be adjustable from 20 footcandle to 300 footcandle, with override.
   d. Ambient Light Sensor: Integral ambient light sensor to switch off lights when sufficient daylight is present.
   e. Device Body: finish to be selected by architect, plastic with momentary on/off override pushbutton designed to mount in a standard switch box with “decora” style switch plate.
3. Dual Level Switching: Provide occupancy sensor capable of controlling two switch legs independently where dual level switching is indicated.
   a. Manufacturers:
      1) Perfect Sense PWD.
      2) Wattstopper PW-200.
      3) Hubbell Building Automation SOM-102.
      4) Greengate OSW-P-0451-DMV.
      5) Sensorswitch WSD-2P.
      6) Philips LRS2215.
      7) Leviton ODSOD-IDW.

C. 360° Ceiling Mounted Dual Technology Occupancy Sensor
1. Manufacturers:
   a. Perfect Sense CDS.
   b. Wattstopper DT 300
   c. Hubbell Building Automation “OMNI-DT” Series.
   d. Greengate OMC-DT-2000-R.
   e. Sensorswitch CM-PDT-R.
   f. Philips LRM2255.
   g. Leviton OSC10-M0W.
2. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.
   a. Housing: White, thermoplastic, tamper resistant ceiling mount.
   b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
   c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
   d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
   e. Manual override function.

D. 110° Wall Mounted Dual Technology Occupancy Sensor
1. Manufacturers:
   a. Perfect Sense DTC.
   b. Wattstopper DT-200
   c. Hubbell Building Automation “LO-DT” Series.
   d. Sensorswitch WV-PDT-R/WV-BR.
   e. Philips LRM2265.

f. Leviton OSW12-M0W.

2. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.
   a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
   b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
   c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 15 minutes.
   d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
   e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
   f. Manual override function.

E. 360° Ceiling Mounted Ultrasonic Occupancy Sensors
   1. Manufacturers:
      a. Perfect Sense WDS.
      b. Wattstopper “WT” Series.
      c. Hubbell Building Automation “OMNI-US” Series.
      d. Greengate OPC-U-2000.
      e. Sensorswitch CM MPT-10.
      f. Philips LRM2255.
      g. Leviton OSC20-U0W.
   2. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.
      a. Housing: White, thermoplastic, tamper resistant.
      b. Adjustments: Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 15 minutes.
      c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
      d. Manual override function.

F. 360° Ceiling Mounted Passive Infrared Occupancy Sensor.
   1. Manufacturers:
      a. Perfect Sense CPS.
      b. Wattstopper CI-200.
      c. Hubbell Building Automation OMNI-IR.
      d. Greengate OMC-P-04500-R.
      e. Sensorswitch CM-9.
      f. Philips LRM2250.
      g. Leviton OSC04-I0W.
   2. Description: Ceiling mounted, 360° coverage, infrared sensing occupancy sensor.
      a. Housing: White, thermoplastic, tamper resistant ceiling mount.
      b. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
      c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
      d. Manual override function.

G. Occupancy Sensor Control Units:
   1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
      a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.

b. Occupancy sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.
c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.
f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

2.06 WALL DIGITAL TIME SWITCH

A. Manufacturers:
1. Greengate
2. WattStopper

B. Description: Self contained time control switch programmed to turn lights off after a preset time and designed to fit a standard single gang switch box in a Decora style switch plate with the following features:
1. Ground wire and ground strap.
2. Latching air gap relay switching mechanism.
3. Zero Crossing Circuitry.
4. Backlit Liquid Crystal Display that shows the timer's countdown.
5. 100% OFF override switch with no leakage current to the load.
6. Compatible with all electronic ballasts, motor loads, compact fluorescent and inductive loads.
7. Concealed calibration switches of for programmable features.
8. Capable of operating as an ON/OFF switch.

C. Operating parameters:
1. 100-300 VAC; 50/60 Hz.
2. 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz
3. 0 to 1200 watts fluorescent @ 230/277 VAC, 50/60 Hz
4. 1/6 hp @ 125 VAC.

D. Programmable features:
1. Time-out period adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
2. Manual override of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
3. One second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
4. Beep warning shall sound every five seconds once the time switch countdown reaches one minute.
5. Manual timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.

PART 3 EXECUTION

3.01 LIGHTING CONTACTOR INSTALLATION

A. Install lighting contactors as indicated on plan. Install at accessible locations. Switch controls where provided shall be no higher than 54" or lower than 48".
B. Demonstrate proper operation of all lighting control functions to the Owner and Engineer.

3.02 OUTDOOR PHOTOELECTRIC CONTROL INSTALLATION

A. Mount photocell on roof or parapet to ½" GRS conduit, supported to building structure below. Coordinate roof penetration with roofing contractor.
B. Install photoelectric control oriented in the northeast direction and not within any potential shadows.
C. Adjust photocell sensitivity and delay to meet owner's requirements. Multiple adjustments may be required, as needed.

3.03 TIME CONTROLLER INSTALLATION

A. Install time controller, near contactor control equipment or as indicated on plan. Install at accessible location.

B. Program time controller as directed by the owner. Train owner in time clock programming.

3.04 OCCUPANCY SENSOR INSTALLATION

A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.

B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.

C. Locate sensors such that motion through open doors will not falsely activate sensors.

D. Do not locate ultrasonic sensors within six feet of supply air diffusers.

E. Locate infrared sensors to avoid obstructions.

F. Provide the services of a manufacturer’s representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.

G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

3.05 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Conductors and Cables".

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.06 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."

B. Label time switches and contactors with a unique designation.

3.07 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION 26 0923

SECTION 26 0943 - LIGHTING CONTROL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the design and installation programmable automatic lighting controls with all input and control devices necessary to meet the performance indicated on the contract drawings and this specification

B. Related Sections include the following:

1. Division26 Section "Lighting Control Devices" for time switches, photoelectric switches, occupancy sensors, and multi-pole contactors.
2. Division 26 Section “LED Interior Lighting” for luminaire specifications and accessories.

1.03 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. Lon Works: A control network technology platform for designing and implementing interoperable control devices and networks.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

D. RS-485: A serial network protocol, like RS-232, complying with TIA/EIA-485-A.

1.04 SUBMITTALS

A. Product Data: Indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature for all sensors, relays, dimming modules, control stations and other devices necessary for complete operation of the system

B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
   1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements for all system components requiring field installation.
   2. Riser Diagram: Show interconnection between all system components.
      a. Identify complete data communication backbone and interconnection between sensors, relays, dimming modules control stations and other components.
      b. Identify typical room/area type configurations.
      c. Indicate interconnections with emergency egress lighting relays and transfer devices required.
   3. Information Technology (IT) connection: Provide information pertaining to interconnection with facility IT networking equipment and third-party systems.
   4. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
   5. Contractor startup and commissioning worksheet.

C. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

D. Submit qualifications of commissioning agent and draft functional test plans for review and approval.

E. Field quality-control test reports and commissioning reports at project closeout.

F. Software licenses and upgrades required by and installed for operation and programming of digital devices.

G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals. Include the following:
   1. Software manuals.
   2. Operation of adjustable zone controls.
   3. Description of operation and servicing procedures.
   4. List of major components and recommended parts.
   5. System operation and integration instructions.

H. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer with total responsibility for compatibility of lighting control system components specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with NFPA 70.

E. Listed as qualified under Design Lights Consortium (DLC) Networked Lighting Control System Specification V2.0.

F. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.

G. Comply with ASHRAE 90.1 - 2013

1.06 COORDINATION

A. Coordinate lighting control components specified in this Section and with systems and components specified in other Sections to form an integrated interconnection of compatible components.

B. Match components and interconnections for optimum performance of lighting control functions.

C. Provide open protocol interface for interoperability with building automation system including status of each occupancy/vacancy sensor, control station, dimming module, relay, time schedule, display graphics and status of lighting controls by zone.

D. Coordinate lighting controls with devices specified in Division 26 Section “Lighting Control Devices”.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.08 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for five years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revise licenses for use of the software.

1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

1.09 SYSTEM COMMISSIONING

A. Provide the services of a third party, independent agent to perform functional testing and verification of the lighting control system to comply with the requirements of ASHRAE 90.1 – 2013.

B. Perform functional testing of all lighting control system operations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acuity nLight Air
2. Lutron Vive
3. WaveLinx – Eaton

2.02 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) system backbone for remote, time based and global operation between control zones.
    a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible to minimize overall device count of system.
    b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.”
    c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling is used to interconnect networked luminaires with control components such as sensors, switches and system backbone.
2. The system shall provide individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.

3. Lighting control zones shall be networked with a higher-level system backbone to provide time-based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality later.
5. System shall be capable of "out of box" sequence of operation for each control zone. Standard sequence is:
    a. All switches control all fixtures in a zone
    b. All occupancy sensors automatically control all fixtures in the control zone with a default timeout.

B. Wired Networked Control Zone Characteristics
1. All networked devices connected with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The "out of box" default sequence of operation is intended to provide typical sequence of operation to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
    a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
    b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.
    c. Emergency egress devices shall be provided, and UL labeled by the lighting control manufacturer.

C. System Integration Capabilities
1. The system shall be capable of interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.
    a. Systems utilizing a third-party converter or systems that require a dedicated server to achieve integration are not acceptable.

2.03 SYSTEM SOFTWARE INTERFACES

A. Management Interface
1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface
1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud-based server.

C. Visualization Interfaces
1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones

1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
2. Programming capabilities through the application shall include, but not be limited to, the following:
    a. Switch, occupancy and photo sensor group configuration
    b. Manual/automatic on modes
    c. Turn-on dim level
    d. Occupancy sensor time delays
    e. Dual technology occupancy sensors sensitivity
    f. Photo-sensor calibration adjustment and auto-setpoint
    g. Trim level settings

2.04 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller

1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall perform the following functions:
    a. Facilitation of global network communication between different areas and control zones.
    b. Time-based control of downstream wired network devices.
    c. Linking into an Ethernet network.
    d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
    e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired communication bridges.
5. Device shall have a standard and astronomical internal time clock.
6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
    a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
    b. BACnet/MSTP shall support 9600 to 115200 baud.
    c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
    d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

2.05 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers

1. Wall switches & dimmers shall support the following device options:
    a. Number of control zones: 1, 2 or 4. Gang multiple switches where more than 4 control zones are required in a single location under a single faceplate.
    b. Control Types Supported: On/Off or On/Off/Dimming
2. Scene controllers shall support the following device options:
    a. Number of scenes: 1, 2 or 4
    b. Control Types Supported:
        1) On/Off or On/Off/Dimming
        2) Preset Level Scene Type
        3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
        4) Selecting a lighting profile to be run by the system's upstream controller to implement a selected lighting profile across multiple zones

3. Match color specified in Division 26 Section "Wiring Devices."
4. Integral green LED pilot light to indicate when circuit is on.
5. Internal white LED locator light to illuminate when circuit is off.
6. Networked switch stations shall have backlit buttons.
7. Wall Plates:
    a. Single and multi-gang plates as specified in Division 26 Section "Wiring Devices."
    b. Where multiple switches and/or dimmers are adjacent to each other, install a single cover plate. Provide separate boxes or barriers as required for the application.
    c. Provide cover plates that are identical in material and dimension to standard single and double gang switch plates.
    d. Verify back box requirements for multiple control points with manufacturer.
8. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

B. Wired Networked Graphic Wall Stations
1. Device shall have a full color touch screen.
2. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
3. Graphic wall stations shall support the following device options:
    a. Number of control zones: Minimum of 16
    b. Number of scenes: Minimum of 16
    c. Optional password protection for setup screens.

C. Wired Networked Auxiliary Input / Output (I/O) Devices
1. Auxiliary Input/output Devices shall be specified as an input or output device with the following options:
    a. Contact closure input: Programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
    b. 0-10V analog input: Programmable to function as a daylight sensor.
    c. RS-232/RS-485 digital input: Supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
    d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current programmable to support all standard sequence of operations supported by system.

D. Wired Networked Occupancy and Photosensors
1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.
2. Sensing technologies that are acoustically passive, meaning they do not transmit sounds waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.
3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.
4. Sensor mounting type shall match project design requirements as shown on plans.
    a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
5. The system shall support the following types of photocell-based control:
    a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.
    b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

E. Wired Networked Wall Switch Sensors
   1. Wall switches sensors shall support the following device options:
      a. User Input Control Types Supported: On/Off or On/Off/Dimming
      b. Occupancy Sensing Technology: PIR only or Dual Tech
      c. Daylight Sensing Option: Inhibit Photosensor
F. Wired Networked Embedded Sensors
   1. Embedded sensors shall support the following device options:
      a. Occupancy Sensing technology: PIR only or Dual Tech
      b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor
G. Distributed System Power, Switching and Dimming Controls
   1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
   2. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
   3. Device shall be plenum rated.
   4. Devices shall be UL Listed for load and load type as specified on the plans.
H. Wired Networked Luminaires
   1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
   2. Networked LED luminaire shall provide low voltage power to other networked control devices.
   3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
   4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
   5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.

2.06 CONDUCTORS AND CABLES
A. General: All conductors and cables shall comply with the requirements of Division 26 Section "Conductors and Cables." Where cable is permitted to be installed exposed in ceiling space, provide plenum rated cable.
B. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG.
C. Classes 2 and 3 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 22 AWG.
D. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.
E. Digital and Multiplexed Signal Cables: As required by system manufacturer. Provide plenum rated cables where installed exposed in ceiling space.

PART 3 EXECUTION
3.01 WIRING INSTALLATION
A. The lighting control system shall be installed and connected as shown on the plans and as directed by the manufacturer.
B. Comply with NECA 1.
C. Wiring Method: Install wiring in raceways except where installed in accessible ceilings. Comply with Division 26 Sections "Conductors and Cables" and “Raceways and Boxes”.
D. Where cables are installed in finished areas with exposed construction, conceal cables from view. Route at top of structural systems and conceal on top of structural members where possible. Where cable is exposed to view, provide raceway. As an alternative to raceway, provide cable that is factory colored to match exposed ceiling. Submit sample to Architect for approval.
E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

F. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
G. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
H. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes as per manufacturers' recommendations.
I. Identify components and power and control wiring according to Division26 Section "Electrical Identification."
J. Label each relay with a unique designation.

3.02 INSTALLATION REQUIREMENTS

A. Review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
B. Install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals, plans and specifications.
C. Coordination with Owner's IT Network Infrastructure to secure all required network connections to the owner's IT network infrastructure. Provide the owner's representative with all network infrastructure requirements of the networked lighting control system. Provide the manufacturer's representative with all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.
D. Verify integration and interoperability scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.

3.03 SYSTEM STARTUP

A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.
    1. Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.
B. System start-up and programming shall include:
    1. Verifying operational communication to all system devices.
    2. Programming the network devices into functional control zones to meet the required sequence of operation.
    3. Programming and verifying all sequence of operations.
    4. Customization of owner's software interfaces and applications.
C. Initial start-up and programming are to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.04 DOCUMENTATION

A. Submit software database file with desired device labels and notes completed.
B. Document the installed location of all networked devices, including networked luminaires. Provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components and equipment installation, including connections and assist in field testing. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:
    1. Test for circuit continuity.
    2. Verify that the control module features are operational.
    3. Check operation of local override controls.
    4. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.06 SYSTEM COMMISSIONING

A. Facilitate the functional testing and verification of the lighting control system by an independent, third party commissioning agent.
B. Perform commissioning in the presence of the Owner's representative.

C. Submit functional test plan checklist signed by the commissioning agent.

3.07 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting programming functions and other system parameters and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to program, adjust, operate, and maintain lighting controls.

B. Demonstration shall be done only after initial system start-up setup has occurred and system is functioning properly.

C. Demonstration shall consist of a four-hour minimum session.

3.10 MANUFACTURER SUPPORT

A. Manufacturer telephone support shall be available at no cost to the Owner during the warranty period and shall include the following:

1. Assistance in solving programming or other application issues pertaining to the control equipment.
2. The manufacturer shall provide a toll-free number for direct technical support available 7 days a week, 24 hours a day.
3. A factory authorized technician shall be located within a 100-mile radius of the project site.

END OF SECTION 26 0943

SECTION 26 0999 - ELECTRICAL TESTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements.”
2. Division 26 Section “Conductors and Cables.”
3. Division 26 Section “Medium Voltage Cables.”
4. Division 26 Section “Grounding and Bonding.”
5. Division 26 Section “Electrical Power Monitoring and Control.”
6. Division 26 Section “Packaged Engine Generators.”
7. Division 26 Section “Central Battery Inverters.”
8. Division 26 Section “Medium-Voltage Transformers.”
9. Division 26 Section “Power Factor Correction Capacitors.”
10. Division 26 Section “Medium Voltage Switchgear.”
11. Division 26 Section “Secondary Unit Substation.”
12. Division 26 Section “Enclosed Switches.”
13. Division 26 Section “Transfer Switch.”
14. Division 26 Section “Enclosed Controllers.”
15. Division 26 Section “Surge Protective Devices”
16. Division 26 Section “Switchgear.”
17. Division 26 Section “Switchboards.”
18. Division 26 Section “Panelboards.”
19. Division 26 Section “Motor Control Centers.”
20. Division 26 Section “Dry Type Transformers (600V and Less).”
21. Division 26 Section “Enclosed Bus Assemblies.”
22. Division 26 Section “Fuses.”
23. Division 26 Section “Static Uninterruptible Power Supply.”
24. Division 26 Section “Electrical Systems Commissioning.”

1.02 SECTION INCLUDES

A. Engage the services of a recognized corporately independent N.E.T.A. certified testing firm to perform inspections and tests as specified herein.

B. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

C. It is the intent of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design Specifications.

D. The test and inspections shall determine suitability for energization.

E. Equipment to be tested and inspected shall be the equipment shown on the one line diagram and schedules as required by part three of each individual Specification Section. In addition, all equipment that is part of an emergency distribution system shall be tested.

1.03 REFERENCES

A. All inspections and tests shall be in accordance with the latest version of the following codes and standards except as provided otherwise herein.
   1. National Electrical Manufacturer's Association - NEMA
   2. American Society for Testing and Materials - ASTM
   3. Institute of Electrical and Electronic Engineers - IEEE
   4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-2017
   5. InterNational Electrical Testing Association - NETA Maintenance Testing Specifications-MTS-2015
   6. American National Standards Institute - ANSI C2: National Electrical Safety Code
   7. State and Local Codes and Ordinances
   8. Insulated Cable Engineers Association - ICEA
   9. Association of Edison Illuminating Companies - AEIC
   10. Occupational Safety and Health Administration
   11. National Fire Protection Association - NFPA
      a. ANSI/NFPA 70: National Electrical Code
      b. ANSI/NFPA 70B: Electrical Equipment Maintenance
      c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
      d. ANSI/NFPA 101: Life Safety Code

1.04 QUALIFICATIONS

A. The testing firm shall be a corporately independent testing organization, which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The lead, on site, technical person and at least 50% of the on site crew shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies in Electrical Power Distribution System Testing.

D. The testing firm shall only utilize technicians who are regularly employed by the firm on a full-time basis for testing services.

E. The Contractor shall submit proof of the above qualifications with bid proposal.

F. The terms used herewithin such as Test Agency, Test Contractor, Testing Laboratory, or Contractor Test Company, shall be construed to mean the testing organization.

G. Acceptable Testing Firms:
   1. Northern Electrical Testing; Phone (248) 689-8980.
   2. Utilities Instrumentation Services; Phone (734) 424-1200.
   3. High Voltage Maintenance Corporation; Phone (248) 305-5596.
   4. Powertech Services, Inc.; Phone (810) 720-2280.
   5. Power Plus Engineering, Inc.; Phone (800) 765-3120.
   6. Premier Power Maintenance, Inc.; (517) 230-6629

1.05 PERFORMANCE REQUIREMENTS

A. The Electrical Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the power requirements.

B. The Electrical Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

C. The testing firm shall notify the Owner's Representative prior to commencement of any testing.

D. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported to the Engineer. The Electrical Contractor shall correct all defects.

E. The testing organization shall maintain a written record of all tests and shall assemble and certify a final test report.

F. Safety and Precautions

1. Safety practices shall include, but are not limited to, the following requirements:
    a. Occupational Safety and Health Act.
    b. Accident Prevention Manual for Industrial Operations, National Safety Council.
    c. Applicable state and local safety operating procedures.
    d. NETA Safety/Accident Prevention Program.
    e. Owner's safety practices.
    f. National Fire Protection Association - NFPA 70E.
    g. American National Standards for Personnel Protection.
2. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
3. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

1.06 TEST INSTRUMENT CALIBRATION

A. Test Instrument Calibration
1. The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
3. Instruments shall be calibrated in accordance with the following frequency schedule:
    a. Field instruments: Analog - 6 months maximum Digital - 12 months maximum
    b. Laboratory instruments: 12 months
    c. Leased specialty equipment: 12 months (Where accuracy is guaranteed by Lessor)
4. Dated calibration labels shall be visible on all test equipment.
5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
6. An up-to-date instrument calibration instruction and procedures shall be maintained for each test instrument.
7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

B. Field Test Instrument Standards
1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
    a. Maintained in good visual and mechanical condition.
    b. Maintained in safe, operating condition.

C. Suitability of Test Equipment
1. All test equipment shall be in good mechanical and electrical condition.
2. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multi-meters may be average of RMS sensing and may include or exclude the dc component. When the variable contains harmonics of dc offset and, in general, any deviation from a pure sine wave, average sensing, average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.
3. Field test metering used to check power system meter calibration must have any accuracy higher than that of the instrument being checked.
4. Accuracy of metering in test equipment shall be appropriate for the test being performed.
5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

1.07 TEST REPORTS

A. A test report shall be generated for each piece of major equipment or groups of equipment and shall include the following:
1. A list of visual and mechanical inspections required by Division 26 Specification Sections in a checklist or similar format.
2. Test reports, including test values where applicable, for all required electrical tests. Clearly indicate where test values fall outside of the limits of recommended values.
3. Summary and interpretation of test results detailing problems located and recommended corrective measures.
4. Record of infrared scan and photos showing potential problem locations.

5. Signed and dated by the testing firm field superintendent stating that all required tests have been completed.

B. Test reports shall be furnished to the Architect/Engineer within 14 days of the completion each test on an ongoing basis. Original copies of the reports shall be furnished directly to the Architect/Engineer by the testing company prior to formal submittal via the Contractors.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 THERMOGRAPHIC SURVEY

A. Visual and Mechanical Inspection
   1. Remove all necessary covers prior to scanning.
   2. Inspect for physical, electrical, and mechanical condition.

B. Equipment to be Scanned
   1. All components of the distribution system down to and including branch circuit panelboards and motor control centers. Return 3 months after equipment has been energized and loaded to do a final scan of all equipment.

C. Provide report indicating the following:
   1. Problem area (location of "hot spot").
   2. Temperature rise between "hot spot" and normal or reference area.
   3. Cause of heat rise.
   4. Phase unbalance, if present.
   5. Areas scanned.

D. Test Parameters
   1. Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
   2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
   3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.

E. Test Results
   1. Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:
      a. Temperature gradients of 37°F to 44.6°F indicate possible deficiency and warrant investigation.
      b. Temperature gradients of 44.6°f to 59°F indicate deficiency; repair as time permits.
      c. Temperature gradients of 61°F and above indicate major deficiency; repair immediately.

END OF SECTION 26 0999

SECTION 26 2200 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 750 kVA:
   1. Distribution transformers.
   2. Buck-boost transformers.
   3. Control and signal transformers.

B. Related Section includes the following:
   1. Division 26 Section “Electrical General Requirements.”
   2. Division 26 Section “Grounding and Bonding.”
   3. Division 26 Section “Conductors and Cables.”
   4. Division 26 Section “Raceways and Boxes.”
   5. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 REFERENCES

A. ANSI/IEEE C57.12.9: Test Code for Dry-Type Distribution and Power Transformers
B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
C. NEMA ST 1: Specialty Transformers
D. NEMA ST 20: Dry Type Transformers for General Applications
E. NEMA TP 1: Guide for Determining Energy Efficiency for Distribution Transformers
F. NEMA TP 2: Standard Test Method for Measuring the Energy Consumption of Distribution Transformers
G. NETA ATS: Acceptable Testing Specifications for Electrical Power Distribution Equipment and Systems
H. NFPA 70: National Electrical Code
I. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors
J. UL 486B: Wire Connectors for Use with Aluminum Conductors

K. UL 506: Specialty Transformers
L. UL 1561: Dry-Type General Purpose and Power Transformers

1.04 SUBMITTALS

A. Product Data Include rated nameplate data, capacities, weights, dimensions, utility or manufacturer's anchorage and base recommendations, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
   1. Transformer Inrush: Provide time-current coordination curves demonstrating transformer inrush and ANSI damage curves with primary overcurrent device selections to clear inrush yet still protecting damage curve.
B. Shop Drawings: Wiring and connection diagrams.
C. Qualification Data: Testing agency.
D. Source quality-control test reports. Include loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
E. Output Settings Reports: Record of tap adjustments specified in Part 3.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined in OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Transformer Inrush: Provide time-current coordination curves demonstrating transformer inrush and ANSI damage curves with primary overcurrent device selections to clear inrush yet still protecting damage curve.
   2. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise onsite testing specified in Part 3.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with IEEE C 57.12.91.
D. Comply with NFPA 70.
E. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting doe 2016 efficiency levels when tested according to NEMA TP2.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
B. Store, protect, and handle products to site under provisions of Division 26 section "Electrical General Requirements."
C. Deliver transformers individually wrapped for protection and mounted on shipping skids.
D. Accept transformers on site. Inspect for damage.
E. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
F. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 "Hangers and Supports for Electrical Systems."
B. Coordinate installation of wall-mounting and structure-hanging supports.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme.
2. Cutler-Hammer.
3. GE Electrical Distribution & Control.
4. Siemens Industries, Inc.
5. Square D/Groupe Schneider NA.
6. Sola/Hevi-Duty Electric.

2.02 MATERIALS

A. Cores: Grain-oriented, non-aging silicon steel.
B. Coils: Continuous windings without splices, except for taps.
   1. Internal Coil Connections: Brazed or pressure type.
   2. Coil Material: Aluminum.
C. Vibration Isolation: Isolate core and coil from enclosure using vibration-absorbing mounts.
D. Grounding: Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

2.03 DISTRIBUTION TRANSFORMERS

A. Description: Factory-assembled and tested, air cooled, dry-type transformer rated for 60 Hz operation. Comply with NEMA ST 20, and list and label as complying with UL 1561.
B. Provide transformers with base KVA as indicated without the use of internal cooling fans.
C. Cores: One leg per phase.
D. Indoor Enclosure: Ventilated, NEMA 250, Type 2. Provide lifting eyes or brackets.
E. Indoor Transformer Enclosure Finish: Comply with NEMA 250 for "Indoor Corrosion Protection."
   1. Finish Color: Gray.
F. Outdoor Enclosure: Ventilated, raintight, NEMA 250, Type 3R. Provide lifting eyes or brackets.
G. Enclosure Finish for Indoor Units: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.
H. Enclosure Finish for Outdoor Units: Manufacturer’s standard green finish under surfaces treated with corrosion resistant undercoating.
I. Insulation Class (15 kVA and larger): 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature TP-1 compliant.
J. Insulation Class (less than 15 kVA): 185 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
K. Basic Impulse Level: 10 kV.
L. Taps for Transformers Smaller Than 3 kVA: None.
M. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
N. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
O. Case Temperature: Do not exceed 35 degrees C rise above ambient at warmest point.
P. Mounting: Suitable for mounting as indicated.
Q. Wall Brackets: Manufacturer's standard brackets.
R. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.04 BUCK-BOOST TRANSFORMERS

A. Description: Factory-assembled and tested, self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer and rated for 60 Hz operation. Transformers shall comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.
B. Sound rating: Comply with NEMA ST 20.
C. Insulation class 185 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
D. Enclosure: Totally enclosed, non-ventilated, NEMA 250, Type 3R.
   1. Finish Color: Gray.
E. Mounting: Wall.

F. Wall Brackets: Manufacturer’s standard brackets.
G. Nameplate: Include transformer connection data.

2.05 CONTROL AND SIGNAL TRANSFORMERS

A. Description: Factory-assembled and tested, self-cooled, two-winding dry type, rated for continuous duty, and 60 Hz operation, complying with NEMA ST 1, and listed and labeled as complying with UL 506.
B. Ratings: Continuous duty. If rating is not indicated, provide at least 50 percent spare capacity above connected peak load.

2.06 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.
B. Provide the following factory tests on each unit provided in accordance with NEMA ST 20:
    1. Voltage ratio.
    2. Polarity and phase relation.
    3. No load losses.
    4. Impedance (501 kVA and larger).
    5. Applied and induced potential.
C. Provide the factory tests on the actual transformers provided or on similar units identical to those provided in accordance with NEMA ST 20:
    1. Impedance (less than 501 kVA).
    2. Temperature rise.
    3. Audible sound level.
    4. Full load losses.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
C. Examine walls and floors for suitable mounting conditions where transformers will be installed.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install Products in accordance with manufacturer’s instructions.
B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
    1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
C. Install floor mounted transformers on and anchor to concrete bases according to manufacturer’s recommendations.
    1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
D. Identification: Engraved metal or laminated-plastic nameplate mounted with corrosion resistant screws. Provide nameplate according to Division 26 Section “Electrical Identification” indicating the following:
    1. Transformer designation (e.g. “T-1”).
    2. Primary power characteristics (e.g. “480V, 3PH, 3W”).
    3. Secondary power characteristics (e.g. “208Y/120V, 3PH, 4W”).
    4. Power rating (e.g. “75 kVA”).
    5. Power source (e.g. “Fed from DP-1).

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."
B. Connect wiring according to Division 26 Section "Conductors and Cables."
C. Provide conduit according to Division 26 Section “Raceways and Boxes” for connections to transformer case. Make conduit connections to side panel of enclosure.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
E. Check for damage and tighten connections prior to energizing transformer.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
   1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
B. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing" for transformers 75KVA and above:
   1. Visual and Mechanical Inspection
      a. Inspect for physical damage, cracked insulators, tightness of connections, defective wiring and general mechanical and electrical conditions.
      b. Verify proper core grounding.
      c. Verify proper equipment grounding.
      d. Compare equipment nameplate with single line diagram and report discrepancies.
   2. Electrical Tests
      a. Perform insulation resistance tests, winding-to-winding and windings-to-ground, utilizing a meg-ohmmeter with test voltage output in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Test duration shall be for 10 minutes with resistance values tabulated at 30 seconds, 1 minute, and 10 minutes. Calculate Polarization index.
      b. Perform a turns ratio test between windings at every tap position. The final tap setting is to be set at the secondary system rated voltage at full load or as directed by the Architect/Engineer.
      c. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
   3. Test Values
      a. Perform insulation resistance tests in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Results to be temperature corrected in accordance with Table 10.14.
      b. The polarization index should be above 1.2 unless an extremely high value is obtained initially, such that when doubled will not yield a meaningful value.
      c. Turns ratio test results shall not deviate more than one half percent (0.5%) from either the adjacent coils or the calculated ratio.

3.05 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent. Submit recording and tap settings as test results.
B. Adjust buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
C. Output Settings Report: Prepare a written report that records output voltages and tap settings.

END OF SECTION 26 2200

SECTION 26 2413 - SWITCHBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes service and distribution switchboards rated 600 V and less.

B. Related Sections:

1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.04 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions, utility or manufacturer’s anchorage and base recommendations, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Related Submittals:

1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.

C. Shop Drawings: For each switchboard and related equipment.
   1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of switchboards and overcurrent protective devices.
      d. Descriptive documentation of optional barriers specified for electrical insulation and isolation if specified.
      e. Utility company's metering provisions with indication of approval by utility company if called out.
      f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Wiring Diagrams: Power, signal, and control wiring.
   3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:
   1. Routine maintenance requirements for switchboards and all installed components.
   2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain switchboards through one source from a single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 2, "Deadfront Distribution Switchboards."

F. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. Handle switchboards according to NEMA PB 2.1 and NECA 400.

1.07 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not exceeding 104 deg F.

2. Altitude: Not exceeding 6600 feet.

1.08 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 “Hangers and Supports for Electrical Systems.”

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 MANUFACTURED UNITS

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Protection Div.
3. Siemens Industries, Inc.
4. Square D.

B. Front-Connected, Front-Accessible Switchboard:

1. Main devices over 1200A: Fixed, individually mounted.
2. Main devices below 1200A, panel mounted.
3. Branch Devices: panel-mounted.
4. Sections rear aligned.

C. Nominal System Voltage: As noted on Drawings.

D. Main-Bus Continuous: As noted on Drawings.

E. Enclosure: Steel, NEMA 250, Type 1 not over 102 in height.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

G. Outdoor Enclosures: Type 3R.

1. Finish: Factory-applied finish in manufacturer's green color; undersurfaces treated with corrosion-resistant undercoating.

H. Insulation and isolation for main and vertical buses of feeder sections.

I. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
2. Space-Heater Power Source: Transformer, factory installed in switchboard.

J. Utility Metering Compartment: Fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.

K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

M. Buses and Connections: Three phase, four wire, unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
   a. If bus is aluminum, use copper- or tin-plated aluminum for circuit-breaker line connections.
   b. If bus is copper, use copper for feeder circuit-breaker line connections.
2. Ground Bus: 1/4-by-2-inch- minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway

feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3. Contact Surfaces of Buses: Silver plated.
4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
5. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
6. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.

N. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.03 SURGE PROTECTIVE DEVICES

A. Direct bus connected type as specified in Division 26 Section "Surge Protective Devices."
B. Provide Surge Protective Device for switchboards that are part of the emergency distribution system.
C. Provide Surge Protective Device for switchboards elsewhere where indicated on the drawings.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
      a. Circuit Breakers 250A and Larger: Magnetic trip element with front-mounted, field-adjustable trip setting with restricted access cover.
   2. Electronic trip-unit circuit breakers shall have RMS sensing, field-replaceable rating plug, and the following field-adjustable settings with restricted access cover:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
   2. Application Listing: Appropriate for application; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Division 26 Section "Electrical Power Monitoring and Control."
   5. Shunt Trip: 120-V trip coil energized from separate circuit.
   6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
   7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.
   1. Fixed circuit-breaker mounting.
   2. Two-step, stored-energy closing.
   3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings with restricted access cover.
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments with I^2t response.
d. Ground-fault pickup level, time delay, and I^2t response.

4. Remote trip indication and control.
5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control"
6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

D. Fused switches rated greater than 800A: Bolted-Pressure Contact Switch.
1. Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
2. Manufacturers:
a. Boltswitch, Inc.
b. Cutler-Hammer Products; Eaton Corporation.
c. Pringle Electrical Mfg. Co.
d. Siemens Industries, Inc.
e. Square D.
3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for closing and opening.
4. Service Rated Switches: Labeled for use as service equipment.
5. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
6. Switches rated 1200A and above shall be provided with an energy-reducing maintenance switch with local status indicator and associated relays.

E. Fused Switches rated 800A and below: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

F. Fuses are specified in Division 26 Section "Fuses."

G. Circuit breaker selection for transformer primary protection:
1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

H. Circuit breakers rated 1200A and above:
1. Circuit breakers rated 1200A and above, not specified elsewhere with zone selective interlocking, shall be provided with an energy reducing maintenance switch with local status indicator.
2. The switch and status indicators shall be remote from the circuit breaker, located at the entrance to the electrical room where the circuit breaker is installed.

2.05 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Megawatts: Plus or minus 2 percent.

e. Megavars: Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.
h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
i. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.06 CONTROL POWER

A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.
B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
B. Provide permanent provisions for locking all overcurrent devices in switchboard. Provisions shall remain in place whether or not lock is installed.
C. Furnish portable test set to test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
D. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

PART 3 EXECUTION

3.01 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.02 EXAMINATION

A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.
B. Install switchboards and anchor to concrete bases according to utility or manufacturer’s recommendations, seismic codes at Project, and requirements in Division 26 Section “Hangers and Supports for Electrical Systems.”
C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
1. Set field-adjustable switches and circuit-breaker trip ranges.
F. Install spare-fuse cabinet.

3.04 ADJUSTING

A. Adjust circuit breaker trip and time delay settings to values as instructed by the Engineer.

3.05 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.06 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing.”
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Instruments, Equipment, and Reports:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
         2) Prepare a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.07 CLEANING

A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 26 2413

SECTION 26 2416 - PANELBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. GFEP: Ground-fault equipment protection.
D. AFCI: Arc-fault circuit interrupter.
E. RFI: Radio-frequency interference.
F. RMS: Root mean square.
G. SPDT: Single pole, double throw.

1.04 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
B. Related Submittals:
   1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.
C. Shop Drawings: For each panelboard and related equipment.
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.
3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports including the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
1. Ambient Temperature: Not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.07 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton Corporation; Cutler-Hammer Products.
b. GE by ABB.
c. Siemens Industries, Inc.
d. Square D.

2.02 MANUFACTURED UNITS

A. Enclosures: Mounting as noted on panel schedules. NEMA PB 1, Type 1.
1. Cabinet Front: Flush or surface cabinet as noted on the Drawings.
a. Eaton LTDD (Piano hinge trim)
b. GE – FGB (front hinge to box).
c. Square D – Continuous piano hinge trim.
d. Siemens – Figure 4 hinge to box w/piano hinge.
2. Finishes:
a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Same finish as panels and trim.
3. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

B. Phase and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

C. Conductor Connectors: Suitable for use with conductor material.
1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Compression type.
3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
4. Double Lugs: Mechanical type mounted at location of main incoming lugs.

D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

F. Surge Protective Devices: Where indicated, provide manufactured units with direct bus connected type as specified in Division 26 Section "Surge Protective Devices."
1. Provide Surge Protective Device for all Distribution and Branch Circuit Panelboards that are part of the Emergency Distribution System.
2. Provide Surge Protective Devices elsewhere where indicated on the drawings.

2.03 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.04 DISTRIBUTION PANELBOARDS

A. Main bus bars, neutral and ground, shall be copper and sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

C. Main Overcurrent Protective Devices: Circuit breaker.

D. Branch Overcurrent Protective Devices:
1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
3. Fused switches.

2.05 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Main bus bars, neutral and ground, shall be sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.06 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
      a. Circuit Breakers 250A and Larger: Magnetic trip element with front-mounted, field-adjustable trip setting with restricted access cover.
   2. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings with restricted access cover:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
   5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
   6. AFCI Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
   5. Shunt Trip: 120-V trip coil energized from separate circuit.
   6. Do not use tandem circuit breakers.
   7. Provide lock on devices for circuit breakers when called out on panel schedules with “LOD” designation.
   8. Provide type GFEP circuit breakers for all self- regulating heating (snow melting and heat trace) cables branch circuits and where noted on panel schedules with “GFEP” designation
   9. Provide GFCI circuit breaker when called out on panel schedules with “GFCI” designation.
   10. Provide Arc-Fault Circuit Interrupters where indicated on panel schedule with “AFCI” designation.
   11. Provide shunt trip breakers when called out on panel schedules with “STB” designation.
   12. Provide smart controllable circuit breakers when called out on panel schedules with “SMT” designation.
   13. Provide permanent padlockable handle for circuit breakers when called out on panel schedules with “PL” designation.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

D. Fuses are specified in Division 26 Section "Fuses."

E. Circuit Breaker Selection for Transformer Primary Protection:
   1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
B. Provide permanent provisions for padlocking all overcurrent devices in Distribution Panelboards. Provisions shall remain in place whether or not lock is installed.
C. Provide permanent provisions for padlocking overcurrent devices in Branch Circuit Panelboards that serve equipment not provided with a local, lockable disconnecting means. Provisions shall remain in place whether or not lock is installed

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.
B. Comply with mounting and anchoring requirements specified in Division 26 Section “Hangers and Supports for Electrical Systems.”
C. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
E. Install overcurrent protective devices and controllers.
    1. Set field-adjustable switches and circuit-breaker trip ranges.
F. Install filler plates in unused spaces.
G. Stub four 1-inch empty conduits from recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
B. Create a directory to indicate installed circuit loads after balancing panelboard loads or created by retrofitting. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Coordinate final directory room names and numbers with Owner.
C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."
B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
    1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
    2. Test continuity of each circuit.
B. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”
    1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters. Perform electrical tests on all breakers and switches 200A and above or that constitute a component of an emergency distribution system. Main circuit breakers in branch circuit panelboards 225A and below are not required to be tested.
    2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 2416

SECTION 26 2713 - ELECTRICITY METERING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes equipment for utility company's electricity metering and electricity metering by Owner.

1.03 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences, both automatic and manual. Include the following:
   1. Electricity-metering equipment.
B. Shop Drawings for Electricity-Metering Equipment:
   1. Dimensioned plans and sections or elevation layouts.
   2. Wiring Diagrams: Power, signal, and control wiring specific to this Project. Identify terminals and wiring designations and color codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For electricity-metering equipment to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
   1. Comply with requirements of utilities providing electrical power and communication services.
   2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 PRODUCTS

2.01 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
B. Meter Sockets: Comply with requirements of electrical power utility company.

C. Modular Meter Center: Factory-coordinated assembly of a main service terminal box with lugs only, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Available Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
      a. Cutler-Hammer; Eaton Corporation.
      b. General Electric Company; Electrical Distribution & Control Div.
      c. Siemens Industries, Inc.
      d. Square D; Schneider Electric.
   3. Housing: NEMA 250, Type 1 or 3R enclosure.
   4. Minimum Short-Circuit Rating: 42,000 amperes symmetrical at rated voltage.
   5. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers.
   6. Tenant Feeder Circuit Breakers: Series-combination-rated molded case units, rated to protect circuit breakers in downstream tenant and house loadcenters and panelboards that have 10,000-A interrupting capacity.
      a. Identification: Complying with Division 26 Section "Electrical Identification" with legend identifying tenant's address.
      b. Physical Protection: Tamper resistant, with hasp for padlock.
   7. Meter Socket: Type as approved by utility company, with rating coordinated with indicated tenant feeder circuit rating.

2.02 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   1. E-MON L.P.
   2. National Meter Industries, Inc.
   3. Osaki Meter Sales, Inc.
   4. Power Measurement.
   5. Square D; Schneider Electric.

B. Kilowatt-Hour Meter: Electronic single- and three-phase meters, measuring electricity used.
   1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
   2. Display: Digital liquid crystal, indicating accumulative kilowatt hours and current kilowatt load.

C. Kilowatt-Hour/Demand Meter: Electronic single- and three-phase meters, measuring electricity use and demand.
   1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
   2. Display: Digital liquid crystal, indicating accumulative kilowatt hours, current time and date, current demand, historic peak demand, and time and date of historic peak demand.
   3. Demand Signal Communication Interface: Match signal to input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.
   4. Programmable Contact Module: Unit shall have push-button switches and a display for setting the demand level at which an integral set of Form C contacts shall be operated to initiate indicated action.
   5. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
   6. Identification: Comply with Division 26 Section "Electrical Identification."
   7. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.

8. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for ratings of circuits indicated for this application.
    a. Type: Split core.
9. Meter Accuracy: Nationally recognized testing laboratory certified to comply with ANSI C12.1.
10. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

3.02 FIELD QUALITY CONTROL

A. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
    1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
    2. Turn off circuits supplied by metered feeder and secure them in off condition.
    3. Run test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use test load placement and setting that ensures continuous, safe operation.
    4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at test load connection. Record test results.
    5. Repair or replace deficient or malfunctioning metering equipment, or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

END OF SECTION 26 2713

SECTION 26 2726 - WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Single and duplex receptacles
   2. Receptacles with integral USB charger.
   3. Ground-fault circuit interrupter receptacles
   4. Controlled receptacles.
   5. Single- and double-pole snap switches.
   6. Device wall plates.
   7. Floor service fittings

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. AFCI: Arc-fault circuit interrupter.
D. PVC: Polyvinyl chloride.
E. RFI: Radio-frequency interference.
F. SPD: Surge protective devices.
G. UTP: Unshielded twisted pair.
H. USB: Universal serial bus.

1.04 REFERENCES

A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.
B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes
D. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
E. NEMA WD 1: General Requirements for Wiring Devices.
F. NEMA WD 6: Wiring Device – Dimensional Requirements.
G. UL 20: General-Use Snap Switches.
H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
I. UL 486B: Wire Connectors for Use with Aluminum Conductors.
J. UL 498: Electrical Attachment Plugs and Receptacles.
K. UL 943: Ground Fault Circuit Interrupters.
L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and source.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NFPA 70.

1.07 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
    1. Cord and Plug Sets: Match equipment requirements.

PART 2 PRODUCTS

2.01 GENERAL WIRING DEVICE REQUIREMENTS

A. Comply with NFPA 70, NEMA WD 1, NEMA WD 6, and UL498.
B. Devices for Owner-Furnished Equipment:
    1. Receptacles: Match plug configurations.
    2. Cord and Plug Sets: Match equipment requirements.
C. Device Color:
    1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
    2. Wall Switches: As selected by Architect, unless otherwise indicated.

2.02 STANDARD GRADE RECEPTACLES

A. Duplex Receptacle, NEMA 5-20R:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Hubbell Wiring Device-Kellems: BR20
        b. Eaton/Arrow Hart Wiring Devices: BR20
        c. Leviton: BR 20
        d. Legrand, Pass & Seymour: CRB5362
B. Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
    1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
    2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Hubbell Wiring Device-Kellems: BR20TR
        b. Eaton/Arrow Hart Wiring Devices: TRBR20
        c. Leviton: TBR20

d. Legrand, Pass & Seymour: TR5352

C. Weather-Resistant Duplex Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wire Device-Kellems: BR20WR
b. Eaton/Arrow Hart Wiring Devices: WRBR20
c. Leviton: WBR20
d. Legrand, Pass & Seymour: WR20TR

D. Weather- and Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wire Device-Kellems: BR20WRTR
b. Eaton/Arrow Hart Wiring Devices: TWRBR20
c. Leviton: TWR20
d. Legrand, Pass & Seymour: WR5352TR

2.03 USB RECEPTACLES

A. Tamper-Resistant Duplex NEMA 5-20R and USB Charging Receptacle:
1. Decorator style.
2. Comply with UL 1310.
3. USB Charging 3.0A (minimum), 5VDC dual ports.
a. Comply with battery charging specification USB BC1.2
b. Compatible with USB 1.1/2.0/3.0 devices, including Apple products.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wiring Device: USB20X2-x
b. Eaton/Arrow Hart Wiring Devices: TR7756-x
c. Leviton: T5632
d. Legrand, Pass & Seymour: TR5362USB Full Duplex and USB

B. USB Charging Receptacle:
1. Decorator style.
2. Comply with UL 1310.
3. USB Charging 4.0A (minimum), 5VDC four-ports.
a. Comply with battery charging specification USB BC1.2
b. Compatible with USB 1.1/2.0/3.0 devices, including Apple products.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wiring Device: USB4
b. Eaton/Arrow Hart Wiring Devices: 7750
c. Leviton: USB4P

2.04 GFCI RECEPTACLES

A. General:
1. Comply with UL 943

B. Duplex GFCI Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Hubbell Wiring Device-Kellems: GFRST20
b. Eaton/Arrow Hart Wiring Devices: SGF20
c. Leviton: GFNT2
d. Legrand, Pass & Seymour: 2097

C. Tamper-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Hubbell Wiring Device-Kellems: GFTRST20

b. Eaton/Arrow Hart Wiring Devices: TRSGF20
c. Leviton: GFTR2
d. Legrand, Pass & Seymour: 2097TR

D. Tamper- and Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Hubbell Wiring Device-Kellems: GFTWRST20
b. Eaton/Arrow Hart Wiring Devices: TWRSGF20
c. Leviton: GFWT2
d. Legrand, Pass & Seymour: 2097TRWR

E. Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Eaton/Arrow Hart Wiring Devices WRSGF20
b. Leviton: GFWR2
c. Legrand, Pass & Seymour: 2097TRWR

A. Dead Front GFCI, 20A:
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Hubbell Wiring Device-Kellems: GFBFST20
b. Eaton/Arrow Hart Wiring Devices: SGF20
c. Leviton: GFRBF
d. Legrand, Pass & Seymour: 2087

2.05 CONTROLLED RECEPTACLES

A. General:
1. Comply with NEC Article 406.3(E). Provide permanent markings of controlled symbol and the word "controlled".

B. Half-Controlled Duplex Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wiring Device-Kellems: BR20C1
b. Eaton/Arrow Hart Wiring Devices: 5262CH
c. Bryant: CBRS20C1
d. Leviton: CR020-1P
e. Legrand, Pass & Seymour: 5362CHW

C. Dual-Controlled Duplex Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wiring Device-Kellems: BR20C2
b. Eaton/Arrow Hart Wiring Devices: 5362CD
c. Bryant: CBRS20C2
d. Leviton: CR020-2P
e. Legrand, Pass & Seymour: 5362CD

2.06 STRAIGHT BLADE AND TWIST-LOCK RECEPTACLES, OTHER THAN NEMA 5-20R

A. Provide commercial specification grade straight blade and twist-lock receptacles with standard NEMA configurations in accordance with the "Special Receptacles" schedule included on the drawings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Wiring Device-Kellems
2. Eaton/Arrow Hart Wiring Devices
3. Leviton
4. Legrand, Pass & Seymour

2.07 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking type plug and receptacle body connector, NEMA WD 6, device configurations as indicated on drawings, heavy-duty grade.

B. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

C. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.08 CORD REELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Reelcraft L4500 Series
   2. Legrand, Pass & Seymour
   3. Hubbell Wiring Device-Kellems
   4. Daniel Woodhead

B. Description: Portable cord reel with portable outlet box and receptacle; steel construction NEMA 1 enclosure; adjustable cord stop; spring retractable with latch; 115V, 20A. rated and capable of being ceiling, wall or bench mounted.

C. Cord: 30 feet of 3 no. 12 SJO cord with strain relief.

D. Wiring device: Portable outlet box with liquidtight cord connector and one NEMA 5-20R duplex GFCI receptacle, outlet box and flip-top cover attached to end of cable reel.

E. Electrical Connection: Provide 48 inch pigtail with NEMA 5-20P plug.

2.09 WALL SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Wiring Device-Kellems: 1220 Series
   2. Eaton/Arrow Hart Wiring Devices: AH1220 Series
   3. Leviton: 1220 Series
   4. Legrand, Pass & Seymour: PS20AC Series
   1. Hubbell Wiring Device-Kellems: 2100 Series
   2. Eaton/Arrow Hart Wiring Devices: 7630
   3. Leviton: 5621 Series
   4. Legrand, Pass & Seymour: 2624

B. Device body: Plastic handle.

C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.

E. Provide single-pole, two-pole, three-way and four-way switches as indicated.

F. Provide pilot light where indicated. Switch shall be illuminated when the switch is on.

G. Provide key type where indicated. Furnish four keys to Owner.

H. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
   1. Switch: 20 A, 120/277-V ac.
   2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.10 WALL PLATES

A. Manufacturers:
   1. Provide wall plates and corresponding wiring devices from same manufacturer.

B. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces:
      a. 0.035-inch- thick, satin-finished stainless steel
      b. Steel with white baked enamel, suitable for field painting
      c. Smooth, high-impact thermoplastic
      d. 0.04-inch thick, brushed brass with factory polymer finish
      e. 0.05-inch- thick anodized aluminum
      f. 0.04-inch thick steel with chrome-plated finish
   3. Material for Unfinished Spaces:
      a. Galvanized steel
      b. Smooth, high-impact thermoplastic.
   4. Material for Wet Locations: Gasketed Non-Metallic with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.
      a. Manufacturers:

1) Hubbell: MM420
2) Legrand, Pass & Seymour: WIUC10FRED
3) Eaton/Arrow Hart: WIU-1VX
4) Red Dot: CKPS
5) Intermatic: WP5000

5. Material for Wet Locations: Recessed Non-Metallic with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.
   a. Coordinate cover type with exterior wall material.
   b. Manufacturers:
      1) Arlington In Box: DB Series
6. Material for Wet Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.
   a. Manufacturers:
      1) Hubbell: MX3200
      2) Red Dot Model: CKLSVU, Thomas & Betts
      3) Intermatic: WP3110MXD
      4) Leviton: IUM1V
7. Material for Damp Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Weatherproof.
   a. Manufacturers:
      1) Red Dot Model CCGV, ABB Installation Products
      2) Eaton/Arrow Hart WLRD1
      3) Legrand, Pass & Seymour
      4) Intermatic: WP3110MXD

2.11 FLOOR SERVICE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Wiring Device-Kellems
   2. Legrand, Wiremold
   3. Steel City
B. Refer to Floor Service Fitting Schedule on Plan.
C. Compartments: Provide barrier separating power from telecommunications cabling. Provide recessed-type floor service fittings with independent compartments and feed through wiring capability.
D. Provide a blank bracket for any unused gangs.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.
C. Install devices and assemblies level, plumb, and square with building lines.
D. Arrangement of Devices:
   1. Coordinate locations of outlet boxes provided under Division 26 Section "Raceways and Boxes" to obtain mounting heights indicated on Drawings.
   2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.
   3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
   4. Install horizontally mounted receptacles with grounding pole on the left.
   5. Install GFCI receptacles so that the "Push To Test" and "Reset" designations can be read correctly. If printed in both directions, install with ground pole on top.
   6. Install switches with OFF position down.

E. Install cover plates on switch, receptacle, and blank outlets in finished areas.
F. Install weather-resistant type receptacles in all damp and wet locations, including pool environments.
G. Install weatherproof cover plates on receptacles in damp locations.
H. Install weatherproof While-In-Use cover plates on receptacles in wet locations.
I. Install tamper-resistant type receptacles in all locations as required by the NEC (406.12) and as indicated on plan.
J. Provide hospital-grade tamper-resistant receptacles in all areas where identified in the National Electrical Code (406.12(s) and 517.18(c)) (i.e., business offices, corridors, waiting areas, lobbies, exam rooms, pediatric patient rooms, etc.).
K. Use oversized plates for outlets installed in masonry walls.
L. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
M. Remove wall plates and protect devices and assemblies during painting.
N. Coordinate installation of access floor boxes with access floor system provided by Architectural trades.
O. Install properly oriented access floor boxes into cutouts in access floor tiles and secure to tiles per Manufacturer's instructions.
P. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
Q. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification."
   1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.
   2. Wall Switches: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black-filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.
B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.
C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Inspect each wiring device for defects.
   2. Operate each wall switch with circuit energized and verify proper operation.
   3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
   4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.
B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 26 2726

SECTION 26 2813 - FUSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Cartridge fuses rated 600 V and less for use in switches and controllers.
   2. Spare-fuse cabinets.

1.03 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:
   1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
   1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
      a. Let-through current curves for fuses with current-limiting characteristics.
      b. Time-current curves, coordination charts and tables, and related data.
      c. Ambient temperature adjustment information.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with:
   1. NEMA FU 1 – Low Voltage Cartridge Fuses.
   2. NFPA 70 – National Electrical Code.
   3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.

4. UL 198E – Class R Fuses.
5. UL 512 – Fuseholders.

1.05 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
1. Service Entrance: Class L, time delay.
2. Feeders: Class RK5, time delay.
3. Motor Branch Circuits: Class RK5, time delay.
4. Other Branch Circuits: Class RK1, time delay.

2.03 SPARE-FUSE CABINET

A. Cabinet: Wall-mounted, 0.05-inch- thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
1. Size: 30 inches high by 24 inches wide by 12 inches deep.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
4. Fuse Pullers: For each size of fuse.

2.04 FLUORESCENT AND H.I.D. LIGHTING BALLAST FUSES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc. – GLR fuses with HLR holder.
2. Tracor, Inc.; Littelfuse, Inc. Subsidiary – LGR fuses with LHR-000 holder.
3. Ferraz Shawmut, Inc. – SLR fuses.

B. Provide each fluorescent and HID lighting ballast with individual protection on the line side.

C. Provide fuse and holder mounted within or as part of the fixture.

D. Provide fuse size and type recommended by the fixture manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

C. Install spare-fuse cabinet(s).

3.03 IDENTIFICATION

A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION 26 2813

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 26 Section “Fuses”.

1.02 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers.
4. Molded-case switches.
5. Enclosures.

B. Related Sections:

1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. HD: Heavy duty.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.04 REFERENCES

A. NECA 1: Practices for Good Workmanship in Electrical Contracting.

B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.
E. NEMA FU 1: Low Voltage Cartridge Fuses.
F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
I. NFPA 70: National Electrical Code.

1.05 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current rating.
   4. UL listing for series rating of installed devices.
   5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
B. Shop Drawings: Diagram power, signal, and control wiring.
C. Qualification Data: For testing agency.
D. Field quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
E. Manufacturer's field service report.
F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NFPA 70.
D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

1.08 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   3. Siemens Industries, Inc.
   4. Square D/Group Schneider.

B. Fusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, with clips or bolt pads to accommodate specified fuses, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:
   1. Provide early break auxiliary contacts in motor disconnect switches for motors that are fed from variable frequency controllers.
   2. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   3. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
   4. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.03 TOGGLE DISCONNECT SWITCH

A. Manufacturers:
   1. Double Pole:
      a. Hubbell 1372.
      b. Leviton 6808G-DAC.
      c. Pass & Seymour 7812.
      d. Bryant 30102.
   2. Three Pole:
      a. Hubbell 1379.
      b. Leviton 7810GD.
      c. Pass & Seymour 7813.
      d. Bryant 30103.

B. Description: Heavy duty, 30A, 600 volt, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

2.04 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   3. Siemens Industries, Inc.
   4. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity as required.

C. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
2. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Enclosure: Provide handle capable of being locked in the open position with padlock.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
6. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.
10. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay. Provide "dummy" trip unit where required for proper operation.
11. Key Interlock Kit: Externally mounted to prohibit operation; key shall be removable only when switch is in off position.
12. Circuit breaker selection for primary

D. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

2.05 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Indoor Dry Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.03 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Install switches with off position down.

D. Install NEMA KS 1 enclosed switch where indicated for motor loads ½ HP and larger and equipment loads greater than 30A.

E. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than ½ HP and equipment loads 30A. and less.

F. Install fuses in fusible disconnect switches.

G. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6’-0” whip.

H. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.

I. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.

J. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.

K. Support enclosures independent of connecting conduit or raceway system.

L. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification."

C. Provide adhesive label as specified in Division 26 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

3.05 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. Certify compliance with test parameters.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.6 for molded-case circuit breakers. Test all NEMA AB1, molded case circuit breakers with thermal magnetic trip or auxiliary, solid-state trip units 100A and larger. Certify compliance with test parameters.
    a. Visual and Mechanical Inspection
        1) Circuit breaker shall be checked for proper mounting and compare nameplate data to Drawings and Specifications.
        2) Operate circuit breaker to ensure smooth operation.

3) Inspect case for cracks or other defects.
4) Check internals on unsealed units.

b. Electrical Tests
1) Perform a contact resistance test.
2) Perform an insulation resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
3) Perform long time delay time-current characteristic tests by passing three hundred percent (300%) rated current through each pole separately. Record trip time. Make external adjustments as required to meet time current curves.
4) Determine short time pickup and delay by primary current injection.
5) Determine ground fault pickup and time delay by primary current injection.
6) Determine instantaneous pickup current by primary injection using run-up or pulse method.
7) Perform adjustments for final settings in accordance with coordination study.
8) For circuit breakers 800A and larger, verify all functions of trip unit by means of secondary injection in lieu of primary injection.

c. Test Values
1) Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.
2) Insulation resistance shall not be less than 100 megohms.
3) Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) All trip times shall fall within N.E.T.A. Acceptance Testing Specifications, Table 10.7 Circuit breakers exceeding specified trip time at three hundred percent (300%) of pickup shall be tagged defective.
5) Instantaneous pickup values shall be within values shown on N.E.T.A. Acceptance Testing Specifications, Table 10.8 or manufacturer’s recommendations.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.06 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip and time delay settings to values as determined by the protective device coordination study.

3.07 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 2816

SECTION 26 2913 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:
   1. Across-the-line, manual and magnetic controllers.

B. Related Sections include the following:
   1. Division 26 Section "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.
   2. Division 20 Section "Variable Frequency Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on constant torque loads in ranges up to 200 hp.
   3. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    a. Each installed unit's type and details.
    b. Nameplate legends.
    c. Short-circuit current rating of integrated unit.
    d. UL listing for series rating of overcurrent protective devices in combination controllers.
    e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Qualification Data: For manufacturer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
1. Routine maintenance requirements for enclosed controllers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.04 REFERENCES

A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.

C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).

E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.

F. NECA 402-2000 – Recommended Practice for Installing and Maintaining Motor Control Centers.

G. NEMA AB 1 - Molded Case Circuit Breakers.

H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

I. NEMA KS 1 - Enclosed Switches.

J. ANSI/NFPA 70 - National Electrical Code.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prior to beginning work on any system, verify all existing conditions that affect the work and coordinate with all other trade Contractors. Determine that the work can be installed as indicated or immediately report to the Architect/Engineer errors, inconsistencies or ambiguities.

B. Deliver products to site under provisions of Section 26 0010. Store and protect products under provisions of Section 26 0010.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift large equipment only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

E. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.07 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 26 0010.

1.08 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Danfoss Inc.; Danfoss Electronic Drives Div.
3. Eaton Corporation; Cutler-Hammer Products.
4. General Electrical Company; GE Industrial Systems.
5. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
6. Siemens/Furnas Controls.
7. Square D.

2.02 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase

matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

3. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 20 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.
   1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
   2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
   3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.03 MULTISPEED ENCLOSED CONTROLLERS

A. Multispeed Enclosed Controller: Match controller to motor type, application, and number of speeds; include the following accessories:
   1. Compelling relay to ensure that motor will start only at low speed.
   2. Accelerating relay to ensure properly timed acceleration through speeds lower than that selected.
   3. Decelerating relay to ensure automatically timed deceleration through each speed.

2.04 VARIABLE FREQUENCY CONTROLLERS

A. Refer to Division 20 “Variable Frequency Controllers.”
B. Equipment furnished by mechanical trades and installed by electrical trades.

2.05 ENCLOSURES

A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
   3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.06 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
B. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.
C. Control Relays: Auxiliary and adjustable time-delay relays.
D. Elapsed Time Meters: Heavy duty with digital readout in hours.
E. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.
F. Manufacturer provided nameplate shall be provided on controller enclosure. Nameplate shall contain the following information:
   1. Manufacturer’s name or identification.
   2. Voltage rating.
   3. Current and/or horsepower rating.
   4. Short-circuit current rating,

2.07 FACTORY FINISHES

A. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.03 INSTALLATION

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Install freestanding equipment on concrete bases.

C. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

D. Install motor control equipment and contactors in accordance with manufacturer’s instructions.

E. Select and install heater elements in motor starters to match installed motor characteristics.

F. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.04 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.05 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.06 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.07 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.08 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
3. Report results in writing.

B. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, "Motor Control - Adjustable Speed Drive Systems." Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.09 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Section "Closeout Procedures".

END OF SECTION 26 2913

SECTION 26 3100 - PHOTOVOLTAIC COLLECTORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. PV system description.
   2. Manufactured PV units.
   3. PV module framing.
   4. PV array construction.
   5. Inverters.
   6. System overcurrent protection.
   7. Mounting structures.

1.03 DEFINITIONS

A. CEC: California Energy Commission.
B. ETFE: Ethylene tetrafluoroethylene.
C. FEP: Fluorinated ethylene propylene.
D. IP Code: Required ingress protection to comply with IEC 60529.
E. MPPT: Maximum power point tracking.
F. PTC: PVUSA Test Condition. Commonly regarded as a "real-world" measure of PV output. See below for definition of "PVUSA."
G. PV: Photovoltaic.
H. PVUSA: Photovoltaics for Utility Systems Applications.
I. STC: Standard Test Conditions defined in IEC 61215.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for PV panels.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For PV modules.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Detail fabrication and assembly.
   4. Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For PV modules to include in operation and maintenance manuals.

1.07 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period.
   1. Manufacturer's materials and workmanship warranties include, but are not limited to, the following:
      a. Faulty operation of PV modules.
   2. Warranty Period: Five years from date of Substantial Completion.

B. Manufacturer's Special Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, applies to materials only, on a prorated basis, for period specified.
   1. Manufacturer's minimum power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:
      a. Specified minimum power output to 80 percent or more, for a period of 20 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 MANUFACTURED UNITS

A. MANUFACTURERS:
   1. Jinko Solar
   2. Hanwha Q CELLS
   3. REC Group

2.03 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.04 PV CAPACITIES AND CHARACTERISTICS

A. Minimum Electrical Characteristics:
   1. Rated Open-Circuit Voltage: 42.05 V dc
   2. Maximum System Voltage: 1000/1500 V dc.
   3. Maximum Power at Voltage (Vpm): 34.72 V dc.
   4. Short-Circuit Temperature Coefficient: 0.045% / deg C.

5. Rated Short-Circuit Current (Isc): 13.99 A
6. Rated Operation Current (Imp): 13.25A
7. Maximum Power at STC (Pmax): 460W

B. Normal Operating Temperature Characteristics (NOTC):
1. Temperature at Nominal Operating Cell Temperature: -40 deg C to 85 deg C
2. Temperature Coefficient (NOTC Open-Circuit Voltage): -0.25% / deg C.
3. Temperature Coefficient (NOTC Short Circuit Current): 0.045% / dec C.
4. Temperature Coefficient (NOTC Maximum Power Voltage): -29% / deg C.

2.05 PV SYSTEMS DESCRIPTION

A. Hybrid PV System: Collectors connected to provide power to dc and ac loads, connected to utility through interactive inverters or meters, and connected to energy storage.
1. A 182-module array to generate a total nominal rated output of 83.7 kW.
2. System Components:
a. PV modules.
b. Array frame.
c. Charge controller.
d. Energy storage.
e. System control.
f. Inverter.
g. Overcurrent protection, disconnect, and rapid shutdown devices.
h. Mounting structure.
i. Meter.
j. Mounting structure.

2.06 MANUFACTURED PV UNITS

A. Cell Materials: Monocrystalline.
1. c-Si.
2. Gallium arsenide (GaAs).

B. Module Construction:
1. Nominal Size: 32 inches wide by 64 inches long.
2. Weight: 42.8 lb.

C. Insulating Substrate Film: Rigid, polyester or polyimide.
D. Conducting Substrate Film: Rigid, ETFE or FEP.
E. Encapsulant: Ethyl vinyl acetate.
F. Front Panel: Fully tempered glass.
G. Front Panel: 0.125-inch- thick glass.
H. Front Panel: Low iron glass.
I. Front Panel: Antireflective coating glass.
J. Front Panel: Laminating film.
K. Front Panel: Laminating material.
L. Backing Material: Tempered glass.
M. Bypass Diode Protection: Internal.
N. Junction Box:
1. Size: 1.56 by 3.96 by 0.52 inch.
2. Fully potted, vandal resistant.
3. IP Code: IP67.
4. Flammability Test: UL 1703.

O. Output Cabling:
1. 0.158 inch
2. Quick, multiconnect, polarized connectors.
3. Two-Conductor Harness: No traditional return wire is needed from the end of a row back to the source combiner.

2.07 PV MODULE FRAMING

A. PV laminates mounted in anodized extruded-aluminum frames.

1. Entire assembly UL listed for electrical and fire safety, Class A, according to UL 1703, and complying with IEC 61215.
2. Frame strength exceeding requirements of certifying agencies in subparagraph above.
3. Finish: Anodized aluminum.
    a. Alloy and temper recommended by framing manufacturer for strength, corrosion resistance, and application of required finish.
    b. Color: As indicated by manufacturer's designations.
4. Finish: High-performance organic finish.
    a. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent PVC resin by weight.
    b. Color: As indicated by manufacturer's designations.
5. Finish: Baked-enamel finish.
    a. Color: As indicated by manufacturer's designations.

2.08 PV ARRAY CONSTRUCTION

A. Framing:
1. Material: Extruded aluminum.
2. Maximum System Weight: Less than 4 lb/sq. ft.
3. Raceway Cover Plates: Aluminum.

B. Flat-Roof Mounting:
1. No roof penetrations.
2. Self-ballasting.
3. Wind-tunnel tested to 110-mph wind.
4. Service Life: 25 years.
5. Freestanding system.

2.09 INVERTER

A. Inverter Type: Central.
B. Control Type: Maximum power point tracker control.
C. Inverter Electrical Characteristics:
1. Maximum Recommended PV Input Power: 45 kW
2. PV Start Voltage: 330 V dc.
3. MPPT Voltage Range: 480-850 V dc.
4. Nominal Output Voltage: 208 V ac.
5. Maximum Output Current: 69.5A.
6. Peak Efficiency: 97 percent.
7. CEC Weighted Efficiency: 96.5percent.
8. Communications Interface: RS 485.
9. Utility Interface: Utility-interactive inverter.

D. Operating Conditions:
1. Operating Ambient Temperatures: Minus 4 to plus 122 deg F.
2. Storage Temperature: Minus 40 to plus 122 deg F.
3. Relative Humidity: Zero to 95 percent, noncondensing.

E. Charge controllers shall have the following:
1. Overcurrent protection.
2. Generator input breaker box.
3. Automatic transfer relay.
4. Digital display.
5. Transformer.
6. Disconnect switch.
7. Shunt controller.
8. Shunt regulator.
9. Surge overload protection.

F. Enclosure:

1. NEMA 250, Type 3R.
2. Enclosure Material: Galvanized steel.
3. Cooling Methods:
    a. Fan convection cooling.
    b. Passive cooling.
4. Protective Functions:
    a. AC over/undervoltage.
    b. AC over/underfrequency.
    c. Ground overcurrent.
    d. Overtemperature.
    e. AC and dc overcurrent.
    f. DC overvoltage.
5. Standard LCD, four lines, 20 characters, with user display and on/off toggle switch.

G. Disconnects: Rated for system voltage and conductor.

H. Regulatory Approvals:
1. IEEE 1547.1.
2. IEEE 1547.3.
3. UL 1741.

I. Characteristics:
1. Inverter Dimensions: 39.4”x23.6”x10.2”.
2. Inverter Weight: 123.5 lbs.

2.10 MOUNTING STRUCTURES

A. Roof Racking: Ballast Bay system, 10 degree tilt.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Do not begin installation until mounting surfaces have been properly prepared.

C. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.

E. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of PV panels with roof and support assembly and other construction.

C. Support PV panel assemblies independent of supports for other elements such as roof and support assemblies, enclosures, vents, pipes, and conduits. Support assembly to prevent twisting from eccentric loading.

D. Install PV inverters, charge controller, rapid shutdown, and system control in locations indicated on Drawings.

E. Install weatherseal fittings and flanges where PV panel assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight. See Section 07 9200 "Joint Sealants" for materials and application.

F. Wiring Method: Install cables in raceways.

G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.03 CONNECTIONS

A. Coordinate PV panel cabling to equipment enclosures to ensure proper connections.

B. Coordinate installation of utility-interactive meter with utility.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
D. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
E. Connection required between PV System and BAS to monitor production levels. Coordinate exact requirements with TC drawings.

END OF SECTION 26 3100

SECTION 26 3213 - PACKAGED ENGINE GENERATORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

1.02 SUMMARY

A. This Section includes packaged engine generator sets for standby power supply with the following features:
   1. Gas engine (Propane).
   2. Load banks.
   3. Outdoor enclosure.

B. Related Sections include the following:
   1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.
   2. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

C. LP: Liquid petroleum.

1.04 SUBMITTALS

A. Product Data: Submit product data under provisions of Section 26 0010. Include the following:
   1. Data on features, components, accessories ratings, and performance.
   2. Thermal damage curve for generator.
   3. Time-current characteristic curves for generator protective device.
   4. Manufacturer’s anchorage and base recommendations.

B. Shop Drawings: Submit shop drawings under provisions of Section 26 0100. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Submit shop drawings showing plan and elevation views with overall interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
   2. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
   3. Internal Wiring Diagrams: For engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, remote radiator, and remote annunciator.

C. Qualification Data: For manufacturer.

D. Source quality-control test reports.
   1. Certified summary of prototype-unit test report.
   2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
   3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
   4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   5. Report of sound generation.
   6. Certified report of exhaust emissions showing compliance with applicable EPA regulations.
   7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

E. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:
   1. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
   2. Include instructions for normal operation, routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

F. Warranty: Special warranty specified in this Section.

G. Submit all required plan review documentation for above ground storage tank registration to the State of Michigan Bureau of Fire Services Storage Tank Division.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
   1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
   2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged generator sets and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
F. Comply with NFPA 30.
G. Comply with NFPA 37.
H. Comply with NFPA 70.
I. UL2200 Listed and labeled
J. Comply with NFPA 110 requirements for Level 2 emergency power supply system.
K. Comply with NECA/EGSA 404-2000 – Recommended Practice for Installing Generator Sets.
L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
    1. Provide engines used for standby applications that carry certification of compliance with current EPA emissions requirements or provide engines which comply with EPA emissions requirements and provide the necessary field testing to certify EPA emissions compliance.
    2. Provide engines used for prime power applicants which carry certification of compliance with EPA emissions requirements. Engines which are compliant, but require field certification are not acceptable.
M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 “Hangers and Supports for Electrical Systems.”

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
    1. Warranty Period: Five years from date of Substantial Completion.

1.08 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts and supplies as used in manufacture and installation of original equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    1. Caterpillar; Engine Div.
    2. Kohler Co; Generator Division.
    3. Onan Corp./Cummins Power Generation; Industrial Business Group.
    4. MTU/Onsite Energy.
    5. Generac.

2.02 ENGINE-GENERATOR SET

A. Packaged engine-generator set shall be a coordinated assembly of compatible components.
B. Safety Standard: Comply with ASME B15.1 and UL 2200.
C. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.
D. Capacities and Characteristics:
    1. Power Output Ratings: Nominal ratings as indicated

2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

E. Generator set performance:
1. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.
2. Steady-State Voltage Modulation Frequency: Less than 1 Hz.
3. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
4. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
7. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
9. Start Time: Comply with NFPA 110, Type 10, system requirements.

F. Provide guards for all external rotating parts to prevent accidental injury. Guards shall be securely bolted to the generator but removable for maintenance. Guards shall be painted with a rust inhibiting primer and an epoxy based gloss topcoat. Guards shall comply with OSHA requirements.

G. Service Conditions:
1. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
a. Ambient Temperature: Minus 15 to plus 40 deg C.
b. Relative Humidity: 0 to 95 percent.
c. Altitude: Rated for altitude at project location.

2.03 ENGINE

A. Fuel: LP/Propane

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: The following items are mounted on engine or skid:
1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Engine Fuel System:
1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
3. LP-Gas System:
a. Carburetor.
b. Secondary Gas Regulators: One for each fuel type.
c. Fuel-Shutoff Solenoid Valves: One for each fuel source.
d. Flexible Fuel Connectors: One for each fuel source.

E. Coolant Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 volts AC.
F. Governor: Adjustable Isochronous with speed sensing.
G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
    1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
    2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
    3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
    4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
    5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
        a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
        b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
H. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
    1. Minimum sound attenuation of 25 dB at 500 Hz.
    2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.
I. Starting System: 24-V electric, with negative ground.
    1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
    2. Cranking Cycle: As required by NFPA 110 for system level specified.
    3. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
    4. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
    5. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
    6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
    7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
        a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
        b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
        c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
        d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
        e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and

loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.04 FUEL OIL STORAGE

A. Comply with NFPA 58:

B. Propane Tank: Comply with UL 142, freestanding, factory-fabricated fuel tank assembly, with integral, float-controlled transfer pump and the following features:

1. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of day tank.
   a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.
2. Tank Capacity: 1000 gallon.
3. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 40 percent of normal fuel level.

2.05 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation:

1. When mode-selector switch on the control and monitoring panel is in the automatic position, remote control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set.
2. When mode-selector switch is switched to the on position the generator set starts.
3. When mode-selector switch is switched to the off position it initiates generator set shutdown.
4. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
5. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation:

1. Switching on-off switch on the generator control panel to the on position starts generator set.
2. The off position of same switch initiates generator-set shutdown.
3. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
4. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 2 system.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."

G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

I. The integrity of the control wiring between the Generator(s) and each Emergency System Automatic Transfer Switch shall be continuously monitored per National Electrical Code Section 700.

2.06 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Matched to generator thermal damage curve as closely as possible.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Mount unit in enclosure to meet ANSI/NEMA 250, Type 1 requirements. Adjacent to or integrated with control and monitoring panel.

a. Where multiple output circuit breakers are provided, the output circuit breaker and load wiring that serves the emergency branch shall be physically separated from breakers serving standby branches

5. Circuit breakers shall be by the same manufacturer of distribution equipment provided and shall selectively coordination with downstream circuit breakers.

B. Generator Disconnect Switch: Molded-case type, 100 percent rated.
   1. Rating: Matched to generator output rating.
   2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.

C. Generator Protector: Microprocessor-based unit that continuously monitors current level in each phase of generator output, integrates generator heating effect over time, and predicts when thermal damage of the alternator will occur. When signaled by the protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from the load circuits. Protector shall perform the following functions:
   1. Initiates a generator overload alarm when the generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
   2. Under single or three-phase fault conditions, regulates the generator to 300 percent of rated full-load current for up to 10 seconds.
   3. As the overcurrent heating effect on the generator approaches the thermal damage point of the unit, the protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
   4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

D. Ground-Fault Indication: Comply with NFPA 70, Article 700-7(d). Integrate ground-fault alarm indication with other generator-set alarm indications.

2.07 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with ANSI/NEMA MG 1

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: ANSI/NEMA MG 1: Class H or Class F.

D. Temperature Rise: 105 degrees C continuous.

E. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: ANSI/NEMA MG 1, open drip proof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
   1. Manual adjustment on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.08 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
   1. Provide sound attenuating enclosure to meet the sound criteria specified in Part 1, “Quality Assurance”

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
   1. Louvers: Fixed-engine cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2.09 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

2.10 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 energy converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
   1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   2. Full load run.
   3. Maximum power.
   4. Voltage regulation.
   5. Transient and steady-state governing.
   6. Single-step load pickup.
   7. Safety shutdown.
   8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

C. Report factory test results within 10 days of completion of test.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Beginning of installation means Installer accepts existing conditions.

3.02 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with vibration isolation devices on concrete base.
   1. Size concrete base as recommended by generator manufacturer.
   2. The top of the concrete pad shall be a minimum of 4” above finished grade or adjacent finished floor.
   3. Secure sets to anchor bolts installed in concrete bases.
   4. Concrete base construction is specified in Division 26 Section "Hangers and Supports for Electrical Systems."
   5. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
B. Install fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
C. Connect cooling-system water piping to engine-generator set and heat exchanger with flexible connectors.
D. Connect engine exhaust pipe to engine with flexible connector.
E. Connect fuel piping to engines with a gate valve and union and flexible connector.
    1. Natural- and LP-gas piping, valves, and specialties for gas distribution outside the building are specified in Division 2 Section "Natural Gas Distribution."
    2. Natural- and LP-gas piping, valves, and specialties for gas piping inside the building are specified in Division 23 Section "Fuel Gas Piping."
F. Ground equipment according to Division 26 Section "Grounding and Bonding."
G. Connect wiring according to Division 26 Section "Conductors and Cables."
H. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 IDENTIFICATION

A. Identify system components according to Division 23 Section "Mechanical Identification" and Division 26 “Section Electrical Identification."

3.05 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”
B. Perform tests and inspections and prepare test reports.
C. Perform the following field tests and inspections and prepare test reports:
    1. Provide full load test utilizing portable resistor test bank, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal. Coordinate with Division 26 Section "Transfer Switches”
    2. During test, record the following at 20 minute intervals:
        a. Kilowatts.
        b. Amperes.
        c. Voltage.
        d. Coolant temperature.
        e. Room temperature.
        f. Frequency.
        g. Oil pressure.
    3. Test alarm and shutdown circuits by simulating conditions.
    4. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.15.2.1 and 7.22.1 (except for vibration baseline test). Certify compliance with test parameters.
    5. Perform tests recommended by manufacturer.
    6. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, the following:
        a. Single-step full-load pickup test.
    7. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
        a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
        b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
        c. Verify acceptance of charge for each element of the battery after discharge.
        d. Verify that measurements are within manufacturer's specifications.

8. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
9. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
10. Exhaust Emissions Test: Comply with applicable government test criteria.
11. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
12. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
13. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line and compare measured levels with required values.

D. Coordinate tests with tests for transfer switches and run them concurrently.
E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of the National Institute for Standards and Technology, and adequate for making positive observation of test results. Make calibration records available for examination on request.
F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
I. Remove and replace malfunctioning units and retest as specified above.
J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
L. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
    1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
    2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 DEMONSTRATION

A. Provide systems demonstration for Owner, Construction Manager and Electrical Engineer.
B. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency power.
C. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 1 Section "Demonstration and Training."
    1. Provide a minimum of two 3-hour training sessions for the Owner’s personnel. One session shall be conducted at time of start-up, the other within three months of start-up.
    2. Training shall include: Review of maintenance procedures and schedule, trouble shooting procedures, demonstration of all alarm and safety functions with appropriate actions to be taken, and review of regular testing and exercising schedule including inspection and observation procedures.
    3. Coordinate with demonstration and training required in Division 26 section “Transfer Switches”.

3.07 CLEANING

A. Clean engine and generator surfaces. Replace oil and fuel filters.

END OF SECTION 26 3213

SECTION 26 3600 - TRANSFER SWITCHES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:
   1. Automatic transfer switches.
B. Related Sections:
   1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
B. Shop Drawings: Dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
   1. Wiring Diagrams: Single-line diagram. Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
C. Field quality-control test reports.
D. Operation and Maintenance Data: Submit under provision of Section “Electrical General Requirements”. For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
   1. Features and operating sequences, both automatic and manual.
   2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.
   3. Include instructions for operating equipment under emergency conditions.
   4. Document ratings of equipment and each major component.
   5. Include routine preventive maintenance and lubrication schedule.
   6. List special tools, maintenance materials, and replacement parts

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
B. Testing Agency Qualifications: Refer to specification section “Electrical Testing”.
C. Source Limitations: Obtain automatic transfer switches, bypass/isolation switches, non-automatic transfer switches, remote annunciators, and remote annunciator and control panels through one source from a single manufacturer.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
E. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
F. UL 1008 - Standard for Automatic Transfer Switches, unless requirements of those specifications are stricter.
G. NFPA 70 - National Electrical Code, including use in emergency and standby systems in accordance with Articles 517, 700, 701 and 702
H. NFPA 99 - Essential Electrical Systems for Health Care Facilities
I. NFPA 110 - Standard for Emergency and Standby Power Systems
J. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems (Orange Book)
K. IEEE Standard 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)
L. NEMA Standard ICS2-447 - AC Automatic Transfer Switches
M. IEC - Standard for Automatic Transfer Switches

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of the transfer switch and associated auxiliary components that fail in materials or workmanship within specified warranty period.
    1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Contactor Transfer Switches:
        a. Emerson; ASCO Power Technologies, LP
        b. Caterpillar; Engine Div.
        c. Generac Power Systems, Inc.
        d. GE Zenith Controls.
        e. Kohler Co.; Generator Division.
        f. Cummins Power Generation.
        g. Russelectric, Inc.
        h. Eaton.

2.02 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

Switch Rating	Minimum WCR with "any breaker" rating
30-200	10,000
260-400	35,000
600-800	50,000
1000-1200	65,000
1600-4000	100,000

1. Provide fault-current and withstand ratings in accordance with UL 1008 standard's 1½ and 3 cycle long-time ratings. Transfer switches which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.
2. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels have communication capability matched with remote device.

D. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

H. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

I. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

J. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

K. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.
1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

M. Enclosures: General-purpose NEMA 250, Type 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.03 AUTOMATIC TRANSFER SWITCH

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

F. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.

G. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:
   1. Fully automatic make-before-break operation.
   2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
   3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
      a. Initiation occurs without active control of generator.
      b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
   4. Failure of power source serving load initiates automatic break-before-make transfer.

H. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

I. Automatic Transfer-Switch Features
   1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
   2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
   3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
   4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   5. Test Switch: Simulates normal-source failure.
   6. Switch-Position Pilot Lights: Indicate source to which load is connected.
   7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
      a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
      b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
   8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
   9. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
   10. Engine Shutdown Contacts:
      a. Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
      b. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

11. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.
12. Provide selective load disconnect control circuit (24 VDC output) to operate 0 to 5 minutes (field adjustable) before transfer of the automatic transfer switch and to reset 0-5 minutes (field adjustable) after transfer, in either direction. The two time delays shall be independently adjustable. This circuit shall be supplied on all transfer switches. For switches that feed elevator loads, provide double-pole/double-throw output relay for interface purposes that is driven by above control circuitry.
13. Transfer inhibit: Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.

2.04 BYPASS/ISOLATION SWITCH

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
    1. Means to lock the bypass/isolation switch in the position that isolates the transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
    2. Separate bypass and isolation handles shall be utilized to provide clear distinction between the two functions. The bypass handle shall provide three operating modes: "Bypass to Normal", "Automatic" and "Bypass to Emergency." Bypass to the load-carrying source shall be affected without any interruption of power to the load (make-before-break contacts). Load break-type bypass for ATS test and isolation shall not be acceptable. The operating speed of the bypass contacts shall be the same as that of the associated automatic transfer switch and shall be independent of the speed at which the manual bypass handle is operated. In the "Automatic" mode, bypass contacts shall be all open so they will not be subjected to fault currents.
    3. The isolation handle shall provide three operating modes: "Closed", "Test" and "Open". The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switch(es), without any interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.
    4. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch allowing transfer and retransfer of the load between the two available sources without the feedback of load-regenerated voltage to the transfer switch. This transfer/retransfer operation shall comply with Paragraph 42.7 of UL 1008.
    5. Bypass Switch Ratings: Match automatic transfer switch for electrical ratings.
    6. Drawout Arrangement Electrically Operated for Transfer Switch: Provides physical separation from live parts and accessibility for testing and maintenance operations.
    7. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.

8. Contact temperatures of bypass/isolation switches do not exceed those of automatic transfer-switch contacts when they are carrying rated load.
9. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.
10. Legend: Manufacturer's standard legend for control labels and instruction signs give detailed operating instructions.
11. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.05 NONAUTOMATIC TRANSFER SWITCHES

A. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." Switch is capable of transferring load in either direction with either or both sources energized.

B. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." In addition, removable manual handle provides quick-make, quick-break manual-switching action. Switch is capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.

C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.

D. Non Automatic Transfer Switch Accessories:
1. Pilot Lights: Indicate source to which load is connected.
2. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.
3. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
4. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."
5. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

2.06 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel annunciates conditions for indicated transfer switches. Annunciation includes the following:
1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
1. Indicating Lights: Grouped for each transfer switch monitored.
2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.07 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Include the following functions for indicated transfer switches:
1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Indication of switch position.
3. Indication of switch in test mode.
4. Indication of failure of digital communication link.
5. Key-switch or user-code access to control functions of panel.
6. Control of switch-test initiation.
7. Control of switch operation in either direction.
8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer

switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
   1. Controls and indicating lights grouped together for each transfer switch.
   2. Label each indicating light control group. Indicate the transfer switch it controls, location of switch, and load it serves.
   3. Digital Communication Capability: Matched to that of transfer switches supervised.
   4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.08 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 EXECUTION

3.01 INSTALLATION

A. Floor-Mounted Switch: Anchor to floor by bolting.
   1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 2 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated. Cast anchor-bolt inserts into bases. Comply with Division 3 Section "Cast-in-Place Concrete."

B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

C. Identify components according to Division 26 Section “Electrical Identification”.

3.02 WIRING TO REMOTE COMPONENTS

A. Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables.”

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect , test, and adjust components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing.”
   1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
   2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.22.3. Certify compliance with test parameters.
   3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
      a. Check for electrical continuity of circuits and for short circuits.
      b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
      c. Verify that manual transfer warnings are properly placed.
      d. Perform manual transfer operation.
   4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
      a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
      b. Simulate loss of phase-to-ground voltage for each phase of normal source.

c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
a. Verify grounding connections and locations and ratings of sensors.
b. Observe reaction of circuit-interrupting devices when simulated fault current is applied at sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 1 Section "Closeout Procedures."
1. Coordinate this training with that for generator equipment.

END OF SECTION 26 3600

SECTION 26 5119 - LED INTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Interior solid-state luminaires that use LED technology.
   2. Lighting fixture supports.
B. Related Requirements:
   1. Division 26 "Lighting Control Devices."

1.03 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color Rendering Index.
C. Fixture: See "Luminaire."
D. IP: International Protection or Ingress Protection Rating.
E. Lamp: LED and substrate as a replaceable assembly.
F. LED: Light-emitting diode.
G. Lumen: Measured output of lamp and luminaire, or both.
H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 SUBMITTALS

A. Product Data: For each type of product.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.
   5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
   6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.
      a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.

B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Qualification Data: For testing laboratory providing photometric data for luminaires.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

F. Sample warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.06 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with:
   1. NFPA 70 - National Electrical Code.
   2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
   3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
   4. Code of Federal Regulations (47 CFR 37342).
   5. Michigan Department of State Police, Fire Marshall Division Policy Number 11-06 “Plastic Materials as Interior Finishes” pertaining to the use of plastic lenses in lighting fixtures for health care facilities.
   6. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.

F. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.08 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.09 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) or manufacturer's standard warranty length (whichever is longer) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 LUMINAIRES (LIGHTING FIXTURES)

A. Provide Luminaires as included in specification 26 5700 "Luminaire Product Data." This section contains product data sheets from the basis of design manufacturer with annotations.

B. Acceptable alternate manufacturers are indicated on the product data sheets. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.

C. The Luminaire schedule shown on the drawings is supplemental provided for convenience and reference only. The requirements of this section and 26 5700 shall govern.

2.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.

E. Unless otherwise specified in Luminaire product data, provide products with a CCT of 3500K.

F. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 70,000 hours.

G. Driver

1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaries.
2. Nominal Input Voltage: All drivers shall be rated for use on either 120V or 277V systems.

2.03 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

D. Provide edge lit signs with a mirror plaque background.

2.04 EMERGENCY AUTOMATIC LOAD CONTROL RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bodine BLCD Series.
2. Nine-24, Inc.: ELCR Series.
3. LVS, EPC Series
4. IOTA, ETS-20 Series
5. Functional Devices, Inc., ESR Series
6. ETC, ALCR Series

7. Wattstopper, ELCU series

B. Description:
   1. The Automatic Load Control Relay (ALCR) shall provide required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area of the building.
   2. The ALCR shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device.
   3. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
   4. Self-contained with integral ½" nipple mount with snap in locking feature for mounting into a standard junction box knock out.
   5. Normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.
   6. Universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
   7. Integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.
   8. Dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.
   9. Separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).
   10. Normal power input leads shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
   11. Automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
   12. Utilize zero crossing circuitry to protect relay contacts from inrush current.
   13. Plenum rated housing equipped with compression flying leads.
   14. The unit shall be UL listed to the UL924 standard and labeled for connection to both normal and emergency lighting power sources.

C. Provide device with proper rating for total load and load type being transferred

D. Provide for devices suitable for line voltage and low voltage dimming control where required such that device bypasses dimming control signal to luminaire to provide full output upon loss of normal power.

E. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings for dimming characteristics.

2.05 BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. LVS EPC-D-F-ATS Series
   2. Bodine.

B. Description: Localized load transfer switch to allow emergency fixture to be powered and controlled by the normal lighting circuit, sense presence of normal power ahead of control circuit and switch luminaire (both line and neutral) over to emergency source upon loss of normal source.

C. Universal dimming capability to allow the lighting to be controlled and dimmed by the normal lighting circuit during normal times. In the event of a loss of the normal branch circuit, and transfer the designated emergency fixtures form normal dimming control to the emergency power source and bring them to full brightness, regardless of the current state of the dimming system.

D. Device shall be mounted remotely for each control circuit as application requires.

E. Listed and labeled by an NRTL to the UL1008 for emergency operation and listed for field installation.

F. Integral test switch and indicating lamps to indicate status.
G. Provide device with proper rating for total load and load type being transferred
H. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings.

2.06 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.
B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
C. Diffusers and Globes:
   1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Glass: Annealed crystal glass unless otherwise indicated.
   3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
D. Factory-Applied Labels: Comply with UL 1598 Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage, and coating.
      c. CCT and CRI for all luminaires.

2.07 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.08 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
B. Single-Stem Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
C. Wires: Unless otherwise specified in Luminaire product data, provide products with a minimum ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
D. Rod Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. Do not use permanent luminaires for temporary lighting.

3.03 INSTALLATION

A. Install in accordance with manufacturer’s instructions and N.E.C.A./I.E.S.N.A. 500-2006 and 502-2006.
B. Locate ceiling luminaires as indicated on reflected ceiling plan.
C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

D. Support luminaires independent of ceiling framing. Support recessed grid luminaries from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
E. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure
F. Install recessed luminaires to permit removal from below.
G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
H. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
I. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.
J. Supports:
1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

K. Flush-Mounted Luminaire Support:
1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

L. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

M. Ceiling-Mounted Luminaire Support:
1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
2. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
3. Ceiling mount with hook mount.

N. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

O. Comply with requirements in Section 26 0519 "Conductors and Cables" for wiring connections.
P. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.
Q. Locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
C. Bond products and metal accessories to branch circuit equipment grounding conductor.
D. Connect luminaires to branch circuit outlet boxes provided under Division 26 Section "Raceways and Boxes" using 1/2" flexible conduit.

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.06 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
    1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
    2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
B. Luminaire will be considered defective if it does not pass operation tests and inspections.
C. Prepare test and inspection reports.
D. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

3.07 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 26 0943.16 "Addressable-Fixture Lighting Controls."

3.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
    1. During adjustment visits, inspect all luminaires. Replace lamps, drivers, or luminaires that are defective.
    2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
    3. Adjust the aim of luminaires in the presence of the Architect.
B. Adjust exit sign directional arrows as indicated on Drawings.
C. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner’s representative and Architect/Engineer.

3.09 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.
B. Remove dirt and debris from enclosures and lenses.
C. Clean photometric control surfaces as recommended by manufacturer.
D. Clean finishes and touch up damage.

END OF SECTION 26 5119

SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Exterior luminaires with lamps and ballasts.
   2. Luminaire-mounted photoelectric relays.
B. Related Sections include the following:
   1. Division 26 Section "LED Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.03 DEFINITIONS

A. CRI: Color-rendering index.
B. HID: High-intensity discharge.
C. Luminaire: Complete lighting fixture, including ballast housing if provided.
D. Pole: Luminaire support structure, including tower used for large area illumination.
E. Standard: Same definition as "Pole" above.

1.04 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
   2. Details of attaching luminaires and accessories.
   3. Details of installation and construction.
   4. Luminaire materials.
   5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Anchor bolts for poles.

B. Samples for Verification: For products designated for sample submission in Exterior Lighting Device Schedule. Each sample shall include lamps and ballasts.
C. Qualification Data: For agencies providing photometric data for lighting fixtures.
D. Field quality-control test reports.
E. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.
F. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with IEEE C2, "National Electrical Safety Code."
D. Comply with NFPA 70.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period.
1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.02 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
G. Exposed Hardware Material: Stainless steel.
H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
    1. White Surfaces: 85 percent.
    2. Specular Surfaces: 83 percent.
    3. Diffusing Specular Surfaces: 75 percent.
K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping.
M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
    1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
    2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
        a. Color: As selected by Architect from manufacturer's full range.
N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
    1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
    2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
        a. Color: As selected by Architect.

2.03 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.
B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
    1. Relay with locking-type receptacle shall comply with NEMA C136.10.
    2. Adjustable window slide for adjusting on-off set points.

PART 3 EXECUTION

3.01 LUMINAIRE INSTALLATION

A. Install exterior lighting system per N.E.C.A./I.E.S.N.A. 501-2006.
B. Install lamps in each luminaire.
C. Fasten luminaire to indicated structural supports.
D. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.02 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 3 Section "Cast-in-Place Concrete."

3.03 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 3 Section "Cast-in-Place Concrete."

3.04 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.05 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding."

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding."

3.06 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 26 5600

TYPE L1A

Catalog Number	
Notes	PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.
Type	

BLT Series LED

2BLT4

2' x 4' LED

ADP Diffuser Option

Ribbed Reflector Option

nLIGHT eldoLED

ISO Class 5-9

Buy American JOT JUST ONE TOUCH

Specifications

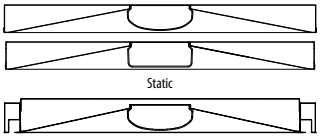
Length: 47-3/4 (121.2)

Width: 23-3/4 (60.3)

Depth: 2-3/8 (6.0)

Depth with Air supply/return: 2-3/4 (6.9)

All dimensions are inches (centimeters) unless otherwise specified.



Static

Air Supply/Return

Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

DIGITAL NAVIGATION

Ordering Tree nLight Platform Sensor Switch JOT Photometrics Performance Data

FEATURES & SPECIFICATIONS

INTENDED USE —The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available - curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight®controls make each luminaire addressable - allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless RIO, RES7 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intutitive mobile app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR— Integrated sensor (individual control): Sensor Switch MSD7ADCX ((Passive infrared (PIR)) or MSDPDT7ADCX ((PIR/Microphonics Dual Tech (PDT)) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminairs and wall switches through our mobile app, CL*AIR*ITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms.

DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN — Product with the BAA option is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT.
Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

2BLT Volumetric Recessed Lighting 2'x4'

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT4 40L ADP EZ1 LP840

2BLT4

Series	Fixture Style	Air function	Lumens ‡		Diffuser	Voltage	Driver	Color temperature
2BLT4 2x4 BLT	(blank) Smooth Reflector	(blank) Static	**Standard efficiency (>100 LPW)**	**High efficiency ‡ (>130 LPW)**	ADP Curved, ribbed	(blank) MVOLT	EZ1 eldoLED dims to 1% (0-10 volt dimming)	LP830 82CRI, 3000 K
	RB Ribbed Reflector	A Air supply/ return ‡	30L 3000	30LHE 3000	ADSM Curved, smooth	120 120V	GZ1 Dims to 1% (0-10V dimming) ‡	LP835 82CRI, 3500 K
			40L 4000	40LHE 4000	SDP Square, ribbed	277 277V	GZ10 Dims to 10% (0-10V dimming) ‡	LP840 82CRI, 4000 K
			48L 4800	48LHE 4800	SDSM Square, smooth	347 347V ‡	SLD Step-level dimming ‡	LP850 82CRI, 5000 K
			60L 6000	60LHE 6000	**Includes trim rings to match sensored version**			LP930 90CRI, 3000K
			72L 7200	72LHE 7200	ADPT Curved, ribbed			LP935 90CRI, 3500K
			85L 8500	85LHE 8500	ADSMT Curved, smooth			LP940 90CRI, 4000K
			100L 10000		SDPT Square, ribbed			LP950 90CRI, 5000K
			120L 12000		SDSMT Square, smooth			

nLight Interface

nLight Wired

(blank)	no nLight ® interface
N80	nLight with 80% lumen management
N80EMG	nLight with 80% lumen management For use with generator supply EM power ‡
N100	nLight without lumen management
N100EMG	nLight without lumen management For use with generator supply EM power ‡

nLight Wireless

(blank)	no nLight ® interface
NLTAIR2	nLight AIR Generation 2 enabled ‡

Control ‡

nLight Wired ‡

(blank)	No sensor control
NES7	nLight™ nES 7 PIR integral occupancy sensor
NESPDT7	nLight™ nES PDT 7 dual technology integral occupancy control
NES7ADCX	nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell
NESPDT7ADCX	nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell

nLight Wireless

RES7	nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities
RES7PDT	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell
RIO	nLight AIR radio module without sensor
RES7EM	nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RES7PDTEM	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RIOEM	nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡

Individual Control

MSD7ADCX	PIR integral occupancy sensor with automatic dimming control photocell ‡
MSDPDT7ADCX	PDT integral occupancy sensor with automatic dimming control photocell ‡
JOT	Wireless room control with "Just One Touch" pairing ‡
JOTVTX15	Wireless occupancy sensor with "Just One Touch" pairing ‡

Standy Mode

NOC	NOC Occupancy sensor disabled ‡

Options

BDP Disconnect Plug

EL7L	700 lumen battery pack (Noncompliant with CA T20) ‡
EL14L	1400 lumen battery pack (Noncompliant with CA T20) ‡
EL14LSD	1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡
E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡

CP	Chicago plenum ‡
BGTD	Bodine Generator Transfer Device ‡
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit
PWS1846 PWSLV	Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡
PWS1856LV	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡

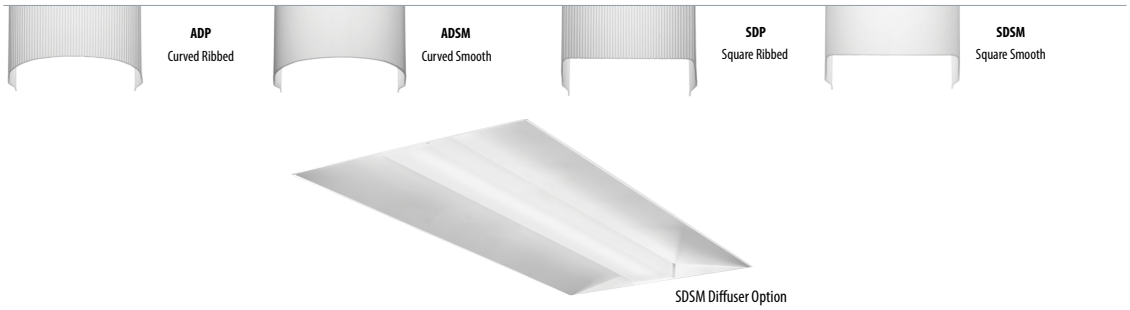
GLR	Fast-blowing fuse ‡
GMF	Slow-blowing fuse ‡
NPLT	Narrow pallet
RRL_	RELOC®-ready luminaire ‡
LATC	Earthquake clip
DWAM	Anti-Microbial paint
JP14	Job packaging ‡
JP18	Job packaging ‡
IP5X	Gasketed diffuser compartment to meet IP5X rating ‡
BAA	Buy America(n) Act Compliant

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restictions chart on the next page. Options are sorted alphanumerically.

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

‡ Option Value Ordering Restrictions	
Option value	**Restriction**
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with TD, JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Controls	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JOT & JOTVTX15
EL14LSD, E10WLCP, EL7L, EL14L	When using pre-wire option, use PWS1846 or PWS1846 PWSLV. For more information, please see the PSSD2 specification sheet.
FAO	EZ1 driver required. Not available with USPOM, FAO or lumen packages > 6000LM. FAO restricts use of external Dimming controls. See chart on page 3 for additional details.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
IP5X	Not available with air supply/return or Wired Networking (NES_) and Individual Control (MSD_) sensors.
JOT, JOTVTX15	Not available with standard efficiency 85L, 100L or 120L lumen options. Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP14	Only available on fixtures with NES7, NESPDT7, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, RIO, JOT,JOTVTX15. Not available when air supply/return function and sensor options are combined.
JP18	Not available with option: NES7, NESPDT7, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com. Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSD7ADCX, MSDPDT7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver. Not available with 85L, 100L, or 120L options.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 4. Not available with 72L, 72LHE, or 85LHE lumen packages.
RRL_	For ordering logic consult: RRL_2013.
SLD	Not available with with any nLight Interface or Control options.

Multiple Diffuser Options



SDSM Diffuser Option

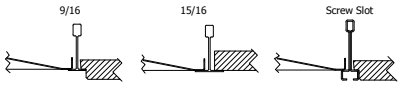
2BLT Volumetric Recessed Lighting 2'x4'

Non-Configurable BLT

Non-Configurable BLT								
Stock/MTO	**Catalog Description ***	**UPC**	**Lumens**	**Wattage**	**LPW**	**Color Temperature**	**Voltage**	**Pallet Qty**
Stock	2BLT4 40L ADP LP835	00190887470789	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP LP840	00190887470765	4063	31.69	128.23	4000K/82CRI	120-277	28
	2BLT4 46L ADP LP835	00190887468656	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP LP840	00190887468649	5039.18	38	132.58	4000K/82CRI	120-277	28
	2BLT4 40L ADP EL14L LP835	00190887470925	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP EL14L LP840	00190887470918	4063	31.69	128.23	4000K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP835	00190887468670	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP840	00190887468663	5039.18	38	132.58	4000K/82 CRI	120-277	28

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	**Appropriate Trim Type**
Exposed grid tee (1' and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

Accessories & Replacement Parts

Accessories: *Order as separate catalog number.*

DGA24	Drywall grid adapter for 2x4 recessed fixture
2X4SMKSHP PAF	Surface Mount Troffer Kit Post Paint
RK8BDP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1
RK8BDP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1
RK8BDP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10
RK8BDP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40

Replacement Parts: *Order as separate catalog number.*

*249P2N	2DBLT48 ADP LENS ASSEMBLY	4 ft. replacement lens
*249P2T	2DBLT48 SDP LENS ASSEMBLY	4 ft. replacement lens
*249P30	2DBLT48 ADSM LENS ASSEMBLY	4 ft. replacement lens
*249P33	2DBLT48 SDSM LENS ASSEMBLY	4 ft. replacement lens
*237LT2	2DBLT48 ADPT LENS ASSEMBLY	4 ft. replacement lens
*237LT4	2DBLT48 SDPT LENS ASSEMBLY	4 ft. replacement lens
*237LT6	2DBLT48 ADSMT LENS ASSEMBLY	4 ft. replacement lens
*237LT8	2DBLT48 SDSMT LENS ASSEMBLY	4 ft. replacement lens
*237LTA	2DBLT48 ADPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237M52	2DBLT48 SDPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237M5A	2DBLT48 ADSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237M5L	2DBLT48 SDSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens

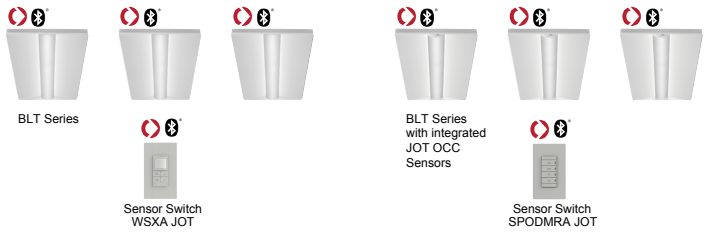
JOT Wireless

JOT Just One Touch

Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

1. **Power:** Install JOT enabled fixtures and controls as instructed.
2. **Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
3. **Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CL**AIR**ITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

nLight Wired Networking

Simple as 1,2,3

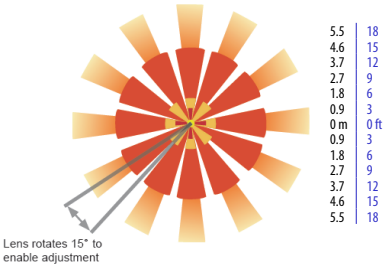
1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSD7ADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPDT7			X	X	
NESPDT7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	X	X	X		X

Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSD7ADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

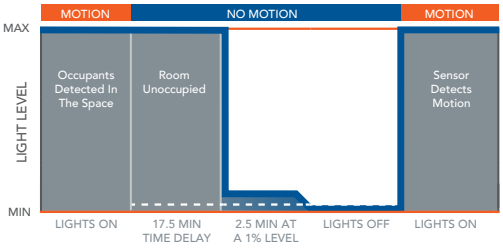
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

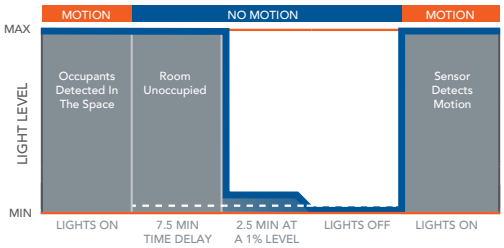
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)



*The presetting on the automatic dimming photocell is 5fc (NES7) and 10fc (RES7).

COMMERCIAL INDOOR: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

Controls Accessories

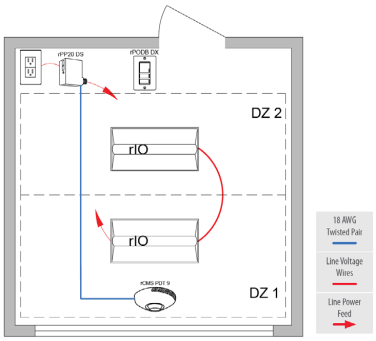
nLight® Wired Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1

nLight® AIR Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS[1] — **Example: RCMS PDT 10 AR G2**

Series / Detection		Power Supply[1]		Occupancy Detection		Lens (Required)		Operating Mode		Generation	
RCMS	nLight AIR occupancy and daylight sensor	[blank]	Power Supply ordered separately	[blank]	PIR Detection	10	Large Motion/ Extended Range 360°	[BLANK]	None	G2	Generation 2 compatibility
		PS 150	Standard 150 mA Power Supply	PDT	Dual Tech PIR/ Microphonics	9	Small Motion/ Extended Range 360°	AR	Auxiliary Relay		
						6	High Bay 360° Lens				

Notes
1 RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.


Sensor Switch WSX


nLight WIRED NPOD UNITOUCH

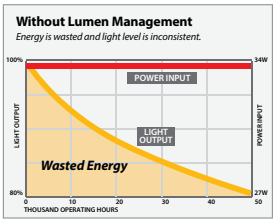

nLight WIRED nPODMA DX

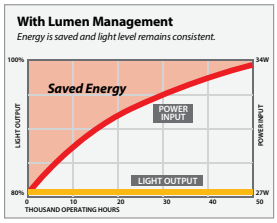

nLight AIR rPODBA


BLT with rIO | rPODBA | RCMS

Constant Lumen Management

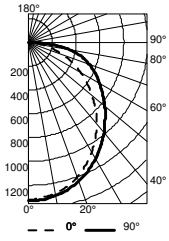
Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.





PHOTOMETRICS

2BLT4 40L ADP LP835, 4000 delivered lumens, test no. ISF36900P109, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1325	1325
5°	1309	1325
15°	1250	1278
25°	1136	1187
35°	981	1058
45°	797	909
55°	601	761
65°	408	621
75°	212	460
85°	48	197
90	1	17

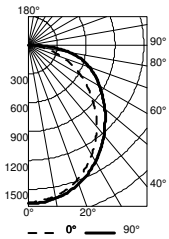
Coefficients of Utilization

	pf			20%								
	pc	80%			70%			50%				
	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%		
RCR	0	119	119	119	116	116	116	111	111	111		
	1	108	102	97	100	96	92	96	92	89		
	2	97	88	81	86	80	74	83	77	72		
	3	88	77	69	76	68	61	72	66	60		
	4	81	68	59	67	58	52	64	57	51		
	5	74	61	51	60	51	44	57	50	44		
	6	68	55	45	54	45	39	52	44	38		
	7	63	50	40	49	40	34	47	39	34		
	8	59	45	36	44	36	30	43	36	30		
	9	55	41	33	41	33	27	40	32	27		
	10	52	38	30	38	30	25	37	30	25		

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1024	25.6	25.6
0° - 40°	1669	41.7	41.7
0° - 60°	2960	74.0	74.0
0° - 90°	3998	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4000	100.0	100.0

2BLT4 48L ADP LP835, 4960 delivered lumens, test no. ISF 36900P117, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1643	1643
5°	1623	1644
15°	1550	1585
25°	1409	1472
35°	1217	1312
45°	988	1127
55°	745	943
65°	505	769
75°	263	571
85°	59	244
90	1	21

Coefficients of Utilization

	pf			20%								
	pc	80%			70%			50%				
	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%		
RCR	0	119	119	119	116	116	116	111	111	111		
	1	108	102	97	100	96	92	96	92	89		
	2	97	88	81	86	80	74	83	77	72		
	3	88	77	69	76	68	61	72	66	60		
	4	81	68	59	67	58	52	64	57	51		
	5	74	61	51	60	51	44	57	50	44		
	6	68	55	45	54	45	39	52	44	38		
	7	63	50	40	49	40	34	47	39	34		
	8	59	45	36	44	36	30	43	36	30		
	9	55	41	33	41	33	27	40	32	27		
	10	52	38	30	38	30	25	37	30	25		

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1270	25.6	25.6
0° - 40°	2070	41.7	41.7
0° - 60°	3671	74.0	74.0
0° - 90°	4957	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4960	100.0	100.0

2BLT Volumetric Recessed Lighting 2'x4'

Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT4 30L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	2962	127.31	23.26	Premium	PWJDEMHS
2BLT4 30L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3009.28	129.34	23.26	Premium	P18J5GLD
2BLT4 30L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	2969.16	127.62	23.26	Premium	P3HB2XSG
2BLT4 40L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4000	126.22	31.69	Premium	PDWKYXFD
2BLT4 40L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4063.86	128.23	31.69	Premium	PEYXAZWD
2BLT4 40L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3946.66	124.53	31.69	Premium	PS63CPK6
2BLT4 40L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4009.67	126.52	31.69	Premium	PK79UR9W
2BLT4 48L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4960	130.5	38	Premium	PJ9CK6C1
2BLT4 48L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	5039.18	132.58	38	Premium	P9W2R5AK
2BLT4 48L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4893.86	128.76	38	Premium	PPFKZU3U
2BLT4 48L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4971.99	130.82	38	Premium	PC8HMCH9
2BLT4 60L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	6016	126.39	47.59	Premium	PSJ6QERM
2BLT4 60L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	6112.04	128.4	47.59	Premium	PVXQXPUV
2BLT4 60L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	5935.78	124.7	47.59	Premium	PHT84BW4
2BLT4 60L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	6030.55	126.69	47.59	Premium	PXV55BC8
2BLT4 72L ADP EZ1 (GZ10) LP840 [All Options]	7360.66	125.3	58.74	Premium	PSCZ22CB
2BLT4 72L ADP GZ1 LP835 [All Options]	7245	119.07	60.84	standard	PISHTCTS
2BLT4 72L ADP GZ1 LP840 [All Options]	7360.66	120.97	60.84	standard	PBERALG7
2BLT4 72L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	7148.4	117.48	60.84	standard	PDQS3CYK
2BLT4 72L ADPT EZ1 (GZ10) LP840 [All Options]	7262.52	123.63	58.74	Premium	P2KKMMVN
2BLT4 72L ADPT GZ1 LP840 [All Options]	7262.52	119.36	60.84	standard	P10DUPC0
2BLT4 85L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	8567	116.43	73.58	standard	PYD2G06V
2BLT4 85L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	8703.77	118.28	73.58	standard	P8Z4IV4X
2BLT4 85L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	8452.77	114.87	73.58	standard	PTZEW3QM
2BLT4 85L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	8587.72	116.71	73.58	standard	P01DMEK9
2BLT4 100L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	9837	103.14	95.36	standard	PGDES20R
2BLT4 100L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	9994.04	104.79	95.36	standard	P007CHGX
2BLT4 100L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	9705.84	101.77	95.36	standard	PSZUQY7M
2BLT4 100L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	9860.79	103.39	95.36	standard	P6V6X6HY
2BLT4 120L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	11709	118.18	99.07	standard	PGM4Y7DP
2BLT4 120L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	11895.9	120.07	99.07	standard	P00DDCG2
2BLT4 120L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	11552.9	116.61	99.07	standard	PXM0FS09
2BLT4 120L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	11737.3	118.47	99.07	standard	PJ4GEBZM

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

HE Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT4 30LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3107	135.17	22.98	Premium	P7KEICW5
2BLT4 30LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3156.6	137.33	22.98	Premium	PDOM06BH
2BLT4 30LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3065.57	133.37	22.98	Premium	P7PZAJDZ
2BLT4 30LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3114.51	135.5	22.98	Premium	P2N23EBP
2BLT4 40LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4085	138.56	29.48	Premium	P67P6S5Y
2BLT4 40LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4150.21	140.77	29.48	Premium	P95UQD66
2BLT4 40LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4030.53	136.71	29.48	Premium	PC15DQEC
2BLT4 40LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4094.88	138.89	29.48	Premium	PGRCSJ2T
2BLT4 48LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4770	138.16	34.52	Premium	PXBJBGN8
2BLT4 48LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4846.15	140.37	34.52	Premium	P5PQ5RRX
2BLT4 48LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4706.4	136.32	34.52	Premium	P2NK2H33
2BLT4 48LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4781.53	138.5	34.52	Premium	PK8C1321
2BLT4 60LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	5894	135.12	43.61	Premium	PQZN176R
2BLT4 60LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	5988.09	137.28	43.61	Premium	PG5CYJUC
2BLT4 60LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	5815.41	133.32	43.61	Premium	PZ72TAWM
2BLT4 60LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	5908.25	135.45	43.61	Premium	PRC4W72B
2BLT4 72LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	7149	135.94	52.58	Premium	PUB38GEQ
2BLT4 72LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	7263.13	138.11	52.58	Premium	P7GDHZTN
2BLT4 72LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	7053.68	134.12	52.58	Premium	P5CC2VKV
2BLT4 72LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	7166.29	136.26	52.58	Premium	P6P1BKDM
2BLT4 85LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	8158	128.96	63.25	Premium	PRTW6BXW
2BLT4 85LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	8288.24	131.02	63.25	Premium	P6H1V2D6
2BLT4 85LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	8049.22	127.24	63.25	Premium	P1VGSTA3
2BLT4 85LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	8177.73	129.27	63.25	Premium	PN5BKJ6E

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Delivered Lumens = 1.25 x P x LPW
P = Ouput power of emergency driver. P = 10W for E10WLCP option.
LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

TYPE L1B

Catalog Number	
Notes	PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.
Type	

BLT Series LED

2BLT4

2' x 4' LED

ADP Diffuser Option

Ribbed Reflector Option

nLIGHT eldoLED

ISO Class 5-9

Buy American JOT JUST ONE TOUCH

Specifications

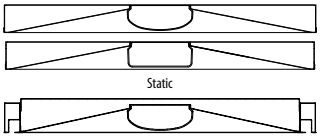
Length: 47-3/4 (121.2)

Width: 23-3/4 (60.3)

Depth: 2-3/8 (6.0)

Depth with Air supply/return: 2-3/4 (6.9)

All dimensions are inches (centimeters) unless otherwise specified.



Static

Air Supply/Return

Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

DIGITAL NAVIGATION

Ordering Tree nLight Platform Sensor Switch JOT Photometrics Performance Data

FEATURES & SPECIFICATIONS

INTENDED USE —The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available - curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight®controls make each luminaire addressable - allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless RIO, RES7 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intutitive mobile app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR— Integrated sensor (individual control): Sensor Switch MSD7ADCX ((Passive infrared (PIR)) or MSDPDT7ADCX ((PIR/Microphonics Dual Tech (PDT)) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminairs and wall switches through our mobile app, CL*AIR*ITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms.

DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN — Product with the BAA option is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT.
Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

2BLT Volumetric Recessed Lighting 2'x4'

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT4 40L ADP EZ1 LP840

2BLT4

Series	Fixture Style	Air function	Lumens ‡		Diffuser	Voltage	Driver	Color temperature
2BLT4 2x4 BLT	(blank) Smooth Reflector	(blank) Static	**Standard efficiency (>100 LPW)**	**High efficiency ‡ (>130 LPW)**	ADP Curved, ribbed	(blank) MVOLT	EZ1 eldoLED dims to 1% (0-10 volt dimming)	LP830 82CRI, 3000 K
	RB Ribbed Reflector	A Air supply/ return ‡	30L 3000	30LHE 3000	ADSM Curved, smooth	120 120V	GZ1 Dims to 1% (0-10V dimming) ‡	LP835 82CRI, 3500 K
			40L 4000	40LHE 4000	SDP Square, ribbed	277 277V	GZ10 Dims to 10% (0-10V dimming) ‡	LP840 82CRI, 4000 K
			48L 4800	48LHE 4800	SDSM Square, smooth	347 347V ‡	SLD Step-level dimming ‡	LP850 82CRI, 5000 K
			60L 6000	60LHE 6000	**Includes trim rings to match sensored version**			LP930 90CRI, 3000K
			72L 7200	72LHE 7200	ADPT Curved, ribbed			LP935 90CRI, 3500K
			85L 8500	85LHE 8500	ADSMT Curved, smooth			LP940 90CRI, 4000K
			100L 10000		SDPT Square, ribbed			LP950 90CRI, 5000K
			120L 12000		SDSMT Square, smooth			

nLight Interface

nLight Wired

(blank)	no nLight ® interface
N80	nLight with 80% lumen management
N80EMG	nLight with 80% lumen management For use with generator supply EM power ‡
N100	nLight without lumen management
N100EMG	nLight without lumen management For use with generator supply EM power ‡

nLight Wireless

(blank)	no nLight ® interface
NLTAIR2	nLight AIR Generation 2 enabled ‡

Control ‡

nLight Wired ‡

(blank)	No sensor control
NES7	nLight™ nES 7 PIR integral occupancy sensor
NESPDT7	nLight™ nES PDT 7 dual technology integral occupancy control
NES7ADCX	nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell
NESPDT7ADCX	nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell

nLight Wireless

RES7	nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities
RES7PDT	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell
RIO	nLight AIR radio module without sensor
RES7EM	nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RES7PDTEM	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RIOEM	nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡

Individual Control

MSD7ADCX	PIR integral occupancy sensor with automatic dimming control photocell ‡
MSDPDT7ADCX	PDT integral occupancy sensor with automatic dimming control photocell ‡
JOT	Wireless room control with "Just One Touch" pairing ‡
JOTVTX15	Wireless occupancy sensor with "Just One Touch" pairing ‡

Standy Mode

NOC	NOC Occupancy sensor disabled ‡

Options

BDP Disconnect Plug

EL7L	700 lumen battery pack (Noncompliant with CA T20) ‡
EL14L	1400 lumen battery pack (Noncompliant with CA T20) ‡
EL14LSD	1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡
E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡

CP	Chicago plenum ‡
BGTD	Bodine Generator Transfer Device ‡
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit
PWS1846 PWSLV	Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡
PWS1856LV	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡

GLR	Fast-blowing fuse ‡
GMF	Slow-blowing fuse ‡
NPLT	Narrow pallet
RRL_	RELOC®-ready luminaire ‡
LATC	Earthquake clip
DWAM	Anti-Microbial paint
JP14	Job packaging ‡
JP18	Job packaging ‡
IP5X	Gasketed diffuser compartment to meet IP5X rating ‡
BAA	Buy America(n) Act Compliant

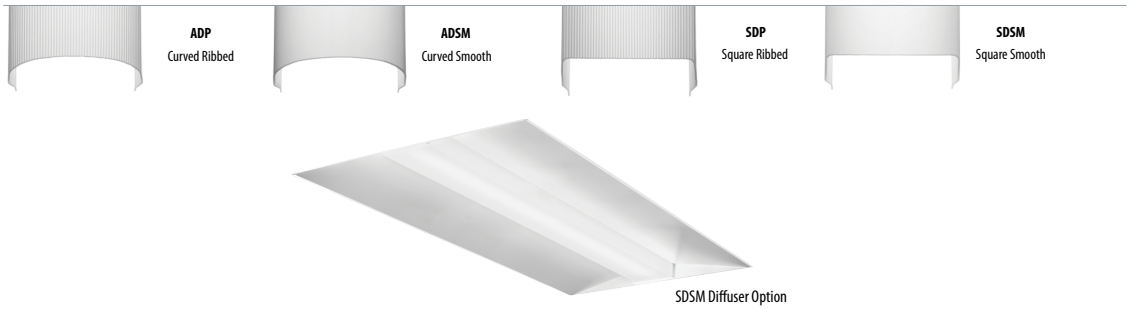
NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restictions chart on the next page. Options are sorted alphanumerically.

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

COMMERCIAL INDOOR: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

‡ Option Value Ordering Restrictions	
Option value	**Restriction**
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with TD, JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Controls	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JOT & JOTVTX15
EL14LSD, E10WLCP, EL7L, EL14L	When using pre-wire option, use PWS1846 or PWS1846 PWSLV. For more information, please see the PSSD2 specification sheet.
FAO	EZ1 driver required. Not available with USPOM, FAO or lumen packages > 6000LM. FAO restricts use of external Dimming controls. See chart on page 3 for additional details.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
IP5X	Not available with air supply/return or Wired Networking (NES_) and Individual Control (MSD_) sensors.
JOT, JOTVTX15	Not available with standard efficiency 85L, 100L or 120L lumen options. Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP14	Only available on fixtures with NES7, NESPDT7, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, RIO, JOT,JOTVTX15. Not available when air supply/return function and sensor options are combined.
JP18	Not available with option: NES7, NESPDT7, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com. Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSD7ADCX, MSDPDT7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver. Not available with 85L, 100L, or 120L options.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 4. Not available with 72L, 72LHE, or 85LHE lumen packages.
RRL_	For ordering logic consult: RRL_2013.
SLD	Not available with with any nLight Interface or Control options.

Multiple Diffuser Options



SDSM Diffuser Option

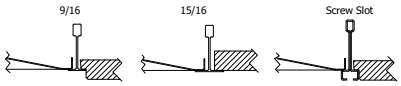
2BLT Volumetric Recessed Lighting 2'x4'

Non-Configurable BLT

Non-Configurable BLT								
Stock/MTO	**Catalog Description ***	**UPC**	**Lumens**	**Wattage**	**LPW**	**Color Temperature**	**Voltage**	**Pallet Qty**
Stock	2BLT4 40L ADP LP835	00190887470789	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP LP840	00190887470765	4063	31.69	128.23	4000K/82CRI	120-277	28
	2BLT4 46L ADP LP835	00190887468656	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP LP840	00190887468649	5039.18	38	132.58	4000K/82CRI	120-277	28
	2BLT4 40L ADP EL14L LP835	00190887470925	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP EL14L LP840	00190887470918	4063	31.69	128.23	4000K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP835	00190887468670	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP840	00190887468663	5039.18	38	132.58	4000K/82 CRI	120-277	28

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	**Appropriate Trim Type**
Exposed grid tee (1' and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

Accessories & Replacement Parts

Accessories: *Order as separate catalog number.*

DGA24	Drywall grid adapter for 2x4 recessed fixture
2X4SMKSHP PAF	Surface Mount Troffer Kit Post Paint
RK8BDP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1
RK8BDP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1
RK8BDP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10
RK8BDP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40

Replacement Parts: *Order as separate catalog number.*

*249P2N	2DBLT48 ADP LENS ASSEMBLY	4 ft. replacement lens
*249P2T	2DBLT48 SDP LENS ASSEMBLY	4 ft. replacement lens
*249P30	2DBLT48 ADSM LENS ASSEMBLY	4 ft. replacement lens
*249P33	2DBLT48 SDSM LENS ASSEMBLY	4 ft. replacement lens
*237LT2	2DBLT48 ADPT LENS ASSEMBLY	4 ft. replacement lens
*237LT4	2DBLT48 SDPT LENS ASSEMBLY	4 ft. replacement lens
*237LT6	2DBLT48 ADSMT LENS ASSEMBLY	4 ft. replacement lens
*237LT8	2DBLT48 SDSMT LENS ASSEMBLY	4 ft. replacement lens
*237LTA	2DBLT48 ADPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237M52	2DBLT48 SDPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237M5A	2DBLT48 ADSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237M5L	2DBLT48 SDSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens

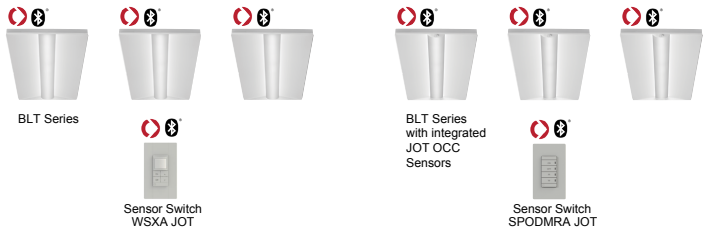
JOT Wireless

JOT Just One Touch

Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

1. **Power:** Install JOT enabled fixtures and controls as instructed.
2. **Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
3. **Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CL**AIR**ITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

nLight Wired Networking

Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

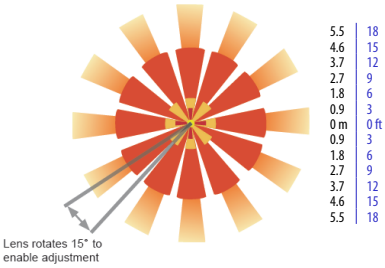
2BLT Volumetric Recessed Lighting 2'x4'

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSD7ADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPDT7			X	X	
NESPDT7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	X	X	X		X

Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSD7ADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

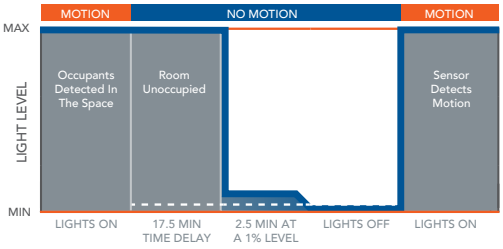
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

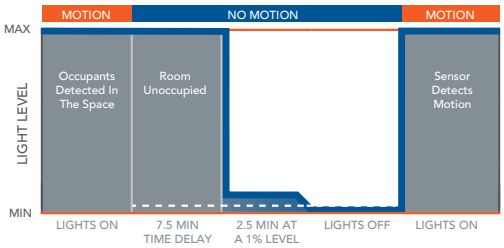
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)



*The presetting on the automatic dimming photocell is 5fc (NES7) and 10fc (RES7).

COMMERCIAL INDOOR: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

2BLT Volumetric Recessed Lighting 2'x4'

Controls Accessories

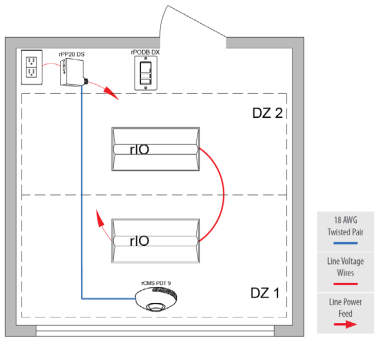
nLight® Wired Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	**Model number**	**Occupancy sensors**	**Model number**
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1

nLight® AIR Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	**Model number**
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS[1]											Example: RCMS PDT 10 AR G2
Series / Detection		Power Supply[1]		Occupancy Detection		Lens (Required)		Operating Mode		Generation	
RCMS	nLight AIR occupancy and daylight sensor	[blank]	Power Supply ordered separately	[blank]	PIR Detection	10	Large Motion/ Extended Range 360°	[BLANK]	None	G2	Generation 2 compatibility
		PS 150	Standard 150 mA Power Supply	PDT	Dual Tech PIR/ Microphonics	9	Small Motion/ Extended Range 360°	AR	Auxiliary Relay		
						6	High Bay 360° Lens				

Notes
1 RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.


Sensor Switch WSX


nLight WIRED NPOD UNITOUCH


nLight WIRED nPODMA DX


nLight AIR rPODBA

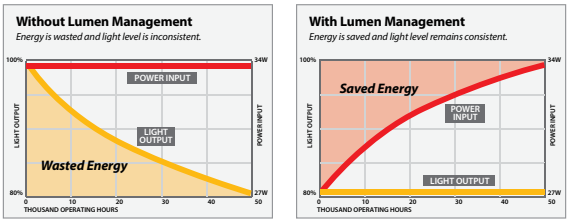

BLT with rIO


rPODBA


RCMS

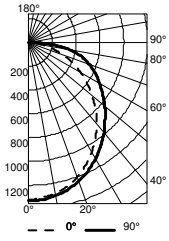
Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.



PHOTOMETRICS

2BLT4 40L ADP LP835, 4000 delivered lumens, test no. ISF36900P109, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1325	1325
5°	1309	1325
15°	1250	1278
25°	1136	1187
35°	981	1058
45°	797	909
55°	601	761
65°	408	621
75°	212	460
85°	48	197
90	1	17

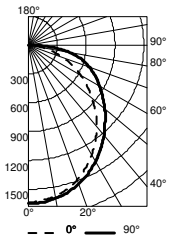
Coefficients of Utilization

RCR	pf 20% pc 80% pw 70%	50%	30%	10%	70%	50%	30%	10%	50%	30%	10%
0		119	119	119	116	116	116	116	111	111	111
1		108	102	97	100	96	92	96	92	89	
2		97	88	81	86	80	74	83	77	72	
3		88	77	69	76	68	61	72	66	60	
4		81	68	59	67	58	52	64	57	51	
5		74	61	51	60	51	44	57	50	44	
6		68	55	45	54	45	39	52	44	38	
7		63	50	40	49	40	34	47	39	34	
8		59	45	36	44	36	30	43	36	30	
9		55	41	33	41	33	27	40	32	27	
10		52	38	30	38	30	25	37	30	25	

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1024	25.6	25.6
0° - 40°	1669	41.7	41.7
0° - 60°	2960	74.0	74.0
0° - 90°	3998	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4000	100.0	100.0

2BLT4 48L ADP LP835, 4960 delivered lumens, test no. ISF 36900P117, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1643	1643
5°	1623	1644
15°	1550	1585
25°	1409	1472
35°	1217	1312
45°	988	1127
55°	745	943
65°	505	769
75°	263	571
85°	59	244
90	1	21

Coefficients of Utilization

RCR	pf 20% pc 80% pw 70%	50%	30%	10%	70%	50%	30%	10%	50%	30%	10%
0		119	119	119	116	116	116	116	111	111	111
1		108	102	97	100	96	92	96	92	89	
2		97	88	81	86	80	74	83	77	72	
3		88	77	69	76	68	61	72	66	60	
4		81	68	59	67	58	52	64	57	51	
5		74	61	51	60	51	44	57	50	44	
6		68	55	45	54	45	39	52	44	38	
7		63	50	40	49	40	34	47	39	34	
8		59	45	36	44	36	30	43	36	30	
9		55	41	33	41	33	27	40	32	27	
10		52	38	30	38	30	25	37	30	25	

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1270	25.6	25.6
0° - 40°	2070	41.7	41.7
0° - 60°	3671	74.0	74.0
0° - 90°	4957	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4960	100.0	100.0

2BLT Volumetric Recessed Lighting 2'x4'

Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT4 30L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	2962	127.31	23.26	Premium	PWJDEMHS
2BLT4 30L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3009.28	129.34	23.26	Premium	P18J5GLD
2BLT4 30L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	2969.16	127.62	23.26	Premium	P3HB2XSG
2BLT4 40L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4000	126.22	31.69	Premium	PDWKYXFD
2BLT4 40L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4063.86	128.23	31.69	Premium	PEYXAZWD
2BLT4 40L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3946.66	124.53	31.69	Premium	PS63CPK6
2BLT4 40L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4009.67	126.52	31.69	Premium	PK79UR9W
2BLT4 48L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4960	130.5	38	Premium	PJ9CK6C1
2BLT4 48L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	5039.18	132.58	38	Premium	P9W2R5AK
2BLT4 48L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4893.86	128.76	38	Premium	PPFKZU3U
2BLT4 48L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4971.99	130.82	38	Premium	PC8HMCH9
2BLT4 60L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	6016	126.39	47.59	Premium	PSJ6QERM
2BLT4 60L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	6112.04	128.4	47.59	Premium	PVXQXPUV
2BLT4 60L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	5935.78	124.7	47.59	Premium	PHT84BW4
2BLT4 60L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	6030.55	126.69	47.59	Premium	PXV55BC8
2BLT4 72L ADP EZ1 (GZ10) LP840 [All Options]	7360.66	125.3	58.74	Premium	PSCZ22CB
2BLT4 72L ADP GZ1 LP835 [All Options]	7245	119.07	60.84	standard	PISHTCTS
2BLT4 72L ADP GZ1 LP840 [All Options]	7360.66	120.97	60.84	standard	PBERALG7
2BLT4 72L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	7148.4	117.48	60.84	standard	PDQS3CYK
2BLT4 72L ADPT EZ1 (GZ10) LP840 [All Options]	7262.52	123.63	58.74	Premium	P2KKMMVN
2BLT4 72L ADPT GZ1 LP840 [All Options]	7262.52	119.36	60.84	standard	P10DUPC0
2BLT4 85L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	8567	116.43	73.58	standard	PYD2G06V
2BLT4 85L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	8703.77	118.28	73.58	standard	P8Z4IV4X
2BLT4 85L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	8452.77	114.87	73.58	standard	PTZEW3QM
2BLT4 85L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	8587.72	116.71	73.58	standard	P01DMEK9
2BLT4 100L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	9837	103.14	95.36	standard	PGDES20R
2BLT4 100L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	9994.04	104.79	95.36	standard	P007CHGX
2BLT4 100L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	9705.84	101.77	95.36	standard	PSZUQY7M
2BLT4 100L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	9860.79	103.39	95.36	standard	P6V6X6HY
2BLT4 120L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	11709	118.18	99.07	standard	PGM4Y7DP
2BLT4 120L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	11895.9	120.07	99.07	standard	P00DDCG2
2BLT4 120L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	11552.9	116.61	99.07	standard	PXM0FS09
2BLT4 120L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	11737.3	118.47	99.07	standard	PJ4GEBZM

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

HE Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT4 30LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3107	135.17	22.98	Premium	P7KEICW5
2BLT4 30LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3156.6	137.33	22.98	Premium	PDOM06BH
2BLT4 30LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3065.57	133.37	22.98	Premium	P7PZAJDZ
2BLT4 30LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3114.51	135.5	22.98	Premium	P2N23EBP
2BLT4 40LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4085	138.56	29.48	Premium	P67P6S5Y
2BLT4 40LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4150.21	140.77	29.48	Premium	P95UQD66
2BLT4 40LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4030.53	136.71	29.48	Premium	PC15DQEC
2BLT4 40LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4094.88	138.89	29.48	Premium	PGRCSJ2T
2BLT4 48LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4770	138.16	34.52	Premium	PXBJBGN8
2BLT4 48LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4846.15	140.37	34.52	Premium	P5PQ5RRX
2BLT4 48LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4706.4	136.32	34.52	Premium	P2NK2H33
2BLT4 48LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4781.53	138.5	34.52	Premium	PK8C1321
2BLT4 60LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	5894	135.12	43.61	Premium	PQZN176R
2BLT4 60LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	5988.09	137.28	43.61	Premium	PG5CYJUC
2BLT4 60LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	5815.41	133.32	43.61	Premium	PZ72TAWM
2BLT4 60LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	5908.25	135.45	43.61	Premium	PRC4W72B
2BLT4 72LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	7149	135.94	52.58	Premium	PUB38GEQ
2BLT4 72LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	7263.13	138.11	52.58	Premium	P7GDHZTN
2BLT4 72LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	7053.68	134.12	52.58	Premium	P5CC2VKV
2BLT4 72LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	7166.29	136.26	52.58	Premium	P6P1BKDM
2BLT4 85LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	8158	128.96	63.25	Premium	PRTW6BXW
2BLT4 85LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	8288.24	131.02	63.25	Premium	P6H1V2D6
2BLT4 85LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	8049.22	127.24	63.25	Premium	P1VGSTA3
2BLT4 85LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	8177.73	129.27	63.25	Premium	PN5BKJ6E

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Delivered Lumens = 1.25 x P x LPW
P = Ouput power of emergency driver. P = 10W for E10WLCP option.
LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

LITHONIA LIGHTING®

TYPE L2

Catalog Number	
Notes	PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.
Type	

DIGITAL NAVIGATION

Ordering Tree nLight Platform Sensor Switch JOT Photometrics Performance Data

BLT Series LED

2BLT2

ADP Diffuser Option

2' x 2' LED

Ribbed Reflector Option

nLIGHT eldoLED

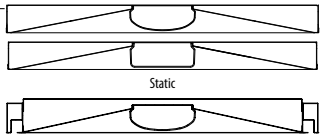
ISO Class 5-9

Buy American JOT JUST ONE TOUCH

Specifications

Length: 23-3/4 (60.3)
Width: 23-3/4 (60.3)
Depth: 2-3/8 (6.0)
Depth with Air supply/return: 2-3/4 (6.9)

All dimensions are inches (centimeters) unless otherwise specified.



FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available - curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight®controls make each luminaire addressable - allowing them to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless rIO and rES7 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intuitive model app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR— Integrated sensor (individual control): Sensor Switch MSD7ADCX ((Passive infrared (PIR)) or MSDPDT7ADCX ((PIR/Microphonics Dual Tech (PDT)) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CL*AIR*ITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms.

DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN — Product with the BAA option is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT.
Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

2BLT Volumetric Recessed Lighting 2'x2'

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT2 33L ADP EZ1 LP835

2BLT2

Series	Fixture Style	Air function	Lumens ‡		Diffuser	Voltage	Driver	Color temperature
2BLT2 2X2 BLT	(blank) Smooth Reflector	(blank) Static	**Standard efficiency ‡ (>125 LPW)**	**High efficiency ‡ (>130 LPW)**	ADP Curved, ribbed	(blank) MVOLT	EZ1 eldoLED dims to 1% (0-10 volt dimming)	LP830 82CRI, 3000 K
	RB Ribbed Reflector	A Air supply/ return ‡	20L 2000	20LHE 2000	ADSM Curved, smooth	120 120V	GZ1 Dims to 1% (0-10V dimming) [8]	LP835 82CRI, 3500 K
			33L 3300	33LHE 3300	SDP Square, ribbed	277 277V	GZ10 Dims to 10% (0-10V dimming) ‡	LP840 82CRI, 4000 K
			40L 4000	40LHE 4000	SDSM Square, smooth	347 347V ‡	SLD Step-level dimming ‡	LP850 82CRI, 5000 K
			48L 4800	48LHE 4800	**Includes trim rings to match sensored version**			LP930 90CRI, 3000K
					ADPT Curved, ribbed			LP935 90CRI, 3500K
					ADSMT Curved, smooth			LP940 90CRI, 4000K
					SDPT Square, ribbed			LP950 90CRI, 5000K
					SDSMT Square, smooth			

nLight Interface

nLight Wired

(blank)	no nLight ® interface
N80	nLight with 80% lumen management
N80EMG	nLight with 80% lumen management For use with generator supply EM power ‡
N100	nLight without lumen management
N100EMG	nLight without lumen management For use with generator supply EM power ‡

nLight Wireless

(blank)	no nLight ® interface
NLTAIR2	nLight AIR Generation 2 enabled ‡

Control ‡

nLight Wired

(blank)	No sensor control
NES7	nLight™ nES 7 PIR integral occupancy sensor ‡
NESPDT7	nLight™ nES PDT 7 dual technology integral occupancy control ‡
NES7ADCX	nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ‡
NESPDT7ADCX	nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell ‡

nLight Wireless

RES7	nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities
RES7PDT	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell
RIO	nLight AIR radio module without sensor
RES7EM	nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RES7PDTEM	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RIOEM	nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡

Individual Control

MSD7ADCX	PIR integral occupancy sensor with automatic dimming control photocell ‡
MSDPDT7ADCX	PDT integral occupancy sensor with automatic dimming control photocell ‡
JOT	Wireless room control with "Just One Touch" pairing ‡
JOTVTX15	Wireless occupancy sensor with "Just One Touch" pairing ‡

Standy Mode

NOC	NOC Occupancy sensor disabled ‡

Options

BDP Disconnect Plug

EL7L	700 lumen battery pack (Noncompliant with CA T20) ‡
EL14L	1400 lumen battery pack (Noncompliant with CA T20) ‡
EL14LSD	1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡
E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡

CP	Chicago plenum ‡
BGTD	Bodine Generator Transfer Device ‡
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit
PWS1846 PWSLV	Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡
PWS1856LV	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡

GLR	Fast-blowing fuse ‡
GMF	Slow-blowing fuse ‡
NPLT	Narrow pallet
RRL_	RELOC®-ready luminaire ‡
LATC	Earthquake clip
DWAM	Anti-Microbial paint
JP28	Job packaging ‡
JP36	Job packaging
IP5X	Gasketed diffuser compartment to meet IP5X rating ‡
BAA	Buy America(n) Act Compliant

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restictions chart on the next page. Options are sorted alphanumerically.

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

2BLT Volumetric Recessed Lighting 2'x2'

‡ Option Value Ordering Restrictions	
Option value	**Restriction**
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Control	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JOT & JOTVTX15
EL7L, EL14L, EL14LSD, E10WLCP	When using pre-wire option, use PWS1846 or PWS1846 PWSLV. For more information on the EL14LSD, please see the PSSD2 specification sheet.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
IP5X	Not available with air supply/return or Wired Networking (NES_) and Individual Control (MSD_) sensors.
JOT, JOTVTX15	Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP28	Only available with options: NES7, NESPDT7, NES7ADCX, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, RIO. Not available when sensor options combined with air supply return option.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com. Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSD7ADCX, MSDPDT7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
PWS1846 PWSLV, PWS1856LV	Not available with nLIGHT wired network or individual controls
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 3.
RRL_	For ordering logic consult: RRL_2013.
SLD	Not available with with any nLight Interface or Control options.

Multiple Diffuser Options

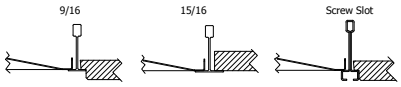
SDSM Diffuser Option

Non-Configurable BLT

Stock/MTO	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT2 33L ADP LP835	190887529708	3332	26.67	124.92	3500K/82 CRI	120-277	56
	2BLT2 33L ADP LP840	190887529739	3385	26.67	126.91	4000K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP835	190887529890	3332	26.67	124.92	3500K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP840	190887529937	3385	26.67	126.91	4000K/82CRI	120-277	56

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	**Appropriate Trim Type**
Exposed grid tee (1' and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

UL924 Sequence of Operation
For 90 minutes following any complete AC power interruption >200 ms:
• Digital dimming is commanded to high end trim level.
• Device ignores wireless lighting control commands.

Accessories & Replacement Parts

Accessories: *Order as separate catalog number.*	
DGA22	Drywall grid adapter for 2x2 recessed fixture
2X2SMKSHP PAF	Surface Mount Troffer Kit Post Paint
RK8BDP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1
RK8BDP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1
RK8BDP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10
RK8BDP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40

Replacement Parts: *Order as separate catalog number.*		
*247WJV	2DBLT24 ADP LENS ASSEMBLY	2 ft. replacement lens
*249P2P	2DBLT24 SDP LENS ASSEMBLY	2 ft. replacement lens
*249P2W	2DBLT24 ADSM LENS ASSEMBLY	2 ft. replacement lens
*249P32	2DBLT24 SDSM LENS ASSEMBLY	2 ft. replacement lens
*237LT1	2DBLT24 ADPT LENS ASSEMBLY	2 ft. replacement lens
*237LT3	2DBLT24 SDPT LENS ASSEMBLY	2 ft. replacement lens
*237LT5	2DBLT24 ADSMT LENS ASSEMBLY	2 ft. replacement lens
*237LT7	2DBLT24 SDSMT LENS ASSEMBLY	2 ft. replacement lens
*237LT9	2DBLT24 ADPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237M4Y	2DBLT24 SDPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237M57	2DBLT24 ADSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237M5H	2DBLT24 SDSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens

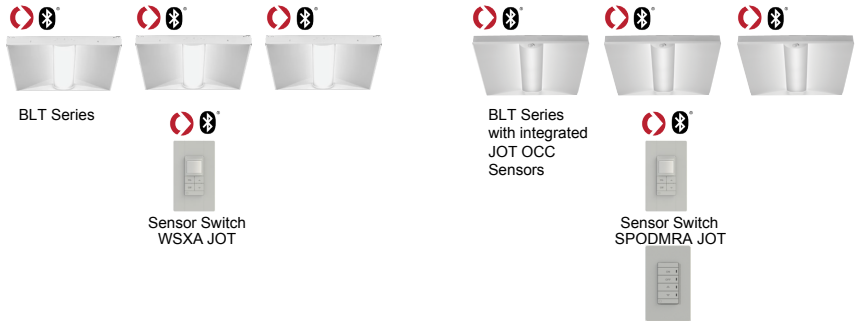
JOT Wireless

JOT
Just One Touch

Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

1. **Power:** Install JOT enabled fixtures and controls as instructed.
2. **Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
3. **Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



2BLT Volumetric Recessed Lighting 2'x2'

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CL**AIR**ITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

nLight Wired Networking

Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

COMMERCIAL INDOOR: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

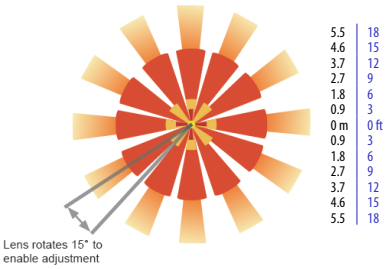
2BLT Volumetric Recessed Lighting 2'x2'

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSD7ADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPDT7			X	X	
NESPDT7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	X	X	X		X

Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSD7ADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

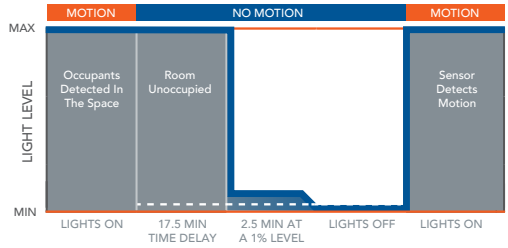
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

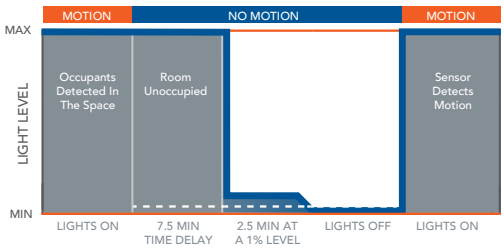
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)



*The presetting on the automatic dimming photocell is 5fc (NES7) and 10fc (RES7).

COMMERCIAL INDOOR: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

2BLT Volumetric Recessed Lighting 2'x2'

Controls Accessories

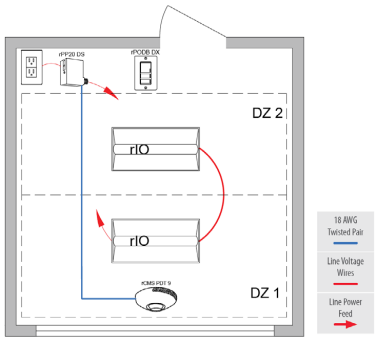
nLight® Wired Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1

nLight® AIR Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS[1]											Example: RCMS PDT 10 AR G2
Series / Detection		**Power Supply[1]**		**Occupancy Detection**		**Lens (Required)**		**Operating Mode**		**Generation**	
RCMS	nLight AIR occupancy and daylight sensor	[blank]	Power Supply ordered separately	[blank]	PIR Detection	10	Large Motion/ Extended Range 360°	[BLANK]	None	G2	Generation 2 compatibility
		PS 150	Standard 150 mA Power Supply	PDT	Dual Tech PIR/ Microphonics	9	Small Motion/ Extended Range 360°	AR	Auxiliary Relay		
						6	High Bay 360° Lens				

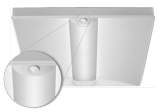
Notes
1 RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.


Sensor Switch WSX


nLight WIRED NPOD UNITOUCH


nLight WIRED nPODMA DX


nLight AIR rPODBA

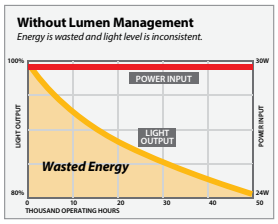

BLT with rIO

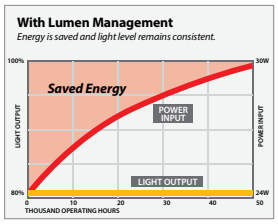

rPODBA


RCMS

Constant Lumen Management

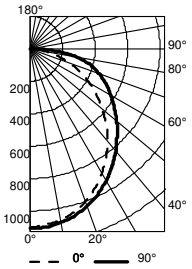
Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.





PHOTOMETRICS

2BLT2 33L ADP LP835, 3332 delivered lumens, test no. ISF36900P19, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1103	1103
5°	1090	1104
15°	1042	1064
25°	946	989
35°	817	881
45°	664	757
55°	500	634
65°	340	517
75°	177	383
85°	40	164
90	1	14

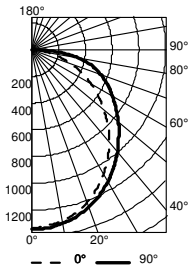
Coefficients of Utilization

RCR	pf 20% pc 80%	70%	50%	pf 20% pc 80%	70%	50%	pf 20% pc 80%	70%	50%
pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	108	102	97	100	96	92	96	92	89
2	97	88	81	86	80	74	83	77	72
3	88	77	69	76	68	61	72	66	60
4	81	68	59	67	58	52	64	57	51
5	74	61	51	60	51	44	57	50	44
6	68	55	45	54	45	39	52	44	38
7	63	50	40	49	40	34	47	39	34
8	59	45	36	44	36	30	43	36	30
9	55	41	33	41	33	27	40	32	27
10	52	38	30	38	30	25	37	30	25

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	853	25.6	25.6
0° - 40°	1390	41.7	41.7
0° - 60°	2466	74.0	74.0
0° - 90°	3330	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	3332	100.0	100.0

2BLT2 40L ADP LP835, 4041 delivered lumens, test no. ISF36900P35, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1338	1338
5°	1322	1339
15°	1263	1291
25°	1148	1199
35°	991	1069
45°	805	918
55°	607	769
65°	412	627
75°	214	465
85°	48	199
90	1	17

Coefficients of Utilization

RCR	pf 20% pc 80%	70%	50%	pf 20% pc 80%	70%	50%	pf 20% pc 80%	70%	50%
pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	108	102	97	100	96	92	96	92	89
2	97	88	81	86	80	74	83	77	72
3	88	77	69	76	68	61	72	66	60
4	81	68	59	67	58	52	64	57	51
5	74	61	51	60	51	44	57	50	44
6	68	55	45	54	45	39	52	44	38
7	63	50	40	49	40	34	47	39	34
8	59	45	36	44	36	30	43	36	30
9	55	41	33	41	33	27	40	32	27
10	52	38	30	38	30	25	37	30	25

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1035	25.6	25.6
0° - 40°	1686	41.7	41.7
0° - 60°	2991	74.0	74.0
0° - 90°	4039	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4041	100.0	100.0

Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT2 20L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	2065.45	124.06	16.64	Premium	PM92196A
2BLT2 20L ADP EZ1 (GZ10) LP835 [All Options]	2033	126.58	16.06	Premium	P6445UVD
2BLT2 20L ADP GZ1 LP835 [All Options]	2033	122.11	16.64	standard	PLNK6MX8
2BLT2 20L ADPT EZ1 (GZ10) LP840 [All Options]	2037.91	126.89	16.06	Premium	PYX15QEQ
2BLT2 20L ADPT GZ1 LP835 [All Options]	2005.89	120.49	16.64	standard	P40HQGLB
2BLT2 20L ADPT GZ1 LP840 [All Options]	2037.91	122.41	16.64	standard	PB3HB9AK
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3332	124.92	26.67	Premium	PHSXHE8F
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3385.19	126.91	26.67	Premium	PD18CKQ8
2BLT2 33L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3340.05	125.22	26.67	Premium	PF98CZ2H
2BLT2 33L ADPT EZ1 (GZ10) LP835 [All Options]	3287.57	125.14	26.27	Premium	PTKZR9WQ
2BLT2 33L ADPT GZ1 LP835 [All Options]	3287.57	123.25	26.67	standard	PTN5023N
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4041	127.35	31.73	Premium	P1XWW9GV
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4105.51	129.38	31.73	Premium	PHCQ2CQF
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3987.12	125.65	31.73	Premium	PW6RMMJ4
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4050.77	127.65	31.73	Premium	P5YYDAA8
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4800	109.9	43.67	standard	PJRH1R1G
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4876.63	111.66	43.67	standard	P8G93YOK
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4736	108.44	43.67	standard	PITU3V6X
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4811.61	110.17	43.67	standard	P5X2XU76

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

HE Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	1948	130.59	14.91	Premium	PUQCZNQI
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	1979.1	132.67	14.91	Premium	PJCZRW21
2BLT2 20LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	1952.71	130.9	14.91	Premium	PLC4RF4L
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3392	137.3	24.7	Premium	PXXZN9PH
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3446.15	139.5	24.7	Premium	PKPJYYRF
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3346.77	135.47	24.7	Premium	PZC8BZSS
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3400.2	137.64	24.7	Premium	PM5G8AFU
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4118	133.71	30.79	Premium	PJ55XFFP
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4183.74	135.85	30.79	Premium	PEGFHPZD
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4063.09	131.93	30.79	Premium	P8E16E9B
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4127.96	134.04	30.79	Premium	PFRSSSVG
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4845	128	37.85	Premium	P558XUZP
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4922.35	130.04	37.85	Premium	P1863H56
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4780.4	126.29	37.85	Premium	PHPTG5M8
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4856.71	128.31	37.85	Premium	PBKN954Z

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Delivered Lumens = 1.25 x P x LPW
P = Ouput power of emergency driver. P = 10W for E10WLCP option.
LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

Rev: 2018/11/08

TYPE L4

CB5518 – POSH™

VISA LIGHTING

Type: Project:

VisaLighting.com/products/Posh

Fill in shaded boxes using information listed below

Order Code:	CB5518		–	MVOLT		
	MODEL	A SOURCE		VOLTAGE	B FINISH	C OPTION(S)

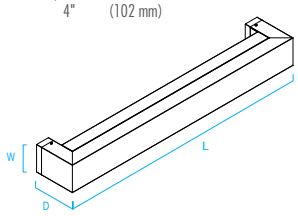
This minimalist design creates a sophisticated look providing soft, indirect light with performance and energy efficiency. Available in 3 lengths, this unique fixture provides beautiful light without harsh glare.

DIMENSIONS

Depth is measured from wall to front of fixture

L = Length D = Depth W = Width

W	3"	(72 mm)
L	27-3/4"	(705 mm)
D	4"	(102 mm)



A SOURCE (Select one) and VOLTAGE

MVOLT fixture accepts 120 through 277 input voltage
LED Sources are 83CRI, within 3-step MacAdam and are dimmable 0-10V to 1%

LED Sources	CCT	Delivered Lumens	Power (Watts)	Voltage
• L30K-L	3000K	1100	10	MVOLT
L35K-L	3500K			
• L40K-L	4000K			
• L30K-H	3000K	1700	15	
L35K-H	3500K			
• L40K-H	4000K	1800		

B FINISHES (Select one)

See page 3 for color chart

Powder Coat Painted Finishes (Standard)

AG7038	Agate Grey	**CVBL**	Cove Blue	**GW9002**	Grey White	**PB1035**	Pearl Beige
BMAT	Bronze Matte	**CW9001**	Cream	**HTHR**	Heather	**RUST**	Rust
BRNZ	Bronze	**GLIM**	Glimmer	**JB9005**	Jet Black	**SUNG**	Sungold
BSIL	Blade Silver	**GSIL**	Graphite Silver	**OBRZ**	Old Bronze	**TW9016**	Traffic White

Metal Finishes (Premium)

BA	Brushed Aluminum	**OBA**	Oil-rubbed Bronze Alternative
BBA	Brushed Brass Alternative	**PRA**	Pewter Alternative
BCA	Brushed Chrome Alternative	**RBA**	Rustic Brass Alternative
BUA	Brushed Copper Alternative	**SNA**	Satin Nickel Alternative
BZA	Brushed Bronze Alternative		

C OPTIONS (Multiple Selections Allowed)

⚠ Option availability may be interdependent with Voltage, Source or Other Options

JBC	Junction box cover (4-1/2" square) for use with an existion 4" octagonal juntion box. Painted to match finish
XPS	Express 10 day shipping. Items marked with a bullet (•) are not available with **XPS**

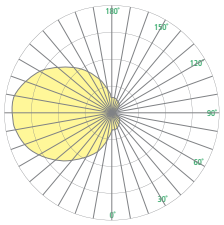
ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

LED ADA Compliant XPS ETL Listed 5 Year Warranty

CB5518 – POSH

VISA LIGHTING

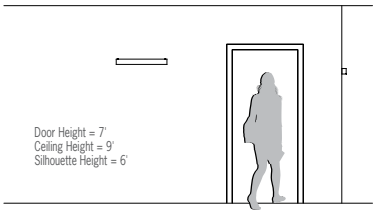
Photometrics



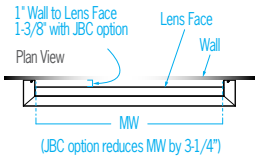
Technical Information

- Integral power supply
- Modular design for replacement of LED source and power supply
- Horizontal or vertical mount
- Mounts without electrical junction box with provided hardware, or to 4" x 4" standard electrical junction box (by others) if JBC option is selected
- Extruded white acrylic diffuser with matte finish
  - UV stable
  - UL-94 HB Flame Class rated
- No VOC powder coat paint; Low VOC clear coat on metal finishes
- ETL listed for damp locations. Not suited for exterior applications

Relative Scale Drawing



JBC Option Detail

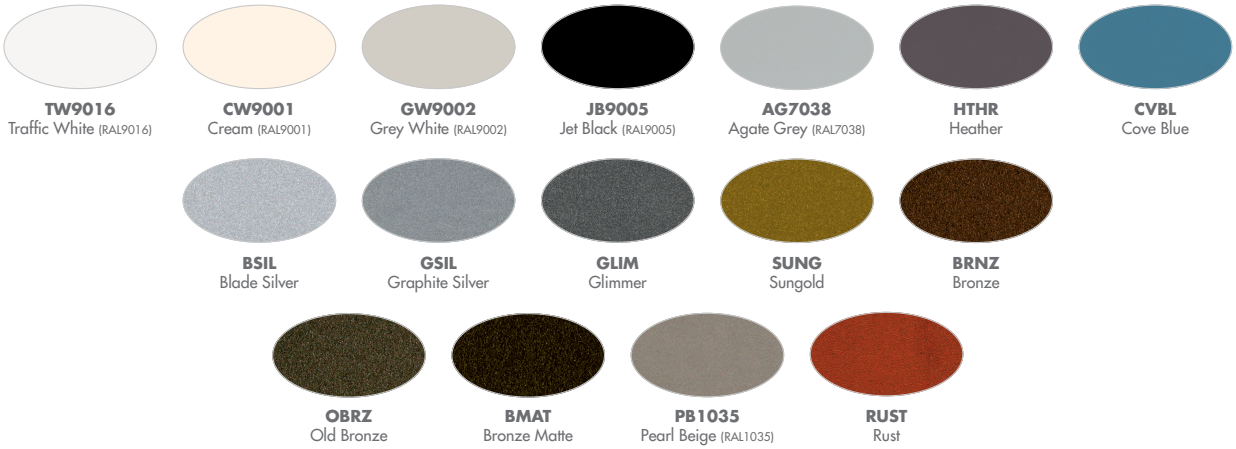


CB5518 – POSH

VISA LIGHTING

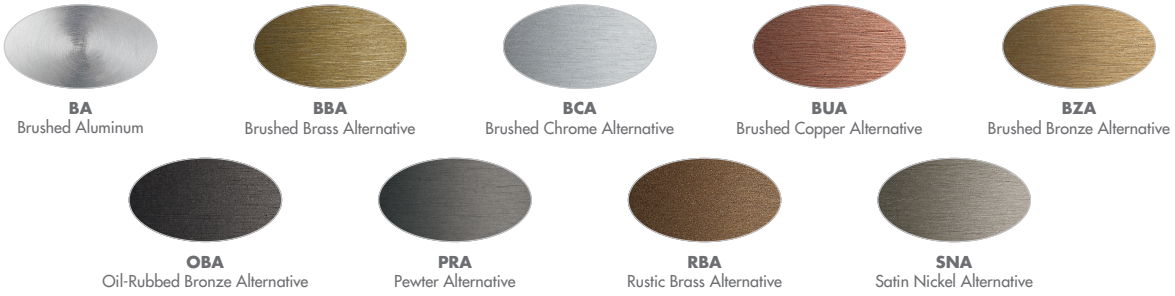
Specify color code when ordering. For accurate color matching, individual paint and finish samples are available upon request
For additional information see VisaLighting.com/materials-finishes

Painted Finishes (Standard)



TW9016 Traffic White (RAL9016)
CW9001 Cream (RAL9001)
GW9002 Grey White (RAL9002)
JB9005 Jet Black (RAL9005)
AG7038 Agate Grey (RAL7038)
HTHR Heather
CVBL Cove Blue
BSIL Blade Silver
GSIL Graphite Silver
GLIM Glimmer
SUNG Sungold
BRNZ Bronze
OBRZ Old Bronze
BMAT Bronze Matte
PB1035 Pearl Beige (RAL1035)
RUST Rust

Metal Finishes (Premium)



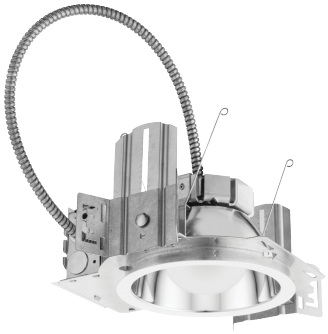
BA Brushed Aluminum
BBA Brushed Brass Alternative
BCA Brushed Chrome Alternative
BUA Brushed Copper Alternative
BZA Brushed Bronze Alternative
OBA Oil-Rubbed Bronze Alternative
PRA Pewter Alternative
RBA Rustic Brass Alternative
SNA Satin Nickel Alternative

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	TYPE L6A

LDN6

6" OPEN and WALLWASH LED
Non-IC
New Construction Downlight



FEATURES & SPECIFICATIONS

INTENDED USE — Typical applications include corridors, lobbies, conference rooms and private offices.

CONSTRUCTION — Galvanized steel mounting/plaster frame; galvanized steel junction box with bottom-hinged access covers and spring latches. Reflectors are retained by torsion springs.

Vertically adjustable mounting brackets with commercial bar hangers provide 3-3/4" total adjustment.

Two combination ½"-3/4" and four ½" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out). No. 12 AWG conductors, rated for 90°C.

Accommodates 12"-24" joist spacing.

Passive cooling thermal management for 25°C standard; high ambient (40°C) option available. Light engine and drivers are accessible from above or below ceiling.

Max ceiling thickness 1-1/2".

OPTICS — LEDs are binned to a 3-step SDCM; 80 CRI minimum. 90 CRI optional.

LED light source concealed with diffusing optical lens.

General illumination lighting with 1.0 S/MH and 55° cutoff to source and source image.

Self-flanged anodized reflectors in specular, semi-specular, or matte diffuse finishes. Also available in white and black painted reflectors.

ELECTRICAL — Multi-volt (120-277V, 50/60Hz) 0-10V dimming drivers mounted to junction box, 10% or 1% minimum dimming level available.

0-10V dimming fixture requires two (2) additional low-voltage wires to be pulled.

70% lumen maintenance at 60,000 hours.

LISTINGS — Certified to US and Canadian safety standards. Wet location standard (covered ceiling). IP55 rated. ENERGY STAR® certified product.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

A+ Capable options indicated by this color background.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: LDN6 35/15 L06AR LSS MVOLT EZ10

LDN6															
Series		**Color temperature**		**Lumens**[1]				**Aperture/Trim Color**				**Finish**		**Voltage**	
LDN6	6" round	27/	2700K	05	500 lumens	25	2500 lumens	L06	Downlight	AR	Clear	LSS	Semi-specular	MVOLT	Multi-volt
		30/	3000K	07	750 lumens	30	3000 lumens	LW6	Wallwash	WR[2]	White	LD	Matte diffuse	120	120V
		35/	3500K	10	1000 lumens	40	4000 lumens			BR[2]	Black	LS	Specular	277	277V
		40/	4000K	15	1500 lumens	50	5000 lumens							347[3]	347V
		50/	5000K	20	2000 lumens										

FINISH TO BE SELECTED BY ARCHITECT

Driver		Options			
GZ10	0-10V driver dims to 10%	SF[4]	Single fuse	N80[8]	nLight™ Lumen Compensation
GZ1	0-10V driver dims to 1%	TRW[5]	White painted flange	NPS80EZ[7]	nLight® dimming pack controls 0-10V eldoLED drivers (EZ10, EZ1).
EZ10	0-10V eldoLED driver with smooth and flicker-free deep dimming performance down to 10%	TRBL[5]	Black painted flange	NPS80EZER[7]	nLight® dimming pack controls 0-10V eldoLED drivers (EZ10, EZ1). ER controls fixtures on emergency circuit.
EZ1	0-10V eldoLED driver with smooth and flicker-free deep dimming perfor-mance down to 1%	EL[6]	Emergency battery pack with integral test switch. 10W Constant Power, Not Certified in CA Title 20 MAEDBS	HAO[11]	High ambient option
		ELR[6]	Emergency battery pack with remote test switch. 10W Constant Power, Not Certified in CA Title 20 MAEDBS	CP[12]	Chicago Plenum
		ELSD[6]	Emergency battery pack with self-diagnostics, integral test switch. 10W Constant Power, Not Certified in CA Title 20 MAEDBS	RRL___	RELOC®-ready luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Available only in RRLA, RRLB, RRLAE, and RRLC12S. Refer to RRL spec sheet on www.acuitybrands.com for the RELOC product specifications.
		ELRSD[6]	Emergency battery pack with self-diagnostics, remote test switch. 10W Constant Power, Not Certified in CA Title 20 MAEDBS	NLTAIR2[9,10]	nLight® Air enabled
		E10WCP[6]	Emergency battery pack, 10W Constant Power with integral test switch. Certified in CA Title 20 MAEDB	NLTAIRER2[9,10]	nLight® AIR Dimming Pack Wireless Controls. Controls fixtures on emergency circuit, not available with battery pack options
		E10WCPR[6]	Emergency battery pack, 10W Constant Power with remote test switch. Certified in CA Title 20 MAEDB	USPOM	US point of manufacture
		NPP16D[7]	nLight® network power/relay pack with 0-10V dimming for non-eldoLED drivers (GZ10, GZ1).	90CRI	High CRI (90+)
		NPP16DER[7]	nLight® network power/relay pack with 0-10V dimming for non-eldoLED drivers (GZ10, GZ1). ER controls fixtures on emergency circuit.		

Accessories: *Order as separate catalog number.*

PS1055CP	FMC Power Sentry batterypack, T20 compliant, field installable, 10w constant power
EAC ISSM 375	Compact interruptible emergency AC power system
EAC ISSM 125	Compact interruptible emergency AC power system
GRA68 JZ	Oversized trim ring with 8" outside diameter[1]
SCA6	Sloped ceiling adapter. Refer to TECH-SCA for more options.

Notes

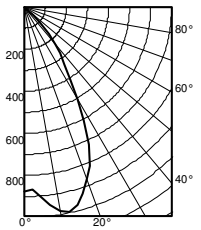
1. Overall height varies based on lumen package; refer to dimensional chart on page 3.
2. Not available with finishes.
3. Not available with emergency options.
4. Must specify voltage 120V or 277V.
5. Available with clear (AR) reflector only.
6. 12.5" of plenum depth or top access required for battery pack maintenance.
7. Specify voltage. ER for use with generator supply EM power. Will require an emergency hot feed and normal hot feed.
8. Fixture begins at 80% light level. Must be specified with NPS80EZ or NPS80EZ ER. Only available with EZ10 and EZ1 drivers.
9. Not available with CP, NPS80EZ, NPS80EZER, NPP16D, NPP16DER or N80 options.
10. NLTAIR2 and NLTAIRER2 not recommended for metal ceiling installations.
11. Fixture height is 6.5" for all lumen packages with HAO.
12. Must specify voltage for 3000lm and above. 5000lm with marked spacing 24 L x 24 W x 14 H. Not available with emergency battery pack option.

LDN6

PHOTOMETRY

Distribution Curve | **Distribution Data** | **Output Data** | **Coefficient of Utilization** | **Illuminance Data at 30″ Above Floor for a Single Luminaire**

LDN6 35/10 LO6AR, input watts: 10.44, delivered lumens: 987.10, LM/W = 94.54, spacing criterion at 0= 1.02, test no. ISF 30716P262.



	Ave	Lumens
0	876	
5	905	89
15	971	269
25	720	322
35	330	214
45	110	87
55	1	4
65	1	1
75	0	0
85	0	0
90	0	

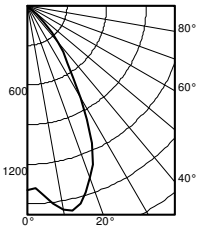
Zone	Lumens	% Lamp
0° - 30°	680.7	69.0
0° - 40°	895.0	90.7
0° - 60°	986.0	99.9
0° - 90°	987.0	100.0
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.0	0.0
90° - 180°	0.0	0.0
0° - 180°	987.0	*100.0

*Efficiency

pf	20%								
pc	80%			70%			50%		
pw	50%	30%	10%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	104	103	101
2	103	99	95	101	97	94	98	95	92
3	96	91	87	94	90	86	92	88	85
4	89	84	79	88	83	79	86	81	78
5	83	77	73	82	77	73	81	76	72
6	78	72	68	77	72	67	76	71	67
7	73	67	63	73	67	63	71	66	62
8	69	63	59	68	62	58	67	62	58
9	65	59	55	64	59	55	63	58	54
10	61	55	51	61	55	51	60	55	51

		50% beam - 54.5°		10% beam - 82.2°	
Mounting Height	Inital FC Center Beam	Diameter	FC	Diameter	FC
8.0	29.0	5.7	14.5	9.6	2.9
10.0	15.6	7.7	7.8	13.1	1.6
12.0	9.7	9.8	4.9	16.6	1.0
14.0	6.6	11.8	3.3	20.1	0.7
16.0	4.8	13.9	2.4	23.6	0.5

LDN6 35/15 LO6AR, input watts: 17.52, delivered lumens: 1572.9, LM/W = 89.77, spacing criterion at 0= 1.02, test no. ISF 30716P265.



	Ave	Lumens
0	1396	
5	1442	142
15	1547	429
25	1147	514
35	526	342
45	176	139
55	2	6
65	1	1
75	1	1
85	0	0
90	0	

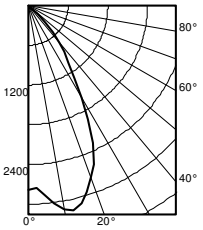
Zone	Lumens	% Lamp
0° - 30°	1084.6	69.0
0° - 40°	1426.2	90.7
0° - 60°	1571.3	99.9
0° - 90°	1572.9	100.0
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.0	0.0
90° - 180°	0.0	0.0
0° - 180°	1572.9	*100.0

*Efficiency

pf	20%								
pc	80%			70%			50%		
pw	50%	30%	10%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	104	103	101
2	103	99	95	101	97	94	98	95	92
3	96	91	87	94	90	86	92	88	85
4	89	84	79	88	83	79	86	81	78
5	83	77	73	82	77	73	81	76	72
6	78	72	68	77	72	67	76	71	67
7	73	67	63	73	67	63	71	66	62
8	69	63	59	68	62	58	67	62	58
9	65	59	55	64	59	55	63	58	54
10	61	55	51	61	55	51	60	55	51

		50% beam - 54.5°		10% beam - 82.2°	
Mounting Height	Inital FC Center Beam	Diameter	FC	Diameter	FC
8.0	46.2	5.7	23.1	9.6	4.6
10.0	24.8	7.7	12.4	13.1	2.5
12.0	15.5	9.8	7.7	16.6	1.5
14.0	10.6	11.8	5.3	20.1	1.1
16.0	7.7	13.9	3.8	23.6	0.8

LDN6 35/30 LO6AR, input watts: 34.75, delivered lumens: 3138.5, LM/W = 90.31, spacing criterion at 0= 1.02, test no. ISF 30716P274.



	Ave	Lumens
0	2786	
5	2877	284
15	3087	855
25	2289	1025
35	1049	682
45	350	277
55	5	12
65	2	2
75	1	1
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	2164.3	69.0
0° - 40°	2845.9	90.7
0° - 60°	3135.3	99.9
0° - 90°	3138.5	100.0
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.0	0.0
90° - 180°	0.0	0.0
0° - 180°	3138.5	*100.0

*Efficiency

pf	20%								
pc	80%			70%			50%		
pw	50%	30%	10%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	104	103	101
2	103	99	95	101	97	94	98	95	92
3	96	91	87	94	90	86	92	88	85
4	89	84	79	88	83	79	86	81	78
5	83	77	73	82	77	73	81	76	72
6	78	72	68	77	72	67	76	71	67
7	73	67	63	73	67	63	71	66	62
8	69	63	59	68	62	58	67	62	58
9	65	59	55	64	59	55	63	58	54
10	61	55	51	61	55	51	60	55	51

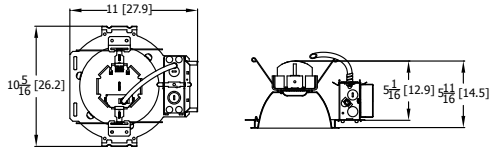
		50% beam - 54.5°		10% beam - 82.2°	
Mounting Height	Inital FC Center Beam	Diameter	FC	Diameter	FC
8.0	92.1	5.7	46.1	9.6	9.2
10.0	49.5	7.7	24.8	13.1	5.0
12.0	30.9	9.8	15.4	16.6	3.1
14.0	21.1	11.8	10.5	20.1	2.1
16.0	15.3	13.9	7.6	23.6	1.5

DOWNLIGHTING: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

LDN6

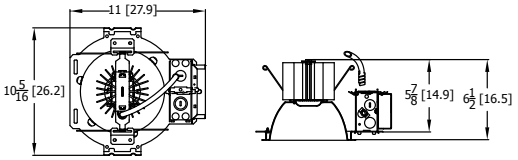
* All dimensions are inches (centimeters) unless otherwise noted.

LDN6 500-1500 LUMEN



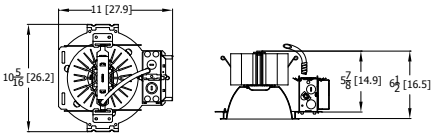
Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap trim: 7-1/2 (19.1)

LDN6 2000-3000 LUMEN



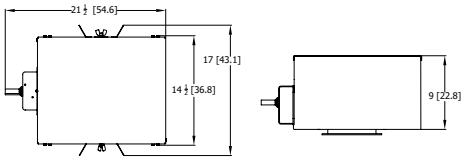
Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap trim: 7-1/2 (19.1)

LDN6 4000-5000 LUMEN



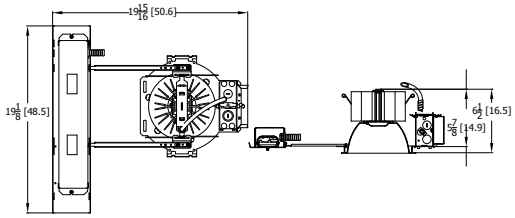
Marked Spacing: 24 x 24 x 10
Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap trim: 7-1/2 (19.1)

LDN6 CP



Aperture: 6-1/4" (15.9)
Ceiling Opening: 7-1/8" (18.1)
Overlap trim: 7-1/2" (19.1)

LDN6 EL-ELR



Marked Spacing above 3000 lumen: 24 x 24 x 10
Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap trim: 7-1/2 (19.1)

LDN6			
Nominal Lumens	**Lumens**	**Wattage**	**Lm/W**
500	527.9	5.8	90.5
750	758.1	8.9	85.1
1000	950.1	10.4	91.0
1500	1514	17.5	86.4
2000	2006	22.5	89.1
2500	2504	28.3	88.6
3000	3021	34.8	86.9
4000	4008	44.3	90.6
5000	4975	57.7	86.3

HOW TO ESTIMATE DELIVERED LUMENS IN EMERGENCY MODE

Use the formula below to estimate the delivered lumens in emergency mode

Delivered Lumens = 1.25 x P x LPW

P = Ouput power of emergency driver. P = 10W for PS1055CP

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet.
The LPW rating is also available at Designlight Consortium.

LUMEN OUTPUT MULTIPLIERS - FINISH			
	Clear (AR)	**White (WR)**	**Black (BR)**
Specular (LS)	1.0	N/A	N/A
Semi-specular (LSS)	0.950	N/A	N/A
Matte diffuse (LD)	0.85	N/A	N/A
Painted	N/A	0.87	0.73

LUMEN OUTPUT MULTIPLIERS - CCT					
	2700K	**3000K**	**3500K**	**4000K**	**5000K**
80CRI	0.950	0.966	1.000	1.025	1.101

Notes

- Tested in accordance with IESNA LM-79-08.
- Tested to current IES and NEMA standards under stabilized laboratory conditions.
- CRI: 80 typical.

DOWNLIGHTING: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

 Rev. 03/11/20

ADDITIONAL DATA

COMPATIBLE 0-10V WALL-MOUNT DIMMERS		
MANUFACTURER	PART NO.	POWER BOOSTER AVAILABLE
Lutron®	Diva® DVTV	
	Diva® DVSCTV	
	Nova T® NTFTV	
	Nova® NFTV	
Leviton®	AWSMT-7DW	CN100
	AWSMG-7DW	PE300
	AMRMG-7DW	
	Leviton Centura Fluorescent Control System	
	IllumaTech® IP7 Series	
Synergy®	ISD BC	RDMFC
	SLD LPCS	
	Digital Equinox (DEQ BC)	
Douglas Lighting Controls	WPC-5721	
Entertainment Technology	Tap Glide TG600FAM120 (120V)	
	Tap Glide Heatsink TGH1500FAM120 (120V)	
	Oasis 0A2000FAMU	
Honeywell	EL7315A1019	EL7305A1010 (optional)
	EL7315A1009	
HUNT Dimming	Preset slide: PS-010-IV and PS-010-WH	
	Preset slide: PS-010-3W-IV and PS-010-3W-WH	
	Preset slide, controls FD-010: PS-IFC-010-IV and PS-IFC-010-WH-120/277V	
	Preset slide, controls FD-010: PS-IFC-010-3W-IV and PS-IFC-010-3W-WH-120/277V	
	Remote mounted unit: FD-010	
Lehigh Electronic Products	Solitaire	PBX
PDM Electrical Products	WPC-5721	
Starfield Controls	TR61 with DALI interface port	RT03 DALInet Router
WattStopper®	LS-4 used with LCD-101 and LCD-103	

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

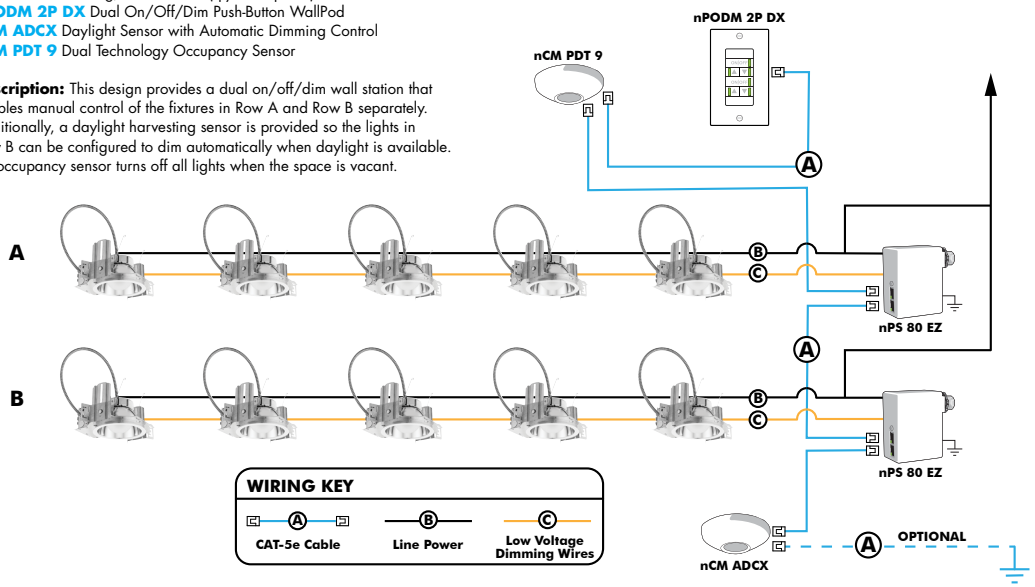
*See ordering tree for details

LDN6

EXAMPLE
Group Fixture Control*
*Appiication diagram applies for fixtures with eldoLED drivers only.

nPS 80 EZ Dimming/Control Pack (qty: 2 required)
nPODM 2P DX Dual On/Off/Dim Push-Button WallPod
nCM ADCX Daylight Sensor with Automatic Dimming Control
nCM PDT 9 Dual Technology Occupancy Sensor

Description: This design provides a dual on/off/dim wall station that enables manual control of the fixtures in Row A and Row B separately. Additionally, a daylight harvesting sensor is provided so the lights in Row B can be configured to dim automatically when daylight is available. An occupancy sensor turns off all lights when the space is vacant.



Choose Wall Controls

nLight offers multiple styles of wall controls - each with varying features and user experience.

Push-Button Wallpod
Traditional tactile buttons and LED user feedback

Graphic Wallpod
Full color touch screen provides a sophisticated look and feel

nLight® Wired Controls Accessories:			
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight for complete listing of nLight controls.			
WallPod Stations	**Model number**	**Occupancy sensors**	**Model Number**
On/Off	nPODM (Color)	Small motion 360°, ceiling (PIR/dual Tech)	nCM 9 / nCM PDT 9
On/Off & Raise/Lower	nPOD DX (Color)	Large motion 360°, ceiling (PIR/dual tech)	nCM 10 / nCM PDT 10
Graphic Touchscreen	nPOD GFX (Color)	Wide View (PIR/dual tech)	nWV 16 / nWV PDT 16
Photocell controls	**Model Number**	Wall Switch w/ Raise/Lower (PIR/dual tech)	nWSX LV DX / nWSX PDT LV DX
Dimming	nCM ADCX	**Cat-5 cables (plenum rated)**	**Model Number**
		10', CAT5 10FT	CAT5 10FT J1
		15, CAT5 15FT	CAT5 15FT J1

nLight® AIR Control Accessories: *Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.*	
Wall switches	**Model number**
On/Off single pole	rPODB [color]
On/Off two pole	rPODB 2P [color]
On/Off & raise/lower single pole	rPODB DX [color]
On/Off & raise/lower two pole	rPODB 2P DX [color]
On/Off & raise/lower single pole	rPODBZ DX WH[1]

Notes
1 Can only be ordered with the RES7Z zone control sensor version.

nLight AIR

nLight AIR is the ideal solution for retrofit or new construction spaces where adding communication is cost prohibitive. The integrated nLight AIR rPP20 Power Pack is part of each Lithonia LDN Luminaire. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

Simple as 1,2,3

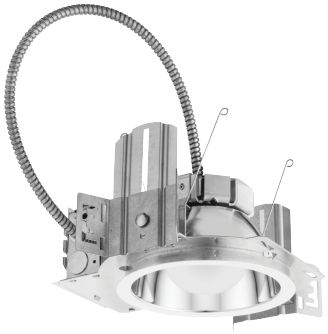
1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	TYPE L6B

LDN6

6" OPEN and WALLWASH LED
Non-IC
New Construction Downlight



FEATURES & SPECIFICATIONS

INTENDED USE — Typical applications include corridors, lobbies, conference rooms and private offices.

CONSTRUCTION — Galvanized steel mounting/plaster frame; galvanized steel junction box with bottom-hinged access covers and spring latches. Reflectors are retained by torsion springs.

Vertically adjustable mounting brackets with commercial bar hangers provide 3-3/4" total adjustment.

Two combination ½"-3/4" and four ½" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out). No. 12 AWG conductors, rated for 90°C.

Accommodates 12"-24" joist spacing.

Passive cooling thermal management for 25°C standard; high ambient (40°C) option available. Light engine and drivers are accessible from above or below ceiling.

Max ceiling thickness 1-1/2".

OPTICS — LEDs are binned to a 3-step SDCM; 80 CRI minimum. 90 CRI optional.

LED light source concealed with diffusing optical lens.

General illumination lighting with 1.0 S/MH and 55° cutoff to source and source image.

Self-flanged anodized reflectors in specular, semi-specular, or matte diffuse finishes. Also available in white and black painted reflectors.

ELECTRICAL — Multi-volt (120-277V, 50/60Hz) 0-10V dimming drivers mounted to junction box, 10% or 1% minimum dimming level available.

0-10V dimming fixture requires two (2) additional low-voltage wires to be pulled.

70% lumen maintenance at 60,000 hours.

LISTINGS — Certified to US and Canadian safety standards. Wet location standard (covered ceiling). IP55 rated. ENERGY STAR® certified product.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

A+ Capable options indicated by this color background.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: LDN6 35/15 L06AR LSS MVOLT EZ10

LDN6															
Series		**Color temperature**		**Lumens**[1]				**Aperture/Trim Color**				**Finish**		**Voltage**	
LDN6	6" round	27/	2700K	05	500 lumens	25	2500 lumens	L06	Downlight	AR	Clear	LSS	Semi-specular	MVOLT	Multi-volt
		30/	3000K	07	750 lumens	30	3000 lumens	LW6	Wallwash	WR[2]	White	LD	Matte diffuse	120	120V
		35/	3500K	10	1000 lumens	40	4000 lumens			BR[2]	Black	LS	Specular	277	277V
		40/	4000K	15	1500 lumens	50	5000 lumens							347[3]	347V
		50/	5000K	20	2000 lumens										

FINISH TO BE SELECTED BY ARCHITECT

Driver		Options			
GZ10	0-10V driver dims to 10%	SF[4]	Single fuse	N80[8]	nLight™ Lumen Compensation
GZ1	0-10V driver dims to 1%	TRW[5]	White painted flange	NPS80EZ[7]	nLight® dimming pack controls 0-10V eldoLED drivers (EZ10, EZ1).
EZ10	0-10V eldoLED driver with smooth and flicker-free deep dimming performance down to 10%	TRBL[5]	Black painted flange	NPS80EZER[7]	nLight® dimming pack controls 0-10V eldoLED drivers (EZ10, EZ1). ER controls fixtures on emergency circuit.
EZ1	0-10V eldoLED driver with smooth and flicker-free deep dimming perfor-mance down to 1%	EL[6]	Emergency battery pack with integral test switch. 10W Constant Power, Not Certified in CA Title 20 MAEDBS	HAO[11]	High ambient option
		ELR[6]	Emergency battery pack with remote test switch. 10W Constant Power, Not Certified in CA Title 20 MAEDBS	CP[12]	Chicago Plenum
		ELSD[6]	Emergency battery pack with self-diagnostics, integral test switch. 10W Constant Power, Not Certified in CA Title 20 MAEDBS	RRL___	RELOC®-ready luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Available only in RRLA, RRLB, RRLAE, and RRLC12S. Refer to RRL spec sheet on www.acuitybrands.com for the RELOC product specifications.
		ELRSD[6]	Emergency battery pack with self-diagnostics, remote test switch. 10W Constant Power, Not Certified in CA Title 20 MAEDBS	NLTAIR2[9,10]	nLight® Air enabled
		E10WCP[6]	Emergency battery pack, 10W Constant Power with integral test switch. Certified in CA Title 20 MAEDB	NLTAIRER2[9,10]	nLight® AIR Dimming Pack Wireless Controls. Controls fixtures on emergency circuit, not available with battery pack options
		E10WCPR[6]	Emergency battery pack, 10W Constant Power with remote test switch. Certified in CA Title 20 MAEDB	USPOM	US point of manufacture
		NPP16D[7]	nLight® network power/relay pack with 0-10V dimming for non-eldoLED drivers (GZ10, GZ1).	90CRI	High CRI (90+)
		NPP16DER[7]	nLight® network power/relay pack with 0-10V dimming for non-eldoLED drivers (GZ10, GZ1). ER controls fixtures on emergency circuit.		

Accessories: *Order as separate catalog number.*

PS1055CP	FMC Power Sentry batterypack, T20 compliant, field installable, 10w constant power
EAC ISSM 375	Compact interruptible emergency AC power system
EAC ISSM 125	Compact interruptible emergency AC power system
GRA68 JZ	Oversized trim ring with 8" outside diameter[1]
SCA6	Sloped ceiling adapter. Refer to TECH-SCA for more options.

Notes

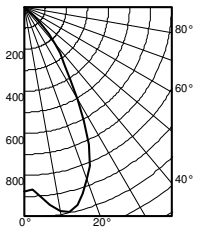
1. Overall height varies based on lumen package; refer to dimensional chart on page 3.
2. Not available with finishes.
3. Not available with emergency options.
4. Must specify voltage 120V or 277V.
5. Available with clear (AR) reflector only.
6. 12.5" of plenum depth or top access required for battery pack maintenance.
7. Specify voltage. ER for use with generator supply EM power. Will require an emergency hot feed and normal hot feed.
8. Fixture begins at 80% light level. Must be specified with NPS80EZ or NPS80EZ ER. Only available with EZ10 and EZ1 drivers.
9. Not available with CP, NPS80EZ, NPS80EZER, NPP16D, NPP16DER or N80 options.
10. NLTAIR2 and NLTAIRER2 not recommended for metal ceiling installations.
11. Fixture height is 6.5" for all lumen packages with HAO.
12. Must specify voltage for 3000lm and above. 5000lm with marked spacing 24 L x 24 W x 14 H. Not available with emergency battery pack option.

LDN6

PHOTOMETRY

Distribution Curve | **Distribution Data** | **Output Data** | **Coefficient of Utilization** | **Illuminance Data at 30″ Above Floor for a Single Luminaire**

LDN6 35/10 LO6AR, input watts: 10.44, delivered lumens: 987.10, LM/W = 94.54, spacing criterion at 0= 1.02, test no. ISF 30716P262.



	Ave	Lumens
0	876	
5	905	89
15	971	269
25	720	322
35	330	214
45	110	87
55	1	4
65	1	1
75	0	0
85	0	0
90	0	

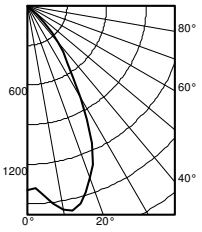
Zone	Lumens	% Lamp
0° - 30°	680.7	69.0
0° - 40°	895.0	90.7
0° - 60°	986.0	99.9
0° - 90°	987.0	100.0
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.0	0.0
90° - 180°	0.0	0.0
0° - 180°	987.0	*100.0

*Efficiency

pf	20%								
pc	80%			70%			50%		
pw	50%	30%	10%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	104	103	101
2	103	99	95	101	97	94	98	95	92
3	96	91	87	94	90	86	92	88	85
4	89	84	79	88	83	79	86	81	78
5	83	77	73	82	77	73	81	76	72
6	78	72	68	77	72	67	76	71	67
7	73	67	63	73	67	63	71	66	62
8	69	63	59	68	62	58	67	62	58
9	65	59	55	64	59	55	63	58	54
10	61	55	51	61	55	51	60	55	51

		50% beam - 54.5°		10% beam - 82.2°	
Mounting Height	Inital FC Center Beam	Diameter	FC	Diameter	FC
8.0	29.0	5.7	14.5	9.6	2.9
10.0	15.6	7.7	7.8	13.1	1.6
12.0	9.7	9.8	4.9	16.6	1.0
14.0	6.6	11.8	3.3	20.1	0.7
16.0	4.8	13.9	2.4	23.6	0.5

LDN6 35/15 LO6AR, input watts: 17.52, delivered lumens: 1572.9, LM/W = 89.77, spacing criterion at 0= 1.02, test no. ISF 30716P265.



	Ave	Lumens
0	1396	
5	1442	142
15	1547	429
25	1147	514
35	526	342
45	176	139
55	2	6
65	1	1
75	1	1
85	0	0
90	0	

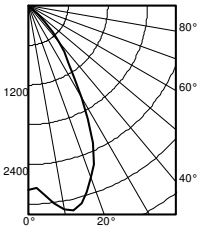
Zone	Lumens	% Lamp
0° - 30°	1084.6	69.0
0° - 40°	1426.2	90.7
0° - 60°	1571.3	99.9
0° - 90°	1572.9	100.0
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.0	0.0
90° - 180°	0.0	0.0
0° - 180°	1572.9	*100.0

*Efficiency

pf	20%								
pc	80%			70%			50%		
pw	50%	30%	10%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	104	103	101
2	103	99	95	101	97	94	98	95	92
3	96	91	87	94	90	86	92	88	85
4	89	84	79	88	83	79	86	81	78
5	83	77	73	82	77	73	81	76	72
6	78	72	68	77	72	67	76	71	67
7	73	67	63	73	67	63	71	66	62
8	69	63	59	68	62	58	67	62	58
9	65	59	55	64	59	55	63	58	54
10	61	55	51	61	55	51	60	55	51

		50% beam - 54.5°		10% beam - 82.2°	
Mounting Height	Inital FC Center Beam	Diameter	FC	Diameter	FC
8.0	46.2	5.7	23.1	9.6	4.6
10.0	24.8	7.7	12.4	13.1	2.5
12.0	15.5	9.8	7.7	16.6	1.5
14.0	10.6	11.8	5.3	20.1	1.1
16.0	7.7	13.9	3.8	23.6	0.8

LDN6 35/30 LO6AR, input watts: 34.75, delivered lumens: 3138.5, LM/W = 90.31, spacing criterion at 0= 1.02, test no. ISF 30716P274.



	Ave	Lumens
0	2786	
5	2877	284
15	3087	855
25	2289	1025
35	1049	682
45	350	277
55	5	12
65	2	2
75	1	1
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	2164.3	69.0
0° - 40°	2845.9	90.7
0° - 60°	3135.3	99.9
0° - 90°	3138.5	100.0
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.0	0.0
90° - 180°	0.0	0.0
0° - 180°	3138.5	*100.0

*Efficiency

pf	20%								
pc	80%			70%			50%		
pw	50%	30%	10%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	104	103	101
2	103	99	95	101	97	94	98	95	92
3	96	91	87	94	90	86	92	88	85
4	89	84	79	88	83	79	86	81	78
5	83	77	73	82	77	73	81	76	72
6	78	72	68	77	72	67	76	71	67
7	73	67	63	73	67	63	71	66	62
8	69	63	59	68	62	58	67	62	58
9	65	59	55	64	59	55	63	58	54
10	61	55	51	61	55	51	60	55	51

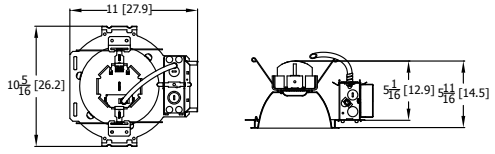
		50% beam - 54.5°		10% beam - 82.2°	
Mounting Height	Inital FC Center Beam	Diameter	FC	Diameter	FC
8.0	92.1	5.7	46.1	9.6	9.2
10.0	49.5	7.7	24.8	13.1	5.0
12.0	30.9	9.8	15.4	16.6	3.1
14.0	21.1	11.8	10.5	20.1	2.1
16.0	15.3	13.9	7.6	23.6	1.5

DOWNLIGHTING: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

LDN6

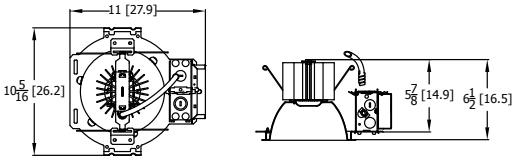
* All dimensions are inches (centimeters) unless otherwise noted.

LDN6 500-1500 LUMEN



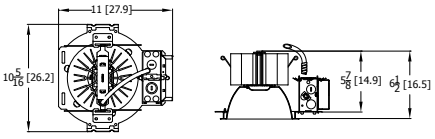
Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap trim: 7-1/2 (19.1)

LDN6 2000-3000 LUMEN



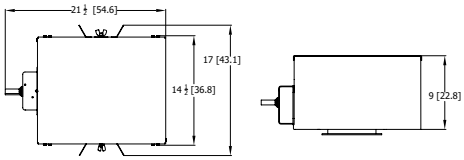
Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap trim: 7-1/2 (19.1)

LDN6 4000-5000 LUMEN



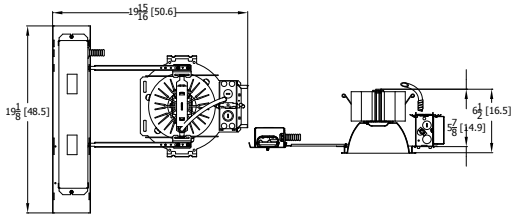
Marked Spacing: 24 x 24 x 10
Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap trim: 7-1/2 (19.1)

LDN6 CP



Aperture: 6-1/4" (15.9)
Ceiling Opening: 7-1/8" (18.1)
Overlap trim: 7-1/2" (19.1)

LDN6 EL-ELR



Marked Spacing above 3000 lumen: 24 x 24 x 10
Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap trim: 7-1/2 (19.1)

LDN6			
Nominal Lumens	**Lumens**	**Wattage**	**Lm/W**
500	527.9	5.8	90.5
750	758.1	8.9	85.1
1000	950.1	10.4	91.0
1500	1514	17.5	86.4
2000	2006	22.5	89.1
2500	2504	28.3	88.6
3000	3021	34.8	86.9
4000	4008	44.3	90.6
5000	4975	57.7	86.3

HOW TO ESTIMATE DELIVERED LUMENS IN EMERGENCY MODE

Use the formula below to estimate the delivered lumens in emergency mode

Delivered Lumens = 1.25 x P x LPW

P = Ouput power of emergency driver. P = 10W for PS1055CP

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet.
The LPW rating is also available at Designlight Consortium.

LUMEN OUTPUT MULTIPLIERS - FINISH			
	Clear (AR)	**White (WR)**	**Black (BR)**
Specular (LS)	1.0	N/A	N/A
Semi-specular (LSS)	0.950	N/A	N/A
Matte diffuse (LD)	0.85	N/A	N/A
Painted	N/A	0.87	0.73

LUMEN OUTPUT MULTIPLIERS - CCT					
	2700K	**3000K**	**3500K**	**4000K**	**5000K**
80CRI	0.950	0.966	1.000	1.025	1.101

Notes

- Tested in accordance with IESNA LM-79-08.
- Tested to current IES and NEMA standards under stabilized laboratory conditions.
- CRI: 80 typical.

DOWNLIGHTING: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

 Rev. 03/11/20

ADDITIONAL DATA

COMPATIBLE 0-10V WALL-MOUNT DIMMERS		
MANUFACTURER	PART NO.	POWER BOOSTER AVAILABLE
Lutron®	Diva® DVTV	
	Diva® DVSCTV	
	Nova T® NTFTV	
	Nova® NFTV	
Leviton®	AWSMT-7DW	CN100
	AWSMG-7DW	PE300
	AMRMG-7DW	
	Leviton Centura Fluorescent Control System	
	IllumaTech® IP7 Series	
Synergy®	ISD BC	RDMFC
	SLD LPCS	
	Digital Equinox (DEQ BC)	
Douglas Lighting Controls	WPC-5721	
Entertainment Technology	Tap Glide TG600FAM120 (120V)	
	Tap Glide Heatsink TGH1500FAM120 (120V)	
	Oasis 0A2000FAMU	
Honeywell	EL7315A1019	EL7305A1010 (optional)
	EL7315A1009	
HUNT Dimming	Preset slide: PS-010-IV and PS-010-WH	
	Preset slide: PS-010-3W-IV and PS-010-3W-WH	
	Preset slide, controls FD-010: PS-IFC-010-IV and PS-IFC-010-WH-120/277V	
	Preset slide, controls FD-010: PS-IFC-010-3W-IV and PS-IFC-010-3W-WH-120/277V	
	Remote mounted unit: FD-010	
Lehigh Electronic Products	Solitaire	PBX
PDM Electrical Products	WPC-5721	
Starfield Controls	TR61 with DALI interface port	RT03 DALInet Router
WattStopper®	LS-4 used with LCD-101 and LCD-103	

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

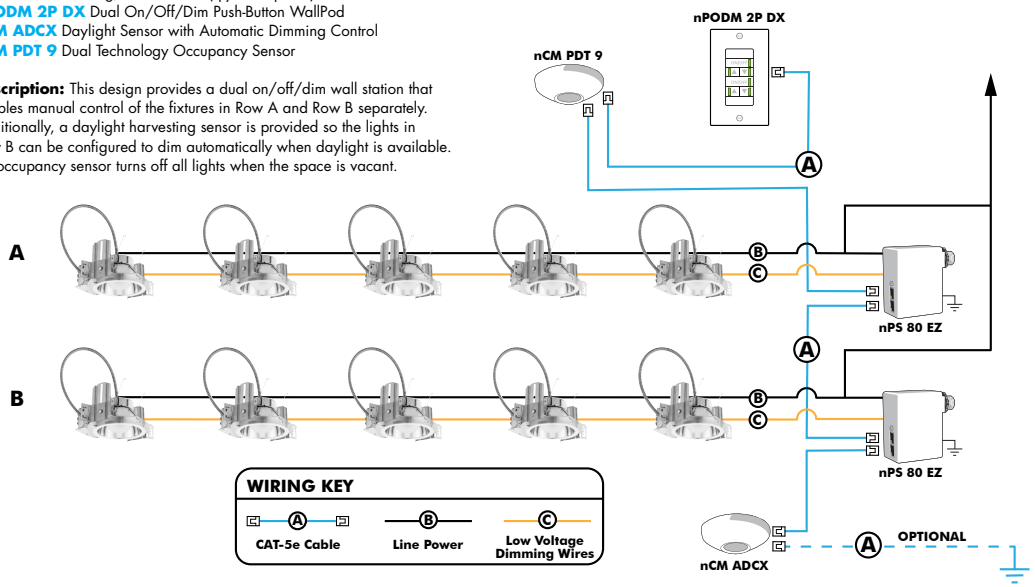
*See ordering tree for details

LDN6

EXAMPLE
Group Fixture Control*
*Appiication diagram applies for fixtures with eldoLED drivers only.

nPS 80 EZ Dimming/Control Pack (qty: 2 required)
nPODM 2P DX Dual On/Off/Dim Push-Button WallPod
nCM ADCX Daylight Sensor with Automatic Dimming Control
nCM PDT 9 Dual Technology Occupancy Sensor

Description: This design provides a dual on/off/dim wall station that enables manual control of the fixtures in Row A and Row B separately. Additionally, a daylight harvesting sensor is provided so the lights in Row B can be configured to dim automatically when daylight is available. An occupancy sensor turns off all lights when the space is vacant.



Choose Wall Controls

nLight offers multiple styles of wall controls - each with varying features and user experience.

Push-Button Wallpod
Traditional tactile buttons and LED user feedback

Graphic Wallpod
Full color touch screen provides a sophisticated look and feel

nLight® Wired Controls Accessories:			
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight for complete listing of nLight controls.			
WallPod Stations	**Model number**	**Occupancy sensors**	**Model Number**
On/Off	nPODM (Color)	Small motion 360°, ceiling (PIR/dual Tech)	nCM 9 / nCM PDT 9
On/Off & Raise/Lower	nPOD DX (Color)	Large motion 360°, ceiling (PIR/dual tech)	nCM 10 / nCM PDT 10
Graphic Touchscreen	nPOD GFX (Color)	Wide View (PIR/dual tech)	nWV 16 / nWV PDT 16
Photocell controls	**Model Number**	Wall Switch w/ Raise/Lower (PIR/dual tech)	nWSX LV DX / nWSX PDT LV DX
Dimming	nCM ADCX	**Cat-5 cables (plenum rated)**	**Model Number**
		10', CAT5 10FT	CAT5 10FT J1
		15, CAT5 15FT	CAT5 15FT J1

nLight® AIR Control Accessories: *Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.*	
Wall switches	**Model number**
On/Off single pole	rPODB [color]
On/Off two pole	rPODB 2P [color]
On/Off & raise/lower single pole	rPODB DX [color]
On/Off & raise/lower two pole	rPODB 2P DX [color]
On/Off & raise/lower single pole	rPODBZ DX WH[1]

Notes
1 Can only be ordered with the RES7Z zone control sensor version.

nLight AIR

nLight AIR is the ideal solution for retrofit or new construction spaces where adding communication is cost prohibitive. The integrated nLight AIR rPP20 Power Pack is part of each Lithonia LDN Luminaire. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CL**AIR**ITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	TYPE L7

FEATURES & SPECIFICATIONS

INTENDED USE — Ideal for use in applications where smart, energy-efficient fixtures are desired. Typical applications include parking garages, canopies, transportation, schools, hospitals, cold storage and exterior retail environments where moisture or dust is a concern. Polycarbonate enclosure protects fixture while remaining easy to service and clean. Not for use or installation in direct outdoor sunlight. Must be installed under canopy or covered ceiling. For direct sunlight installations, please refer to the FEX product family. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate. Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.**

CONSTRUCTION — UV-stabilized, injection-molded, impact-resistant, frosted polycarbonate housing with continuous poured in place, closed-cell gasket. 20-gauge steel channel and channel cover. Aluminum sheet metal board plate for thermal conduction and support. Captive, tamper-resistant, polycarbonate latches standard (8 Torx T-20 tamper-resistant screws included). Stainless steel latches also available. Fixture design allows for approximately 4% up-light.

OPTICS — UV-stabilized, injection-molded, impact-resistant, clear transparent and frosted, polycarbonate lens with aesthetic rib detail (.080" thick). Miro 5 aluminum reflector used to achieve wide distribution.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Standard 0-10V dimming. Integral 6kV/3kA surge protection, tested in accordance to IEEE/ANSI standards. >L88 at 60,000 hours (see chart on page 3).

INSTALLATION — Two stainless steel surface mount brackets standard (unless another mounting option is chosen) allowing for ceiling or suspended mount. A variety of mounting options are available including stainless steel mounting options: J-box mounting and mounting brackets for suspension with aircraft cable (cable not included). Optional stainless steel V-hooks available for chain hanging (chain not included). Surface conduit entry on one end or each end (WLFEND or WLFEND2) and on top (WLF or WLFIN) allow for rigid conduit entry. For horizontal and vertical mounting on a wall, application must be under a covered ceiling and QMB option recommended. 1/2" - 3/4" KO. When wall mounted the product will be rated for damp location only.

LISTINGS — CSA Certified to UL and C-UL standards. For use in ambient temperatures ranging from -20°F (-29°C) to 104°F(40°C). VAP LED is wet location listed for covered ceiling applications. IP65 and IP66 rated. VAP LED is NSF Splash Zone rated when suspended or ceiling mounted. When wall mounted the product will be rated for damp location only. DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN — Product with the BAA option is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT. Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

For installed Rough Service Product(s), Acuity warrants that, for the lifetime of the product(s), the polycarbonate lens and/or polycarbonate housing will withstand breakage resulting from occasional physical abuse and rough handling (the "Rough Service Warranty"), not withstanding the vandalism exclusion set forth at www.acuitybrands.com/support/warranty/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

ARCHWAY PASSAGE™

Rough Service Fixture

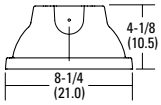
VAP LED

CEILING/
SUSPEND MOUNT

Buy American

Specifications

Length: 54-3/4 (139.1)
Width: 8-1/4 (21.0)
Depth: 4-1/8 (10.5)
Weight: 13.5 lbs. (5.9 kg)



All dimensions are shown in inches (centimeters) unless otherwise noted.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or control networks marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

VAP Linear Rough Service, LED

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: VAP 4000LM FST MD MVOLT GZ10 40K 80CRI

VAP							
Series	**Nominal lumens**	**Diffuser**	**Distribution**	**Voltage**	**Driver**	**Color temperature**	**CRI**
VAP	4000LM 4,000 lumens	FST Frosted polycarbonate lens	MD Medium	MVOLT 120-277V	GZ10 0 - 10V dimming	30K 3000K	80CRI 80 CRI
	6000LM 6,000 lumens	PCL Clear polycarbonate lens	WD Wide	120 120V		35K 3500K	90CRI 90 CRI
	8000LM 8,000 lumens‡			277 277V		40K 4000K	
	12000LM 12,000 lumens‡			HVOLT 347-480V		50K 5000K	
	15000LM 15,000 lumens‡			347 347V			
				480 480V			

Options

Emergency:
- BGTD Bodine® generator transformer device‡
- BSL722C Bodine® emergency LED battery pack for -20°C and up, CA Title 20 Noncompliant‡
- E15WCP Emergency battery pack, 15W constant power, Certified in CA Title 20 MAEDBS‡

Other Options:
- BAA Buy America(n) Act Compliant
- DL Damp location
- LSC Lens safety clip
- SPD Surge protection device‡
- WLF Wet location fitting (two outboard, top)‡
- WLFIN Wet location fitting (two inboard, top)‡
- WLFEND Wet location fitting (one end)
- WLFEND2 Wet location fitting (both ends)‡

Cord Sets:
- CS89 Cord only (no plug), 16 gauge, 3 conductors, 6ft, white, wet location‡
- CS88 Brad Harrison Mini-Change® cordset with straight blade plug, 16 gauge, 3 conductors, 6ft, yellow‡
- CS88L12 Brad Harrsion Mini-Change® cordset with straight blade plug, 16 gauge, 3 conductors, 12ft, yellow‡

Mounting Brackets:
- CMB Chain-mount suspension bracket
- JSB Junction box snap-bracket
- STSL Stainless steel tamper resistant latches
- QMB Quick-mount ceiling bracket

Individual Controls:‡
- MSI10NWL 360° Low mount sensor, (8-15' mounting heights), outdoor PIR, ON/OFF occupancy, wet location (LINK)
- MSI102L3VWL 360° Low mount sensor, (8-15' mounting heights), outdoor PIR, occupancy controlled dimming (bi-level), wet location (LINK)
- MSI10NWL DSCNWL 360° Low mount sensor, (8-15' mounting heights), outdoor PIR, ON/OFF photocell, wet location (LINK)

nLight® Wireless:‡
- NLTAIR2 RSBOR10 nLight® Air Generation 2 enabled, 360° low mount sensor, (8-15' heights), (LINK)

Accessories: *Order as separate catalog number. (Ships separately)*

- VAPSMB Surface-mount bracket
- VAPQMB Quick-mount ceiling bracket
- VAPCMB Chain-mount bracket
- VAPJSB Junction box snap bracket
- HC36 M12 Wire hook and 36" chain set‡
- HC36 STS M12 Wire hook and 36" chain set‡
- RK1 T20BIT U Hex base driver bit, Torx T20 Tamper resistant screws with center reject pin

‡ Option Value Ordering Restrictions

Option Value	Restriction
8000LM	Not available with BSL722C.
12000LM	Not available with BSL722C or E15WCP.
15000LM	Not available with BSL722C, E15WCP, HVOLT, 347 or 480. Maximum ambient temperature 35°C.
BGTD	Must specify voltage. Not available with HVOLT, 347 or 480. If used with 8000LM, 12000LM or 15000LM, maximum ambient temperature is 35°C. SPD is standard and does not require specification in nomenclature. Not available with battieries.
BSL722C	Not available with HVOLT, 347 or 480. SPD is standard and does not require specification in nomenclature. Maximum ambient temperature 35°C.
CS88, CS88L12	Must specify voltage. 6 foot is the standard cord length. Other lengths are available by specifying the cord length in the nomenclature. Example: CS88L15.
CS89	6 foot is the standard cord length. Other lengths are available by specifying the cord length in the nomenclature. Example: CS89L15.
E15WCP	Utilizes PS1555CP. Not available with HVOLT, 347 or 480. SPD is standard and does not require specification in nomenclature. Minimum ambient temperature is 0°C. Maximum mounting height is 25ft.
HC36, HC36 STS	Requires CMB (chain mount bracket) option.
Individual Controls	Must specify voltage. Not available with HVOLT, 347, 480 or other sensors. SPD is standard and does not require specification in nomenclature.
nLight® Wireless	Must specify voltage. Not available with HVOLT, 347, 480 or other sensors. SPD is standard and does not require specification in nomenclature. Normal luminaires (non-emergency) can be used as a normal power sensing device for nearby nLight AIR devices and luminaires with EM emergency options.
SPD	For additional protection up to 10kV. Not available with BSL722C, E15WCP, BGTD, MSI10NWL, MSI102L3VWL and MSI10NWL DSCNWL. The SPD is already included when the fixture is ordered with those options. SPD will not be called out in the nomenclature.
WLF, WLFIN, WLFEND	Utilizes 5/8" long NPT threaded hub.
WLFEND2	Not available with cordsets or sensor options. Utilizes 5/8" long NPT threaded hub.

INDUSTRIAL: One Lithonia Way, Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

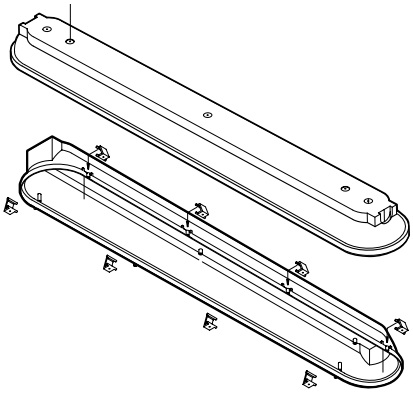
Rev. 05/05/2022

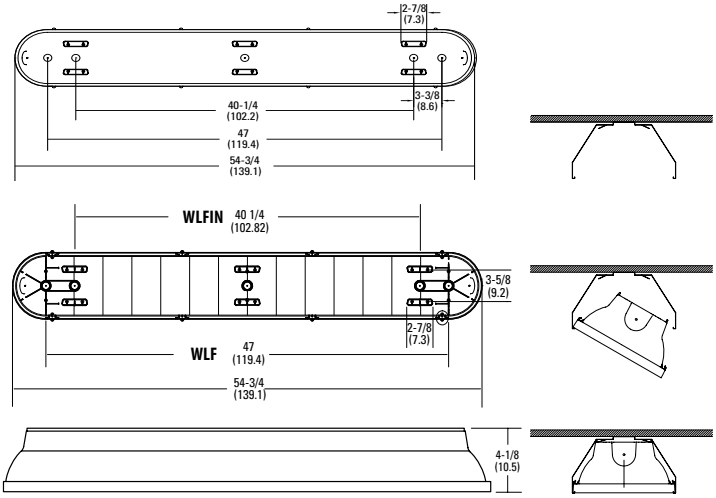
VAP Linear Rough Service, LED

DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.

Specifications subject to change without notice.

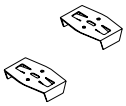




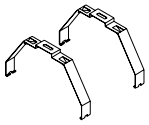
MOUNTING ACCESSORIES

CMB - Chain Mounting Brackets

JSB - Junction Box Mounting Bracket



QMB - Quick-Mount Mounting Brackets



SMB - Surface Mount Brackets (ship with fixture as standard)

ARCHWAY™ PASSAGE™ LED Specification Matrix											
Nominal lumens	Distribution	Initial delivered lumens @ 80CRI with clear polycarbonate lens				Initial delivered lumens @80CRI with frosted polycarbonate lens				Wattage @120V	Comparable source
		30K	35K	40K	50K	30K	35K	40K	50K		
4000LM	MD	4295	4446	4517	4647	3695	3777	3887	3998	33	2-lamp 32W T8, 1-lamp 54W T5, 70W HID
	WD	4208	4357	4426	4553	3623	3750	3810	3919		
6000LM	MD	6013	6226	6325	6506	5174	5357	5443	5598	49	3-lamp 32W T8, 2-lamp 54W T5, 100W HID
	WD	5892	6100	6198	6375	5072	5251	5335	5488		
8000LM	MD	8348	8643	8781	9032	7183	7437	7556	7772	67	4-lamp 32W T8, 2-lamp 54W T5, 150W HID
	WD	8180	8469	8604	8850	7042	7290	7407	7618		
12000LM	MD	11742	12156	12350	12703	10103	10460	10627	10931	99	6-lamp 32W T8, 3-lamp 54W T5, 250W HID
	WD	11505	11911	12101	12447	9904	10254	10417	10715		
15000LM	MD	14519	15031	15271	15708	12493	12934	13140	13516	115	6-lamp 32W T8, 4-lamp 54W T5, 250W HID
	WD	14226	14728	14963	15391	12246	12679	12881	13249		

Lumen Mantenance @ 25C

Operating Hours	0	10,000	20,000	25,000	35,000	50,000	60,000	75,000	100,000
4000LM	1	0.980	0.973	0.969	0.962	0.952	0.95	0.935	0.919
6000LM	1	0.972	0.962	0.957	0.950	0.933	0.923	0.909	0.886
8000LM	1	0.962	0.947	0.94	0.925	0.903	0.889	0.868	0.834
12000LM	1	0.970	0.960	0.952	0.940	0.922	0.910	0.900	0.865
15000LM	1	0.969	0.956	0.949	0.936	0.917	0.905	0.886	0.857

INDUSTRIAL: One Lithonia Way, Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

OPTIONS AND ACCESSORIES

The VAP Series fixture offers numerous options for almost every electrical and optical component, including a long list of field-installable accessories.

rSBOR/SBOR – Fixture Mount Sensor (see www.sensorswitch.com for additional information)

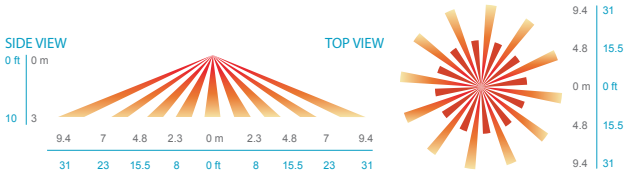
- 360° coverage
- On/Off dim
- Photocell optional
- IP66 rated
- Photocell and 0-10VDC dimming options.

Fixture sensor nomenclature	RSBOR/SBOR sensor nomenclature
For shortest lead times use one of the following SBOR configurations	
NLTAIR2 RSBOR10	RSBOR 10 EB4 WH G2
MSI10NWL	SBOR 10 OEX EB4 WH
MSI102L3VWL	SBOR 10 OEX D EB4 WH 3V
MSI10NWL DSCNWL	SBOR 10 OEX P EB4 WH

COVERAGE PATTERNS

PARKING GARAGE / LOW MOUNT APPLICATIONS

In general, the SBOR 10 is recommended for 8-15 ft (2.44-4.57 m) mounting and provides a coverage area radius for walking motion of greater than 2x the mounting height. The SBOR 10 ODP is ideal for parking garage and low pole mount applications. When mounted 10 ft high, for example, on a luminaire in a parking garage, the sensor's coverage for walking motion extends out 30 ft in a 360º pattern. This closely matches the lighting distribution of a typical parking garage luminaire. When mounted to a light pole, for example, in a parking lot or along a path, the sensor provides 270º of coverage (90º is blocked by the pole). Note, walking askew to sensor typically results in earlier detection than walking directly at sensor.



Coverage Pattern of Low Mount Lens Option (SBOR 10)

LITHONIA LIGHTING®

Catalog Number	
Notes	PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.
Type	TYPE L8

FEATURES & SPECIFICATIONS

INTENDED USE

Recessed housing rated IC. For new construction and remodel applications. Approved for all ceiling types except air handling plenums. Not for pulling wires. Romex only. Approved for direct burial in insulation.

CONSTRUCTION

Air-tight standard. Tested to meet current energy codes.

Aluminum housing with engineering-grade thermoplastic frame.

Galvanized bar hangers span up to 24" o.c. and feature built-in nailer and T-bar clips.

Engineering-grade thermoplastic junction box with four built-in romex clamps; six ¾" knockouts with slots for pryout.

Maximum 8 (4 in, 4 out) No 12 AWG conductors. Rated for 90° C.

Ground wire provided.

Pre-assembled poke-home connectors for ease of wiring.

Tilt-up J-box doors for easy access.

Trim retention (clips): Retaining clips riveted to top of reflector hold trim inside housing.

Trim retention (TOR): Two-side mounted torsion springs on the trim and 2 receiving brackets in the can ensure a consistently tight fit with the ceiling.

ELECTRICAL

Durable medium base porcelain socket with nickel-plated, copper alloy screw shell and contact.

Socket clips to top of housing to prevent paint overspray in socket screw shell.

Socket attaches to reflector to ensure proper and consistent lamp position.

Thermal protection provided against improper lamp usage.

120 volt only.

INSTALLATION

Air-tight housing suitable for air-tight installations. Refer to energy codes for proper installations.

2 x 6 wood joist or T-bar installation.

Expandable bar hangers allow for off-center mounting in wood joist or T-bar ceilings.

Length of 25-¼" maximum 13-¼" minimum or cut to fit 9" on center joist construction.

Vertical adjustment of housing allows for flush mounting with ceiling face.

Suitable for ceiling up to 1-1/2" thick.

LISTINGS

UL Listed to US and Canadian safety standards. Damp location listed.

See trim selection for wet location listing.

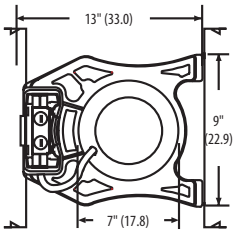
WARRANTY — 1-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

6" Housing

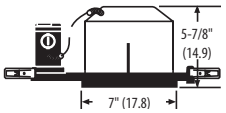
LCP

INCANDESCENT
IC Shallow
New Construction/Remodel



Specifications

Height: 5-7/8 (14.9)
Length: 13 (33.0)
Width: 9 (22.9)
Ceiling cutout: 7 (17.8)



All dimensions are inches (centimeters) unless otherwise specified.

LAMP WITH RED LED RETROFIT A-LAMP

ORDERING INFORMATION For shortest lead times, configure product using **standard options (shown in bold).** **Example**: LCP R6

LCP		
Series	**Options**	**Packaging**
LCP [1]	**GSKT** Foam gasketing. Aids in air-tight installation.	**R6** Resale pack of six U Unit pack (non-stock)

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

Accessories: *Order as separate catalog number.*

LSMC	T-Bar mounting clips, set of four	HS6875	6-7/8" Hole saw
ARC R24	Remodeler clips[1]	CTR6	6" goof ring, white (8-3/4" O.D.)
ATK6 R6	6" Air-tight trim kit		

ELECTRICAL CONTRACTOR TO DETERMINE NEEDED ACCESSORIES

Notes

1 When using in remodel applications the ARC R24 clips must be ordered separately. Sold in packages of 24 only.

See trim summary on reverse side for maximum wattages.

LCP 6" New Construction Shallow Housing

Description Catalog number		Maximum wattage [1]

General/Task

Open Wide Flange
C01 White

60 A19
65 BR30
75 PAR30

IC

Open Wide Flange
C01 TOR White
C01BN TOR Brushed nickel
C01ORB TOR Oil-rubbed bronze
C01BZA TOR Antique bronze

60 A19
65 BR30
75 PAR30

IC

Open Narrow Flange
C02 White
C02A Clear diffuse
C02AZ Clear specular

60 A19
65 BR30
75 PAR30

IC

Open Wide Flange
701 TOR White

65 BR30
75 PAR30

IC

Baffle Wide Flange
CB1 Black
CB1W White

40 A19
65 BR30
75 PAR 30

IC

Baffle Wide Flange
CB1 TOR Black
CB1W TOR White
CB1BN TOR Brushed nickel

40 A19
65 BR30
75 PAR 30

IC

Baffle Narrow Flange
7B0W White

65 BR30
75 PAR30

IC

Baffle Wide Flange
7B1 Black
7B1W White

65 BR30
75 PAR30

IC

Accent/Adjustable

Eyeball Narrow Flange
CE1 White

65 BR30
75 PAR30

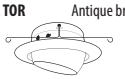
IC

Baffled Eyeball Narrow Flange
CE2 White/black
CE2W White/white

65 BR30
75 PAR30

IC

Eyeball Wide Flange
7E1 TOR White
7E1BN TOR Brushed nickel
7E10RB TOR Oil-rubbed bronze
7E1BZA TOR Antique bronze



65 BR30
75 PAR30

IC

Regressed Eyeball Wide Flange
7RE1 White

65 BR30
50 PAR30

IC

Pinhole Narrow Flange
CS1 White

40 A19
50 BR20
50 PAR20

IC

Wallwash Narrow Flange
CW1 White

40 A19

IC

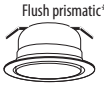
Lens/Wet Location [2]

Shower/Closet Narrow Flange
CLD1 Drop opal*

40 A19

IC

Shower/Closet Narrow Flange
CLF1 Flush opal*
CLF2 Flush prismatic*



40 A19

IC

Shower/Closet Narrow Flange
7LD1 Drop opal metal flange
7LD1 PF Drop opal plastic*
7LD2 PF Drop prismatic plastic*

40 A19

IC

** For plastic flange add suffix PF*

Notes

1 Maximum wattage listed. Lower wattage lamps may be used.

2 Lens trims are wet location listed. All others are damp location.

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DOWNLIGHTING: One Lithonia Way Conyers, GA 30012 Phone: 800-315-4935 Fax: 770-860-3129 www.lithonia.com

LCP 6" New Construction Shallow Housing

P Series Open and Baffle Wide Flange LED Modules (Wet Location) [1]

Example: 6BP TRMW LED 27K 90CRI LCP[1]

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series/Finish		Lamp	CCT / CRI / W / Lumens[2]		Voltage
6BPMW	6" Baffle LED module, matte white	LED	(blank)	3000 K / 83 CRI / 8.9W / 620L	(blank) 120V
6BP TRMW	6" Baffle LED module, black baffle, matte white flange		27K 90CRI	2700 K / 93 CRI / 11.2W / 600L	
6BPBN	6" Baffle LED module, brushed nickel		30K 90CRI	3000 K / 93 CRI / 11.2W / 600L	
6BPORB	6" Baffle LED module, oil-rubbed bronze		40K 90CRI	4000K / 92CRI / 9.9W / 650L	
6OPA	6" Open LED module, clear diffuse				
6OPAZ	6" Open LED module, clear specular	HL LED	(blank)	3000 K / 83 CRI / 15.2W / 950L	
6OPA TRMW	6" Open LED module, clear diffuse, matte white flange		27K 90CRI	2700 K / 93 CRI / 16.5W / 860L	
6OPAZ TRMW	6" Open LED module, clear specular, matte white flange		30K 90CRI	3000 K / 93 CRI / 16.5W / 860L	
			40K 90CRI	4000K / 92CRI / 16.4W / 950L	

Notes
1 LCP housing ordered on a separate line.
2 Total system delivered lumens.

LED Gimbal Module (Damp location)

Example: 6G1MW LED LCP[1]

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

6G1			LED		
Series/Finish			**Lamps**	**CCT / CRI / W / Lumens[2]**	**Voltage**
Series		Finish	**LED**	(blank) 3000k / 83CRI / 10.8W / 620L	**(blank)** 120V
6G1	6" Gimbal Module	**MW** Matte white		27K 90CRI 2700K / 91CRI / 11W / 680L	
		MB Matte black		30K 90CRI 3000K / 91CRI / 10.3W / 790L	
		BN Brush nickel		40K 90CRI 4000K / 94CRI / 10.5W / 820L	
		ORB Oil-rubbed bronze			

Notes
1 LCP housing ordered on a separate line.
2 Total system delivered lumens.

E Series Baffle Wide Flange LED Modules (Wet Location)

Example: 65BEMW LED 27K LCP[1]

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

65BEMW		LED		
Series/Finish		**Lamp**	**CCT / CRI / W / Lumens[2]**	**Voltage**
65BEMW	5" / 6" Baffle LED module, matte white	**LED**	**27K** 2700 K / 82CRI / 11.9W /640L	(blank) 120V
			30K 3000 K / 82CRI / 11.9W / 687L	
			40K 4000K / 82CRI / 11.9W / 711L	

Notes
1 LCP housing ordered on a separate line.
2 Total system delivered lumens.

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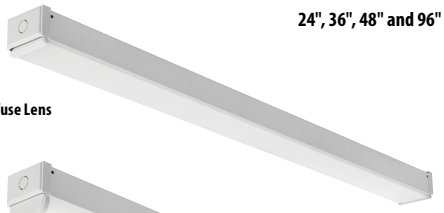
LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	TYPE L9A

LED Linear

CLX

24", 36", 48" and 96" Lengths



Flat Diffuse Lens

Round Diffuse Lens

Wide Diffuse Lens

FEATURES & SPECIFICATIONS

INTENDED USE — The CLX is a linear lighting solution that is available in multiple lengths, lumen packages and distributions. Designed for versatility, the CLX can address virtually any indoor lighting need. The CLX is also offered in standard and high efficacy configurations and capable of being continuous row mounted or installed as a stand-alone fixture. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate. Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.**

CONSTRUCTION — Channel and cover are formed from code-gauge cold-rolled steel. Housing and lens endcaps are injection molded plastic to provide a more architectural look and feel. The endcaps come standard with a 7/8" knock out for continuous mounting but can be ordered without.

Finish: Paint options include high-gloss, baked white polyester (WH), galvanized (GALV), matte black (MB) and smoke gray (SKGY). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Offered with acrylic lens and less lens configurations. Provides a choice of optical distributions including, wide, narrow, and aisle.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications. (See PLR_ ordering information on page 14.) Electronic LED driver is multi-volt input and 0-10V dimming standard (see Operational Data on page 12 for actual wattage consumption). This fixture is designed to withstand a maximum line surge of 2.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

L70>100,000 hours at 25˚C.

LEDs provide nominal 80 CRI or 90CRI at 3000 K, 3500 K,4000 K, or 5000 K.

Lumen output up to 2,500 lumens per foot.

INSTALLATION — Fixture may be ceiling or wall mounted (with or without THCLX hanger or angle mounted with CLXANGBRT), pendant or stem mounted with appropriate mounting options.

WARNING — Removing the lens and opening the fixture during installation exposes the LEDs, putting them at risk for damage.

If you plan to surface mount the fixture, we recommend using the THCLX. This eliminates the need to open the fixture.

If you plan to continuous row mount, we recommend using the PLR wiring harness option. This eliminates the need to open the fixture.

Damage to the LEDs caused during installation will not be covered under the warranty.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 104°F (40°C). Optional High Ambient (HA) ranging to 122°F(50°C) available on certain lumen packages (See ambient temperature chart for additional information).
DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at:
www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Stock configurations are offered for shorter lead times:

Stock Part Number	UPC	DLC QPL Product ID	DLC Premium
CLX L48 3000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525816	PJANKZR4	Yes
CLX L48 3000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525885	PKW32VKL	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525939	P77I8Z20	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525908	P8A42C1H	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525861	PPFTGRBV	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525915	PW6250TE	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525922	PYKOC7EW	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525830	PKYPL35K	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525960	PJANKZR4	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525892	PKW32VKL	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525854	P77I8Z20	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525946	P8A42C1H	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525878	PPFTGRBV	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525823	PD0SSIAD	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 40K 80CR WH	00191723525953	PYKOC7EW	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525847	PKYPL35K	Yes

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or XPoint™ Wireless control networks marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

CLX LED Linear

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example**: CLX L48 5000LM SEF WDL MVOLT GZ10 40K 80CRI WH

Series	Length		Nominal lumens		Performance package		Louver		Lens	
CLX LED linear	L24	24" [1,2]	1500LM	1,500 lumens	SEF	Standard efficiency[5]	(Blank)	Less louver	L/Lens	Less lens
			2000LM	2,000 lumens	HEF	Premium efficiency	SBLW	Straight blade louver, white[6]	FDL	Flat diffuse[7,8]
			2500LM	2,500 lumens			SBLMB	Straight blade louver, matte black[6]	RDL	Round diffuse[7,8]
			3500LM	3,500 lumens			SBLGV	Straight blade louver, galvanized[6]	WDL	Wide diffuse[7,8]
			4500LM	4,500 lumens			SBLSKGY	Straight blade louver, smoke gray[6]		
			5000LM	5,000 lumens [3,4]						
	L36	36" [2]	2250LM	2,250 lumens						
			3000LM	3,000 lumens						
			3750LM	3,750 lumens						
			5250LM	5,250 lumens						
			6750LM	6,750 lumens						
			7500LM	7,500 lumens [3,4]						
	L48	48"	3000LM	3,000 lumens						
			4000LM	4,000 lumens						
			5000LM	5,000 lumens						
			7000LM	7,000 lumens [2]						
			9000LM	9,000 lumens [2]						
			10000LM	10,000 lumens [2,4]						
	L96	96"	6000LM	6,000 lumens						
			8000LM	8,000 lumens						
			10000LM	10,000 lumens						
			14000LM	14,000 lumens [2,4]						
			18000LM	18,000 lumens [2,4]						
			20000LM	20,000 lumens [2,4]						

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

Distribution		Voltage			Driver[14]		Color temperature		Coloring rendering index	
(Blank)	General	MVOLT	120-277V[10]	277 277V	GZ10	0 -10V dimming[15]	30K	3000 K	80CRI	80 CRI
ND	Narrow[8,9]	120	120V	347 347V[12,13]	EZ1	Dimming to 1%[2]	35K	3500 K	90CRI	90 CRI
WD	Wide[8,9]	208	208V[11]	480 480V[12,13]			40K	4000 K		
AD2	Aisle, 24° off center[8,9]	240	240V[11]				50K	5000 K		

Options						Finish	
PS1050	Emergency battery pack, 10W, CA Title 20 Noncompliant[2,11,13,16,17]	PLR___	Plug-in wiring, see page 16 for ordering information	nLight® Wired:[23,25]		WH	White
E10WLCP	Emergency battery pack, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS[2,11,13,16,17]	PLR1LVG	Plug-in wiring,low voltage dimming[22]	N100	nLight® without lumen management	GALVW	Galvanized with white lens end caps
BGTD	Generator transfer device, not avaialble with PS1050[13,16,18]	RRL___	RELOC®-ready luminaire. See page 15 for ordering information	NES7	nLight® nES 7 PIR integral occupancy sensor[26]	GALVB	Galvanized with black lens end caps
OCS	5', 18/3 Reloc selectable One Pass cable[16]	SPD	Surge protection device, provides up to 6kV protection[20]	NESPDT7	nLight® nES PDT 7 dual technology integral occupancy control[26]	MB	Matte black
HA	High ambient, for use in ambient temperatures up to 50°C [11]	USPOM	Assembled in the United States	NES7ADCX	nLight® nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell[26]	SKGYW	Smoke gray with white lens end caps
EPNKO	Decorative endplate, no knock out[19]	nLight® Wireless:[23,24]		NESPDT7ADCX	nLight® nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell[26]	SKGYB	Smoke gray with black lens end caps
OUTCTR	Wiring leads pulled through back center of fixture[20]	NLTAIR2 RES7	nLight® Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell	Individual controls:[23,25]			
OUTEND	Wiring leads pulled through end of fixture[21]	NLTAIR2 RES7PDT	nLight AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell	MSD7	PIR integral occupancy sensor		
Cord Sets:		NLTAIR2 RIO	No sensor control	MSDPDT7	PDT 7 dual technology integral occupancy control		
CS1W	Staight blade plug, 120V[10,16]			MSD7ADC	PIR integral occupancy sensor with automatic dimming control photocell		
CS3W	NEMA twist-lock plug, 120V[10,16]			MSDPDT7ADC	PDT integral occupancy sensor with automatic dimming control photocell		
CS7W	Staight blade plug, 277V[10,16]						
CS11W	NEMA twist-lock plug, 277V[10,16]						
CS25W	NEMA twist-lock plug, 347V[10,16]						
CS97W	NEMA twist-lock plug, 480V[10,16]						
CS93W	600V SEOOW white cord, no plug (no voltage required)						
CS6WG16STOWD5D	6' white cord, 16/5, no plug, includes low voltage dimming wires (no voltage required)[15]						

See Accessories and footnotes on next page

Accessories: *Order as separate catalog number.*

Mounting:	
ZACVH	Aircraft cable 120" (one pair)
ZAC120	One adjustable aircraft cable with canopy 120" [27]
ZACFP120	One adjustable aircraft cable with feed (3 conductor) and canopy, 120" [27]
ZACFPD120	One adjustable aircraft cable with feed (5 conductor) and canopy 120" [27]
ZAC240	One adjustable aircraft cable with canopy 240" [27]
ZACFP240	One adjustable aircraft cable with feed (3 conductor) and canopy, 240" [27]
ZACFPD240	One adjustable aircraft cable with feed (5 conductor) and canopy 240" [27]
SQ_	Stem kit, 2" increments up to 48" [27]
THCLX __	Tong hanger (Must specify color) (one pair) [28]
CLXANGBKT ___	Angle bracket, (Must specify color) (one pair) [28]
HC36	Hanger chain, 36" (one pair)
Sensors & Controls:	
LSXR	Sensor Switch ® LSXR occupancy sensor [29]
NPP16D	nLight® switching/dimming module
NPP16DER	nLight® switching/dimming module with emergency relay
rPP20D	nLight® air dimming/switching module
XPA CMRB0	XPoint™ Wireless 0-10V relay, external, 55°C max ambient
Reflectors:	
CLXRW24__	Wide decorative 24" reflector, (Must specify color) [30]
CLXRW36__	Wide decorative 36" reflector, (Must specify color) [30]
CLXRW48__	Wide decorative 48" reflector, (Must specify color) [30]
CLXRW96__	Two wide decorative 48" reflectors, (Must specify color) [30]
CLXRWU24__	Wide decorative 24" reflector with uplight, (Must specify color) [30]
CLXRWU36__	Wide decorative 36" reflector with uplight, (Must specify color) [30]
CLXRWU48__	Wide decorative 48" reflector with uplight, (Must specify color) [30]
CLXRWU96__	Two wide decorative 48" reflectors with uplight, (Must specify color) [30]
CLXRN24	Narrow 24" reflector, (Must specify color) [31]
CLXRN36	Narrow 36" reflector, (Must specify color) [31]
CLXRN48	Narrow 48" reflector, (Must specify color) [31]
CLXRN96__	Two narrow 48" reflectors, (Must specify color) [31]
Wireguards:	
WGCLX24__	24" wireguard, (Must specify color) [32]
WGCLX36__	36" wireguard, (Must specify color) [32]
WGCLX48__	48" wireguard, XX, (Must specify color) 96" fixture requires two [32]

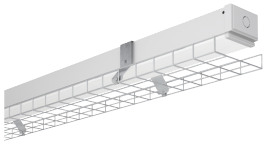
Notes

1 Not available with OUTCTR option.
2 Not available with HA option.
3 Not available with SEF when ordered in combination with EZ1.
4 Not available with NLTAIR2 RES7, NLTAIR2 RES7PDT, or NLTAIR2 RIO.
5 Not available with EZ1 when ordered with L24 with 5000LM or L36 with 7500LM.
6 When ordered with L24 only available with 1500LM or 2000LM in combination with GZ10 driver. Not for use with THCLX, CLXANGBKT, CLX reflectors or WGCLX accessories. Not available with RDL lens options.
7 Only available with general distribution.
8 Not available with CLXRN accessories.
9 Available L/LENS only.
10 Not available with PS1050, E10WLCP, or BGTD.
11 Not available with BGTD option.
12 Voltage selected utilizes a step-down transformer. Not available with L24 when ordered with N100.Not available with PS1050, E10WLCP or BGTD option.
13 Requires SPD option.
14 When continuous row mounting, fixtures must all have the same driver selection.
15 Not available with Individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
16 Must specify voltage.
17 Not available with L24 or L36. Not available with L48 in combination with N100.
18 Available with L48 or L96 only. 20 Not available with PS1050 or E10WLCP options. Not available with 208 or 240V. Not available Individual controls, NLight Wired, or NLight Wireless options.
19 Not available OUTEND.
20 Required with PS1050, E10WLCP, BGTD, XAD, or XAD924.
21 Not available with PLR options.
22 Not available with XPoint, Individual controls, NLight Wired, or NLight Wireless options.
23 Sensor housing will be the same color as lens end caps.
24 Not available with L24 in combination with 5000LM, not available with L36 in combination with 7500LM, not available with L48 in combination with 10000LM, and not available with L96 in combination with 14000LM, 18000LM, or 20000LM. Not available with PLRs containing low voltage dimming wires.
25 Not available with any other control option. Requires EZ1.
26 Requires N100 option.
27 Ships standard as white.
28 Not available with louver, wireguards, wide reflectors.
29 More configurations on LSXR Specification Sheet.
30 L24 reflector is 22.65", L36 reflector is 34.01", L48 reflector is 46.80", L96 comes with two L48 reflectors.
31 For use with L/LENS fixtures only. L24 reflector is 22.75", L36 reflector is 34.20", L48 reflector is 46.85", L96 comes with two L48 reflectors.
32 Not for use with CLX wide reflector accessories.

OPTIONS AND ACCESSORIES

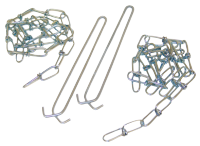
Narrow reflector
Ships separtely from fixture.
Order as:
CLXRN24__
CLXRN36__
CLXRN48__
CLXRN96__

Wide decorative reflector
Ships separtely from fixture.
Order as:
CLXRW24__
CLXRW36__
CLXRW48__
CLXRW96__



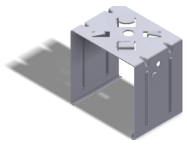
Wireguard
Ships separately from fixture:
96" fixture requires two WGCLX48.
Order as:
WGCLX24__
WGCLX36__
WGCLX48__

Aircraft Cable with Canopy
Available in 120" or 240"
Order as:
ZAC120
ZAC240



HANGER CHAIN
36" chain with Y hanger. ships as a pair
Order as:
HC36

ZACVH HANGER
10' Aircraft cable with Y hanger.
Order as:
ZACVH



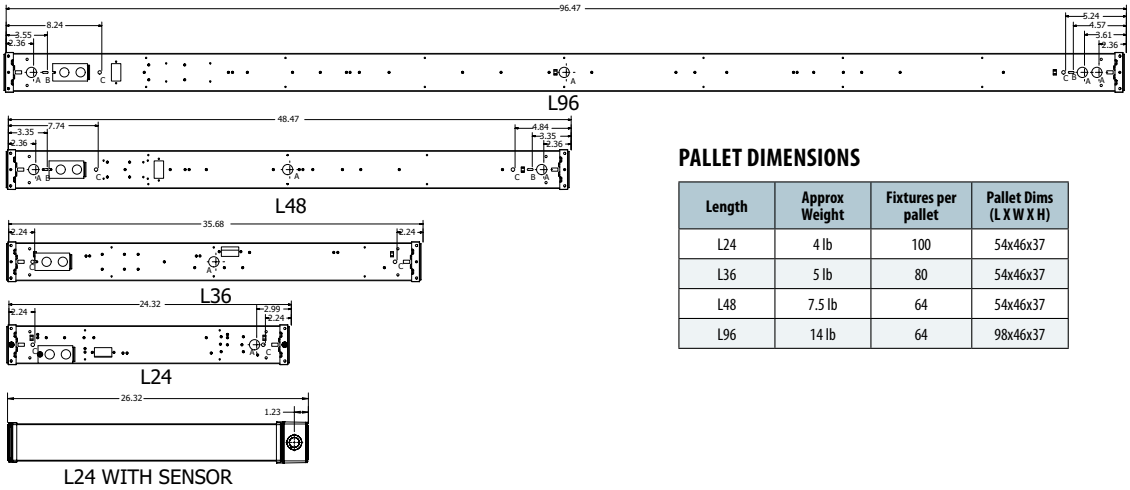
Tong hanger
Ships as a pair
Order As:
THCLX__

DIMENSIONS

All dimensions are in inches (centimeters) unless otherwise indicated.
Dimensions may vary with options or accessories.

INTEGRATED SENSOR ADDS 2.0 INCHES TO STANDALONE FIXTURE LENGTH
HOUSING END CAP ADDS 0.236 INCHES TO FIXTURE LENGTH PER SIDE. DIMENSIONS BELOW INCLUDE ENDCAPS.

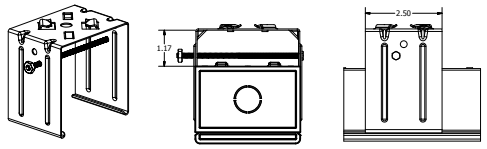
A - 7/8" KNOCK OUT
B - 0.5" by 0.16" SLOT
C - 0.3" DIA HOLE



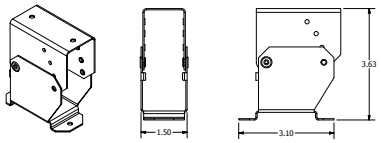
PALLET DIMENSIONS

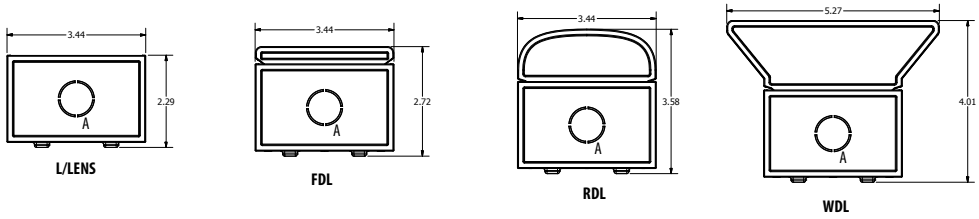
Length	Approx Weight	Fixtures per pallet	Pallet Dims (L X W X H)
L24	4 lb	100	54x46x37
L36	5 lb	80	54x46x37
L48	7.5 lb	64	54x46x37
L96	14 lb	64	98x46x37

THCLX - SHIPS TWO PER ORDER,
UTILIZES A #8 HEX HEAD SCREW AND NUT
FIXTURE SITS 1.3 INCHES FROM STRUCTURE WHEN MOUNTED



CLXANGBKT - SHIPS TWO PER ORDER
HOLES TO MOUNTING STRUCTURE ARE 0.175" DIA, 2.5" APART
FIXTURE SITS APPROXIMATELY 3.5" FROM STRUCTURE
WHEN MOUNTED HORIZONTAL TO STRUCTURE





PHOTOMETRICS

See www.lithonia.com.

POWER SENTRY EMERGENCY BATTERY PACKS

		SEF Emergency Lumens	HEF Emergency Lumens
PS1050	Factory installable	1400	1500
E10WLCP	Factory installable	1400	1500
PS1555LCP	Field installable, remote mount only	2000	2100

Note: For emergency lumen output of specific model, please consult factory. One board will be illuminated during emergency operation.

CLX CHARACTERISTICS

Nominal Lumen Package	Length	Wattage								Length	Width	Depth	Comparable Light Source
		Standard efficiency				High efficiency							
		120V	277V	347V	480V	120V	277V	347V	480V	Dimensions are shown in inches			
2500LM	24"	19.9	19.9	25.9	25.9	18.5	18.5	24.5	24.5	24	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
5000LM	24"	41.9	41.9	47.9	47.9	37.9	37.9	43.9	43.9	24	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
3750LM	36"	28.1	28.1	34.1	34.1	27.0	27.0	33.0	33.0	36	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
7500LM	36"	62.9	62.9	68.9	68.9	56.8	56.8	62.8	62.8	36	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
5000LM	48"	35.4	35.4	41.4	41.4	32.9	32.9	38.9	38.9	48	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
10000LM	48"	77.1	77.1	83.1	83.1	70.4	70.4	76.4	76.4	48	3.5	3.75	3 -lamp 32WT8, 2-lamp 54W T5HO, 100W HID
10000LM	96"	70.8	70.8	76.8	76.8	65.8	65.8	71.8	71.8	96	3.5	3.75	3 -lamp 32WT8, 2-lamp 54W T5HO, 100W HID
20000LM	96"	154.2	154.2	160.2	160.2	140.8	140.8	146.8	146.8	96	3.5	3.75	6 - lamp 32WT8, 4 -lamp 54T5HO, 200W HID

AMBIENT TEMPERATURE RATINGS

Driver Package		GZ10			EZ1			Any Driver	
Length	Lumen package	Direct Surface	THCLX/ Suspended	HA Option (Direct or Suspended)	Direct Surface	THCLX	Suspended 18"	Xpoint/ BGTD Direct Surface	PS1050 Suspended
L24	1500LM	40C	40C	N/A	35C	35C	35C	N/A	N/A
	2000LM	40C	40C		35C	35C	35C		
	2500LM	40C	40C		35C	35C	35C		
	3000LM	40C	40C		40C	40C	40C		
	4500LM	40C	40C		35C	35C	40C		
	5000LM	40C	40C		25C	30C	35C		
L36	2250LM	40C	40C		40C	40C	40C		
	3000LM	40C	40C		40C	40C	40C		
	3750LM	40C	40C		40C	40C	40C		
	5250LM	40C	40C		35C	35C	40C		
	6750LM	30C	40C		35C	35C	40C		
	7500LM	30C	40C		25C	30C	35C		
L48	3000LM	40C	40C	50C	40C	40C	40C	35C	25C
	4000LM	40C	40C	50C	40C	40C	40C		
	5000LM	40C	40C	50C	35C	35C	40C		
	7000LM	30C	40C	N/A	35C	35C	40C		
	9000LM	30C	40C		25C	30C	35C		
	10000LM	30C	40C		25C	30C	35C		
L96	6000LM	40C	40C	50C	35C	35C	40C		
	8000LM	30C	40C	50C	35C	35C	40C		
	10000LM	30C	40C	50C	25C	30C	35C		
	14000LM	40C	40C	N/A	35C	35C	40C		
	18000LM	30C	40C		25C	30C	35C		
	20000LM	30C	40C		25C	30C	35C		

CLX OPERATIONAL DATA

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L24	1500LM	SEF	80	1497	1540	1582	1619	10.85
				90	1305	1333	1371	1441	10.85
			HEF	80	1493	1514	1582	1586	10.39
				90	1220	1237	1301	1301	10.39
		2000LM	SEF	80	2066	2125	2183	2235	14.48
				90	1801	1840	1892	1989	14.48
			HEF	80	2060	2089	2183	2189	13.46
				90	1684	1708	1796	1796	13.46
		2500LM	SEF	80	2616	2689	2763	2829	18.41
				90	2279	2329	2394	2517	18.41
			HEF	80	2607	2644	2763	2771	17.42
				90	2132	2161	2273	2273	17.42
		3500LM	SEF	80	3518	3617	3716	3804	25.83
				90	3065	3132	3220	3385	25.83
			HEF	80	3506	3556	3716	3726	25.04
				90	2867	2907	3057	3057	25.04
		4500LM	SEF	80	5040	5182	5325	5451	38.7
				90	4392	4487	4614	4851	38.7
			HEF	80	5024	5096	5325	5339	34.8
				90	4108	4165	4380	4380	34.8
		5000LM	SEF	80	5355	5506	5657	5791	41.48
				90	4667	4767	4902	5153	41.48
			HEF	80	5338	5414	5657	5672	38.11
				90	4364	4425	4653	4653	38.11
	L36	2250LM	SEF	80	2411	2547	2101	2207	16.36
				90	2479	2607	2146	2320	16.36
			HEF	80	2437	2554	1965	2095	15.47
				90	2547	2403	1992	2095	15.47
		3000LM	SEF	80	3221	3388	2730	2868	20.8
				90	3310	3133	2789	3015	20.8
			HEF	80	3167	3319	2553	2722	19.98
				90	3310	3123	2589	2722	19.98
		3750LM	SEF	80	4123	4337	3495	3671	26.47
				90	4236	4010	3570	3859	26.47
			HEF	80	4054	4248	3268	3485	25.09
				90	4236	3997	3314	3485	25.09
		5250LM	SEF	80	5545	5833	4700	4937	39.9
				90	5698	5393	4801	5190	39.9
			HEF	80	5452	5713	4396	4687	34.3
				90	5698	5376	4457	4687	34.3
		6750LM	SEF	80	7081	7448	6001	6303	54.85
				90	7275	6886	6131	6627	54.85
			HEF	80	6962	7294	5613	5984	47.97
				90	7275	6864	5691	5984	47.97
		7500LM	SEF	80	7756	8158	6574	6905	62.6
				90	7969	7543	6716	7260	62.6
			HEF	80	7626	7991	6148	6555	54.02
				90	7969	7519	6234	6555	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L48	3000LM	SEF	80	3019	3104	3190	3265	20.32
				90	2631	2688	2764.	2906.	20.32
			HEF	80	3010	3052	3190	3198	19.01
				90	2461	2495	2624	2624	19.01
		4000LM	SEF	80	4034	4148	4262	4363	27.58
				90	3515	3591	3693	3882	27.58
			HEF	80	4021	4078	4262	4273	24.75
				90	3288	3334	3505	3505	24.75
		5000LM	SEF	80	5047	5189	5332	5458	34.8
				90	4398	4493	4620	4857	34.8
			HEF	80	5031	5102	5332	5346	31.77
				90	4113	4171	4386	4386	31.77
		7000LM	SEF	80	7311	7517	7724	7907	49.05
				90	6371	6509	6692	7036	49.05
			HEF	80	7288	7391	7724	7744	44.67
				90	5959	6042	6353	6353	44.67
		9000LM	SEF	80	9215	9475	9735	9967	63.99
				90	8031	8204	8435	8869	63.99
			HEF	80	9186	9317	9735	9762	58.58
				90	7511	7615	8008	8008	58.58
		10000LM	SEF	80	10299	10590	10880	11139	73.37
				90	8975	9169	9427	9912	73.37
			HEF	80	10266	10412	10880	10910	66.27
				90	8394	8511	8950	8950	66.27
	L96	6000LM	SEF	80	5942	6110	6278	6427	38.15
				90	5178	5290	5439	5719	38.15
			HEF	80	5923	6008	6278	6294	35.54
				90	4843	4911	5164	5164	35.54
		8000LM	SEF	80	7929	8153	8376	8575	52.32
				90	6910	7059	7258	7631	52.32
			HEF	80	7903	8016	8376	8399	48.5
				90	6462	6552	6890	6890	48.5
		10000LM	SEF	80	9808	10085	10362	10608	66.47
				90	8548	8732	8978	9439	66.47
			HEF	80	9777	9916	10362	10390	60.89
				90	7994	8106	8523	8523	60.89
		14000LM	SEF	80	14323	14727	15131	15491	94.78
				90	12482	12752	13111	13784	94.78
			HEF	80	14277	14480	15131	15172	85.96
				90	11674	11836	12447	12447	85.96
		18000LM	SEF	80	18458	18979	19500	19963	128.98
				90	16086	16433	16896	17764	128.98
			HEF	80	18399	18661	19500	19552	116.92
				90	15044	15254	16040	16040	116.92
		20000LM	SEF	80	20386	20962	21537	22048	146.83
				90	17766	18150	18661	19619	146.83
			HEF	80	20321	20610	21537	21595	131.6
				90	16616	16847	17716	17716	131.6

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L24	1500LM	SEF	80	1359	1397	1436	1470	10.85
				90	1184	1210	1244	1308	10.85
			HEF	80	1355	1374	1436	1439	10.39
				90	1107	1123	1181	1181	10.39
		2000LM	SEF	80	1875	1928	1981	2028	14.48
				90	1634	1670	1717	1805	14.48
			HEF	80	1869	1896	1981	1987	13.46
				90	1528	1550	1630	1630	13.46
		2500LM	SEF	80	2374	2441	2508	2567	18.41
				90	2069	2113	2173	2284	18.41
			HEF	80	2366	2400	2508	2514	17.42
				90	1935	1962	2063	2063	17.42
		3500LM	SEF	80	3192	3282	3372	3452	25.83
				90	2782	2842	2922	3072	25.83
			HEF	80	3182	3227	3372	3381	25.04
				90	2602	2638	2774	2774	25.04
		4500LM	SEF	80	4574	4703	4832	4947	38.7
				90	3986	4072	4187	4402	38.7
			HEF	80	4560	4624	4832	4845	34.8
				90	3728	3780	3975	3975	34.8
		5000LM	SEF	80	4860	4997	5134	5256	41.48
				90	4235	4327	4448	4677	41.48
			HEF	80	4844	4913	5134	5148	38.11
				90	3961	4016	4223	4223	38.11
	L36	2250LM	SEF	80	2188	2250	2311	2366	16.36
				90	1907	1948	2003	2106	16.36
			HEF	80	2181	2212	2311	2318	15.47
				90	1783	1808	1901	1901	15.47
		3000LM	SEF	80	2843	2924	3004	3075	20.8
				90	2478	2531	2603	2736	20.8
			HEF	80	2834	2875	3004	3012	19.98
				90	2317	2350	2471	2471	19.98
		3750LM	SEF	80	3639	3742	3845	3936	26.47
				90	3171	3240	3331	3502	26.47
			HEF	80	3628	3679	3845	3855	25.09
				90	2966	3007	3162	3162	25.09
		5250LM	SEF	80	4895	5033	5171	5294	39.9
				90	4265	4357	4480	4710	39.9
			HEF	80	4879	4948	5171	5185	34.3
				90	3989	4045	4253	4253	34.3
		6750LM	SEF	80	6250	6426	6602	6759	54.85
				90	5446	5564	5721	6014	54.85
			HEF	80	6230	6318	6602	6620	47.97
				90	5094	5165	5431	5431	47.97
		7500LM	SEF	80	6846	7039	7232	7404	62.6
				90	5966	6095	6266	6588	62.6
			HEF	80	6824	6921	7232	7252	54.02
				90	5580	5657	5949	5949	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L48	3000LM	SEF	80	2740	2817	2895	2963	20.32
				90	2388	2439	2508	2637	20.32
			HEF	80	2731	2770	2895	2902	19.01
				90	2233	2264	2381	2381	19.01
		4000LM	SEF	80	3661	3764	3868	3959	27.58
				90	3190	3259	3351	3523	27.58
			HEF	80	3649	3701	3868	3878	24.75
				90	2984	3025	3181	3181	24.75
		5000LM	SEF	80	4580	4710	4839	4954	34.8
				90	3992	4078	4193	4408	34.8
			HEF	80	4566	4631	4839	4852	31.77
				90	3733	3785	3980	3980	31.77
		7000LM	SEF	80	6635	6822	7009	7176	49.05
				90	5782	5907	6073	6385	49.05
			HEF	80	6614	6708	7009	7028	44.67
				90	5408	5483	5766	5766	44.67
		9000LM	SEF	80	8363	8599	8835	9045	63.99
				90	7288	7446	7655	8049	63.99
			HEF	80	8336	8455	8835	8859	58.58
				90	6816	6911	7268	7268	58.58
		10000LM	SEF	80	9347	9611	9874	10109	73.37
				90	8145	8321	8556	8995	73.37
			HEF	80	9317	9450	9874	9901	66.27
				90	7618	7724	8122	8122	66.27
	L96	6000LM	SEF	80	5393	5545	5697	5832	38.15
				90	4700	4801	4936	5190	38.15
			HEF	80	5375	5452	5697	5712	35.54
				90	4395	4457	4686	4686	35.54
		8000LM	SEF	80	7196	7399	7602	7782	52.32
				90	6271	6406	6587	6925	52.32
			HEF	80	7173	7275	7602	7622	48.5
				90	5865	5946	6253	6253	48.5
		10000LM	SEF	80	8902	9153	9404	9627	66.47
				90	7757	7925	8148	8567	66.47
			HEF	80	8873	8999	9404	9429	60.89
				90	7255	7356	7735	7735	60.89
		14000LM	SEF	80	12999	13366	13732	14058	94.78
				90	11328	11573	11899	12510	94.78
			HEF	80	12957	13142	13732	13769	85.96
				90	10594	10742	11296	11296	85.96
		18000LM	SEF	80	16751	17224	17697	18117	128.98
				90	14598	14913	15334	16121	128.98
			HEF	80	16698	16936	17697	17744	116.92
				90	13653	13843	14557	14557	116.92
		20000LM	SEF	80	18501	19023	19545	20009	146.83
				90	16123	16471	16935	17805	146.83
			HEF	80	18442	18705	19545	19598	131.6
				90	15079	15290	16078	16078	131.6

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L24	1500LM	SEF	80	1320	1358	1395	1428	10.85
				90	1151	1175	1208	1271	10.85
			HEF	80	1316	1335	1395	1399	10.39
				90	1076	1091	1147	1147	10.39
		2000LM	SEF	80	1822	1874	1925	1971	14.48
				90	1588	1622	1668	1754	14.48
			HEF	80	1816	1842	1925	1930	13.46
				90	1485	1506	1583	1583	13.46
		2500LM	SEF	80	2306	2371	2436	2494	18.41
				90	2010	2053	2111	2219	18.41
			HEF	80	2299	2332	2436	2443	17.42
				90	1880	1906	2004	2004	17.42
		3500LM	SEF	80	3102	3189	3277	3354	25.83
				90	2703	2761	2839	2985	25.83
			HEF	80	3092	3136	3277	3285	25.04
				90	2528	2563	2695	2695	25.04
		4500LM	SEF	80	4444	4570	4695	4807	38.7
				90	3873	3957	4068	4277	38.7
			HEF	80	4430	4493	4695	4708	34.8
				90	3622	3673	3862	3862	34.8
		5000LM	SEF	80	4722	4855	4988	5107	41.48
				90	4115	4204	4322	4544	41.48
			HEF	80	4707	4774	4988	5002	38.11
				90	3848	3902	4103	4103	38.11
	L36	2250LM	SEF	80	2126	2186	2246	2299	16.36
				90	1852	1892	1946	2046	16.36
			HEF	80	2119	2149	2246	2252	15.47
				90	1732	1757	1847	1847	15.47
		3000LM	SEF	80	2762	2840	2918	2988	20.8
				90	2407	2459	2529	2659	20.8
			HEF	80	2754	2793	2918	2926	19.98
				90	2251	2283	2401	2401	19.98
		3750LM	SEF	80	3536	3636	3735	3824	26.47
				90	3081	3148	3237	3403	26.47
			HEF	80	3525	3575	3735	3745	25.09
				90	2882	2922	3073	3073	25.09
		5250LM	SEF	80	4755	4890	5024	5143	39.9
				90	4144	4234	4353	4577	39.9
			HEF	80	4740	4808	5024	5037	34.3
				90	3876	3930	4132	4132	34.3
		6750LM	SEF	80	6072	6243	6415	6567	54.85
				90	5292	5406	5558	5844	54.85
			HEF	80	6053	6139	6415	6432	47.97
				90	4949	5018	5276	5276	47.97
		7500LM	SEF	80	6651	6839	7027	7194	62.6
				90	5796	5922	6088	6401	62.6
			HEF	80	6630	6725	7027	7046	54.02
				90	5421	5497	5780	5780	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L48	3000LM	SEF	80	2662	2737	2812	2879	20.32
				90	2320	2370	2437	2562	20.32
			HEF	80	2654	2691	2812	2820	19.01
				90	2170	2200	2313	2313	19.01
		4000LM	SEF	80	3557	3657	3758	3847	27.58
				90	3100	3167	3256.	3423	27.58
			HEF	80	3546	3596	3758	3768	24.75
				90	2899	2939	3091	3091	24.75
		5000LM	SEF	80	4450	4576	4701	4813	34.8
				90	3878	3962	4073	4283	34.8
			HEF	80	4436	4499	4701	4714	31.77
				90	3627	3678	3867	3867	31.77
		7000LM	SEF	80	6446	6628	6810	6972	49.05
				90	5618	5739	5901	6204	49.05
			HEF	80	6426	6517	6810	6829	44.67
				90	5254	5327	5602	5602	44.67
		9000LM	SEF	80	8126	8355	8584	8788	63.99
				90	7081	7234	7438	7820	63.99
			HEF	80	8100	8215	8584	8607	58.58
				90	6623	6715	7061	7061	58.58
		10000LM	SEF	80	9081	9338	9594	9822	73.37
				90	7914	8085	8313	8740	73.37
			HEF	80	9052	9181	9594	9620	66.27
				90	7402	7505	7892	7892	66.27
	L96	6000LM	SEF	80	5240	5387	5535	5667	38.15
				90	4566	4665	4796	5042	38.15
			HEF	80	5223	5297	5535	5550	35.54
				90	4270	4330	4553	4553	35.54
		8000LM	SEF	80	6991	7189	7386	7561	52.32
				90	6093	6224	6400	6728	52.32
			HEF	80	6969	7068	7386	7406	48.5
				90	5698	5778	6075	6075	48.5
		10000LM	SEF	80	8649	8893	9137	9354	66.47
				90	7537	7700	7917	8323	66.47
			HEF	80	8621	8744	9137	9161	60.89
				90	7049	7147	7516	7516	60.89
		14000LM	SEF	80	12630	12986	13342	13659	94.78
				90	11006	11244	11561	12154	94.78
			HEF	80	12589	12768	13342	13378	85.96
				90	10293	10437	10975	10975	85.96
		18000LM	SEF	80	16276	16735	17194	17602	128.98
				90	14184	14490	14898	15663	128.98
			HEF	80	16223	16454	17194	17240	116.92
				90	13265	13450	14143	14143	116.92
		20000LM	SEF	80	17976	18483	18990	19441	146.83
				90	15665	16004	16454	17300	146.83
			HEF	80	17918	18173	18990	19041	131.6
				90	14651	14855	15621	15621	131.6

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L24	1500LM	SEF	80	1377	1415	1454	1489	10.85
				90	1200	1226	1260	1325	10.85
			HEF	80	1372	1392	1454	1458	10.39
				90	1122	1138	1196	1196	10.39
		2000LM	SEF	80	1900	1953	2007	2055	14.48
				90	1656	1691	1739	1828	14.48
			HEF	80	1894	1921	2007	2012	13.46
				90	1548	1570	1651	1651	13.46
		2500LM	SEF	80	2405	2472	2540	2601	18.41
				90	2095	2141	2201	2314	18.41
			HEF	80	2397	2431	2540	2547	17.42
				90	1960	1987	2090	2090	17.42
		3500LM	SEF	80	3234	3325	3416	3497	25.83
				90	2818	2879	2960	3112	25.83
			HEF	80	3223	3269	3416	3426	25.04
				90	2636	2672	2810	2810	25.04
		4500LM	SEF	80	4634	4765	4895	5012	38.7
				90	4038	4125	4242	4459	38.7
			HEF	80	4619	4685	4895	4908	34.8
				90	3777	3829	4027	4027	34.8
		5000LM	SEF	80	4923	5062	5201	5324	41.48
				90	4290	4383	4506	4738	41.48
			HEF	80	4907	4977	5201	5215	38.11
				90	4012	4068	4278	4278	38.11
	L36	2250LM	SEF	80	2216	2279	2341	2397	16.36
				90	1931	1973	2029	2133	16.36
			HEF	80	2209	2241	2341	2348	15.47
				90	1806	1832	1926	1926	15.47
		3000LM	SEF	80	2880	2962	3043	3115	20.8
				90	2510	2564	2636	2772	20.8
			HEF	80	2871	2912	3043	3051	19.98
				90	2347	2380	2503	2503	19.98
		3750LM	SEF	80	3687	3791	3895	3987	26.47
				90	3213	3282	3375	3548	26.47
			HEF	80	3675	3727	3895	3905	25.09
				90	3005	3047	3204	3204	25.09
		5250LM	SEF	80	4958	5098	5238	5362	39.9
				90	4321	4414	4539	4772	39.9
			HEF	80	4942	5013	5238	5252	34.3
				90	4041	4097	4309	4309	34.3
		6750LM	SEF	80	6331	6510	6688	6847	54.85
				90	5517	5636	5795	6093	54.85
			HEF	80	6311	6401	6688	6706	47.97
				90	5160	5232	5502	5502	47.97
		7500LM	SEF	80	6935	7131	7326	7500	62.6
				90	6044	6174	6348	6674	62.6
			HEF	80	6913	7011	7326	7346	54.02
				90	5652	5731	6027	6027	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L48	3000LM	SEF	80	2776	2854	2932	3002	20.32
				90	2419	2471	2541	2671	20.32
			HEF	80	2767	2806	2932	2940	19.01
				90	2262	2294	2412	2412	19.01
		4000LM	SEF	80	3709	3813	3918	4011	27.58
				90	3232	3302	3395	3569	27.58
			HEF	80	3697	3749	3918	3929	24.75
				90	3023	3065	3223	3223	24.75
		5000LM	SEF	80	4640	4771	4902	5018	34.8
				90	4044	4131	4247	4465	34.8
			HEF	80	4625	4691	4902	4915	31.77
				90	3782	3834	4032	4032	31.77
		7000LM	SEF	80	6721	6911	7101	7269	49.05
				90	5857	5984	6152	6469	49.05
			HEF	80	6700	6795	7101	7120	44.67
				90	5478	5554	5841	5841	44.67
		9000LM	SEF	80	8472	8711	8950	9163	63.99
				90	7383	7543	7755	8154	63.99
			HEF	80	8445	8565	8950	8974	58.58
				90	6905	7001	7362	7362	58.58
		10000LM	SEF	80	9469	9736	10003	10240	73.37
				90	8252	8430	8667	9112	73.37
			HEF	80	9438	9573	10003	10030	66.27
				90	7717	7825	8228	8228	66.27
	L96	6000LM	SEF	80	5463	5617	5771	5908	38.15
				90	4761	4864	5001	5258	38.15
			HEF	80	5445	5523	5771	5787	35.54
				90	4452	4515	4747	4747	35.54
		8000LM	SEF	80	7289	7495	7701	7884	52.32
				90	6353	6490	6672	7015	52.32
			HEF	80	7266	7370	7701	7722	48.5
				90	5941	6024	6334	6334	48.5
		10000LM	SEF	80	9017	9272	9526	9752	66.47
				90	7858	8028	8254	8678	66.47
			HEF	80	8988	9117	9526	9552	60.89
				90	7349	7452	7836	7836	60.89
		14000LM	SEF	80	13168	13540	13911	14241	94.78
				90	11476	11723	12054	12673	94.78
			HEF	80	13126	13313	13911	13949	85.96
				90	10732	10882	11443	11443	85.96
		18000LM	SEF	80	16970	17448	17927	18353	128.98
				90	14788	15108	15533	16331	128.98
			HEF	80	16915	17156	17927	17975	116.92
				90	13831	14024	14746	14746	116.92
		20000LM	SEF	80	18742	19271	19800	20270	146.83
				90	16333	16686	17156	18037	146.83
			HEF	80	18682	18948	19800	19853	131.6
				90	15276	15489	16287	16287	131.6

RRL - RELOC®-Ready Luminaire

- RRL connectors can be used with Quick-Flex®, System 820 and OnePass® systems.
- Load side of connector factory installed to luminaire.
- 4-pole mating connector with push-in terminations allows for simple installation.
- Touch-safe design on both halves meets UL/CSA requirement.
- Wiping contact design allows safe disconnect under load.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example**: RRLA

Series		Wiring instructions	
RRL	RELOC®-ready luminaire	A	Hot conductor wired to position #1 (phase A)
		B	Hot conductor wired to position #2 (phase B)
		C	Hot conductor wired to position #3 (phase C) [1]

Compatible RELOC® Cables for Industrial Luminaires (ordered and shipped separately)

OCS

OCU

OD

DC

PT

Notes

1 C, ABE, and C12S options are not used with Quick-Flex QFC, QSFC, QPT, and QD.

PRODUCT INFORMATION

Advanced plug-in system with two-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. 1, 2, 3 and 4-lamp fixtures. PLR22 (2-circuit) and crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G ground required.

Note: Specifications subject to change without notice.

Wiring

PLR

Advanced 1 or 2-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires		Branch circuits				Dimming		Ground	
			Circuits to which ballast is connected		Emergency circuit connected					
PLR	(blank)	Not required for 22	(blank)	Not required for 22	(blank)	No emergency circuit	LV	Low-voltage dimming	G	Ground
PLR22	1	Black	A	Black wire	ELA	Emergency circuit wired to black wire				
	2	Black and red	B	Red wire	ELB	Emergency circuit wired to red wire				

Typical Applications

- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits and 2-circuit (PLR 22)
- Multiple circuit with night-lights located along row as desired

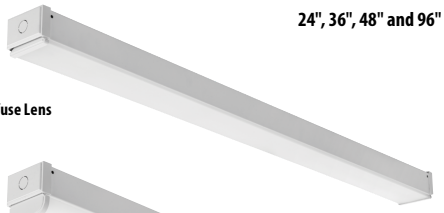
LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	TYPE L9B

LED Linear

CLX

24", 36", 48" and 96" Lengths



Flat Diffuse Lens

Round Diffuse Lens

Wide Diffuse Lens

FEATURES & SPECIFICATIONS

INTENDED USE — The CLX is a linear lighting solution that is available in multiple lengths, lumen packages and distributions. Designed for versatility, the CLX can address virtually any indoor lighting need. The CLX is also offered in standard and high efficacy configurations and capable of being continuous row mounted or installed as a stand-alone fixture. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate. Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.**

CONSTRUCTION — Channel and cover are formed from code-gauge cold-rolled steel. Housing and lens endcaps are injection molded plastic to provide a more architectural look and feel. The endcaps come standard with a 7/8" knock out for continuous mounting but can be ordered without.

Finish: Paint options include high-gloss, baked white polyester (WH), galvanized (GALV), matte black (MB) and smoke gray (SKGY). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Offered with acrylic lens and less lens configurations. Provides a choice of optical distributions including, wide, narrow, and aisle.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications. (See PLR_ ordering information on page 14.) Electronic LED driver is multi-volt input and 0-10V dimming standard (see Operational Data on page 12 for actual wattage consumption). This fixture is designed to withstand a maximum line surge of 2.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

L70>100,000 hours at 25˚C.

LEDs provide nominal 80 CRI or 90CRI at 3000 K, 3500 K,4000 K, or 5000 K.

Lumen output up to 2,500 lumens per foot.

INSTALLATION — Fixture may be ceiling or wall mounted (with or without THCLX hanger or angle mounted with CLXANGBRT), pendant or stem mounted with appropriate mounting options.

WARNING — Removing the lens and opening the fixture during installation exposes the LEDs, putting them at risk for damage.

If you plan to surface mount the fixture, we recommend using the THCLX. This eliminates the need to open the fixture.

If you plan to continuous row mount, we recommend using the PLR wiring harness option. This eliminates the need to open the fixture.

Damage to the LEDs caused during installation will not be covered under the warranty.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 104°F (40°C). Optional High Ambient (HA) ranging to 122°F(50°C) available on certain lumen packages (See ambient temperature chart for additional information).
DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at:
www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Stock configurations are offered for shorter lead times:

Stock Part Number	UPC	DLC QPL Product ID	DLC Premium
CLX L48 3000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525816	PJANKZR4	Yes
CLX L48 3000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525885	PKW32VKL	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525939	P77I8Z20	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525908	P8A42C1H	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525861	PPFTGRBV	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525915	PW6250TE	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525922	PYKOC7EW	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525830	PKYPL35K	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525960	PJANKZR4	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525892	PKW32VKL	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525854	P77I8Z20	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525946	P8A42C1H	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525878	PPFTGRBV	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525823	PD0SSIAD	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 40K 80CR WH	00191723525953	PYKOC7EW	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525847	PKYPL35K	Yes

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or XPoint™ Wireless control networks marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

CLX LED Linear

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example**: CLX L48 5000LM SEF WDL MVOLT GZ10 40K 80CRI WH

Series	Length	Nominal lumens	Performance package	Louver	Lens
CLX LED linear	L24 24" [1,2]	1500LM 1,500 lumens 2000LM 2,000 lumens 2500LM 2,500 lumens 3500LM 3,500 lumens 4500LM 4,500 lumens 5000LM 5,000 lumens [3,4]	SEF Standard efficiency[5] HEF Premium efficiency	(Blank) Less louver SBLW Straight blade louver, white[6] SBLMB Straight blade louver, matte black[6] SBLGV Straight blade louver, galvanized[6] SBLSKGY Straight blade louver, smoke gray[6]	L/Lens Less lens FDL Flat diffuse [7,8] RDL Round diffuse [7,8] WDL Wide diffuse [7,8]
	L36 36" [2]	2250LM 2,250 lumens 3000LM 3,000 lumens 3750LM 3,750 lumens 5250LM 5,250 lumens 6750LM 6,750 lumens 7500LM 7,500 lumens [3,4]			
	L48 48"	3000LM 3,000 lumens 4000LM 4,000 lumens 5000LM 5,000 lumens 7000LM 7,000 lumens [2] 9000LM 9,000 lumens [2] 10000LM 10,000 lumens [2,4]			
	L96 96"	6000LM 6,000 lumens 8000LM 8,000 lumens 10000LM 10,000 lumens 14000LM 14,000 lumens [2,4] 18000LM 18,000 lumens [2,4] 20000LM 20,000 lumens [2,4]			

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

Distribution	Voltage		Driver[14]	Color temperature	Coloring rendering index
(Blank) General	MVOLT 120-277V[10]	277 277V	GZ10 0 -10V dimming[15]	30K 3000 K	80CRI 80 CRI
ND Narrow[8,9]	120 120V	347 347V[12,13]	EZ1 Dimming to 1%[2]	35K 3500 K	90CRI 90 CRI
WD Wide[8,9]	208 208V[11]	480 480V[12,13]		40K 4000 K	
AD2 Aisle, 24° off center[8,9]	240 240V[11]			50K 5000 K	

Options

PS1050	Emergency battery pack, 10W, CA Title 20 Noncompliant[2,11,13,16,17]
E10WLCP	Emergency battery pack, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS[2,11,13,16,17]
BGTD	Generator transfer device, not avaialble with PS1050[13,16,18]
OCS	5', 18/3 Reloc selectable One Pass cable[16]
HA	High ambient, for use in ambient temperatures up to 50°C[11]
EPNKO	Decorative endplate, no knock out[19]
OUTCTR	Wiring leads pulled through back center of fixture[20]
OUTEND	Wiring leads pulled through end of fixture[21]
Cord Sets:	
CS1W	Staight blade plug, 120V[10,16]
CS3W	NEMA twist-lock plug, 120V[10,16]
CS7W	Staight blade plug, 277V[10,16]
CS11W	NEMA twist-lock plug, 277V[10,16]
CS25W	NEMA twist-lock plug, 347V[10,16]
CS97W	NEMA twist-lock plug, 480V[10,16]
CS93W	600V SEOOW white cord, no plug (no voltage required)
CS6WG16STOWD5D	6' white cord, 16/5, no plug, includes low voltage dimming wires (no voltage required)[15]
PLR___	Plug-in wiring, see page 16 for ordering information
PLR1LVG	Plug-in wiring,low voltage dimming[22]
RRL___	RELOC®-ready luminaire. See page 15 for ordering information
SPD	Surge protection device, provides up to 6kV protection[20]
USPOM	Assembled in the United States
nLight® Wireless: [23,24]	
NLTAIR2 RES7	nLight® Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell
NLTAIR2 RES7PDT	nLight AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell
NLTAIR2 RIO	No sensor control
nLight® Wired: [23,25]	
N100	nLight® without lumen management
NES7	nLight® nES 7 PIR integral occupancy sensor[26]
NESPDT7	nLight® nES PDT 7 dual technology integral occupancy control[26]
NES7ADCX	nLight® nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell[26]
NESPDT7ADCX	nLight® nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell[26]
Individual controls: [23,25]	
MSD7	PIR integral occupancy sensor
MSDPDT7	PDT 7 dual technology integral occupancy control
MSD7ADC	PIR integral occupancy sensor with automatic dimming control photocell
MSDPDT7ADC	PDT integral occupancy sensor with automatic dimming control photocell

Finish

WH	White
GALVW	Galvanized with white lens end caps
GALVB	Galvanized with black lens end caps
MB	Matte black
SKGYW	Smoke gray with white lens end caps
SKGYB	Smoke gray with black lens end caps

See Accessories and footnotes on next page

Accessories: *Order as separate catalog number.*

Mounting:	
ZACVH	Aircraft cable 120" (one pair)
ZAC120	One adjustable aircraft cable with canopy 120" [27]
ZACFP120	One adjustable aircraft cable with feed (3 conductor) and canopy, 120" [27]
ZACFPD120	One adjustable aircraft cable with feed (5 conductor) and canopy 120" [27]
ZAC240	One adjustable aircraft cable with canopy 240" [27]
ZACFP240	One adjustable aircraft cable with feed (3 conductor) and canopy, 240" [27]
ZACFPD240	One adjustable aircraft cable with feed (5 conductor) and canopy 240" [27]
SQ_	Stem kit, 2" increments up to 48" [27]
THCLX __	Tong hanger (Must specify color) (one pair) [28]
CLXANGBKT ___	Angle bracket, (Must specify color) (one pair) [28]
HC36	Hanger chain, 36" (one pair)
Sensors & Controls:	
LSXR	Sensor Switch ® LSXR occupancy sensor [29]
NPP16D	nLight® switching/dimming module
NPP16DER	nLight® switching/dimming module with emergency relay
rPP20D	nLight® air dimming/switching module
XPA CMRB0	XPoint™ Wireless 0-10V relay, external, 55°C max ambient
Reflectors:	
CLXRW24__	Wide decorative 24" reflector, (Must specify color) [30]
CLXRW36__	Wide decorative 36" reflector, (Must specify color) [30]
CLXRW48__	Wide decorative 48" reflector, (Must specify color) [30]
CLXRW96__	Two wide decorative 48" reflectors, (Must specify color) [30]
CLXRWU24__	Wide decorative 24" reflector with uplight, (Must specify color) [30]
CLXRWU36__	Wide decorative 36" reflector with uplight, (Must specify color) [30]
CLXRWU48__	Wide decorative 48" reflector with uplight, (Must specify color) [30]
CLXRWU96__	Two wide decorative 48" reflectors with uplight, (Must specify color) [30]
CLXRN24	Narrow 24" reflector, (Must specify color) [31]
CLXRN36	Narrow 36" reflector, (Must specify color) [31]
CLXRN48	Narrow 48" reflector, (Must specify color) [31]
CLXRN96__	Two narrow 48" reflectors, (Must specify color) [31]
Wireguards:	
WGCLX24__	24" wireguard, (Must specify color) [32]
WGCLX36__	36" wireguard, (Must specify color) [32]
WGCLX48__	48" wireguard, XX, (Must specify color) 96" fixture requires two [32]

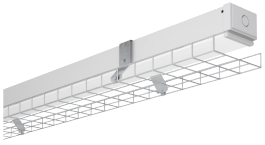
Notes

1 Not available with OUTCTR option.
2 Not available with HA option.
3 Not available with SEF when ordered in combination with EZ1.
4 Not available with NLTAIR2 RES7, NLTAIR2 RES7PDT, or NLTAIR2 RIO.
5 Not available with EZ1 when ordered with L24 with 5000LM or L36 with 7500LM.
6 When ordered with L24 only available with 1500LM or 2000LM in combination with GZ10 driver. Not for use with THCLX, CLXANGBKT, CLX reflectors or WGCLX accessories. Not available with RDL lens options.
7 Only available with general distribution.
8 Not available with CLXRN accessories.
9 Available L/LENS only.
10 Not available with PS1050, E10WLCP, or BGTD.
11 Not available with BGTD option.
12 Voltage selected utilizes a step-down transformer. Not available with L24 when ordered with N100.Not available with PS1050, E10WLCP or BGTD option.
13 Requires SPD option.
14 When continuous row mounting, fixtures must all have the same driver selection.
15 Not available with Individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
16 Must specify voltage.
17 Not available with L24 or L36. Not available with L48 in combination with N100.
18 Available with L48 or L96 only. 20 Not available with PS1050 or E10WLCP options. Not available with 208 or 240V. Not available Individual controls, NLight Wired, or NLight Wireless options.
19 Not available OUTEND.
20 Required with PS1050, E10WLCP, BGTD, XAD, or XAD924.
21 Not available with PLR options.
22 Not available with XPoint, Individual controls, NLight Wired, or NLight Wireless options.
23 Sensor housing will be the same color as lens end caps.
24 Not available with L24 in combination with 5000LM, not available with L36 in combination with 7500LM, not available with L48 in combination with 10000LM, and not available with L96 in combination with 14000LM, 18000LM, or 20000LM. Not available with PLRs containing low voltage dimming wires.
25 Not available with any other control option. Requires EZ1.
26 Requires N100 option.
27 Ships standard as white.
28 Not available with louver, wireguards, wide reflectors.
29 More configurations on LSXR Specification Sheet.
30 L24 reflector is 22.65", L36 reflector is 34.01", L48 reflector is 46.80", L96 comes with two L48 reflectors.
31 For use with L/LENS fixtures only. L24 reflector is 22.75", L36 reflector is 34.20", L48 reflector is 46.85", L96 comes with two L48 reflectors.
32 Not for use with CLX wide reflector accessories.

OPTIONS AND ACCESSORIES

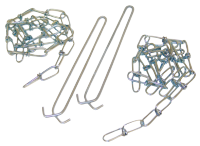
Narrow reflector
Ships separtely from fixture.
Order as:
CLXRN24__
CLXRN36__
CLXRN48__
CLXRN96__

Wide decorative reflector
Ships separtely from fixture.
Order as:
CLXRW24__
CLXRW36__
CLXRW48__
CLXRW96__



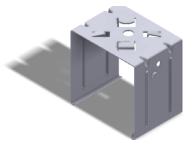
Wireguard
Ships separately from fixture:
96" fixture requires two WGCLX48.
Order as:
WGCLX24__
WGCLX36__
WGCLX48__

Aircraft Cable with Canopy
Available in 120" or 240"
Order as:
ZAC120
ZAC240



HANGER CHAIN
36" chain with Y hanger. ships as a pair
Order as:
HC36

ZACVH HANGER
10' Aircraft cable with Y hanger.
Order as:
ZACVH



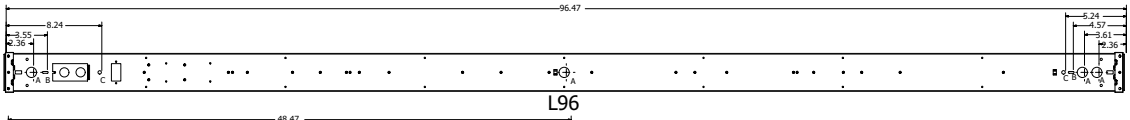
Tong hanger
Ships as a pair
Order As:
THCLX__

DIMENSIONS

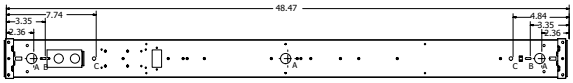
All dimensions are in inches (centimeters) unless otherwise indicated.
Dimensions may vary with options or accessories.

INTEGRATED SENSOR ADDS 2.0 INCHES TO STANDALONE FIXTURE LENGTH
HOUSING END CAP ADDS 0.236 INCHES TO FIXTURE LENGTH PER SIDE. DIMENSIONS BELOW INCLUDE ENDCAPS.

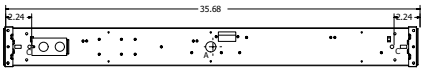
A - 7/8" KNOCK OUT
B - 0.5" by 0.16" SLOT
C - 0.3" DIA HOLE



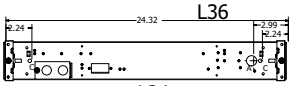
L96



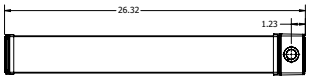
L48



L36



L24

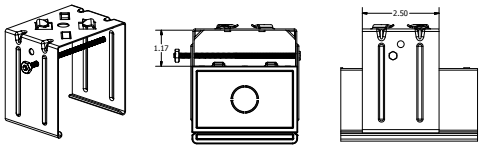


L24 WITH SENSOR

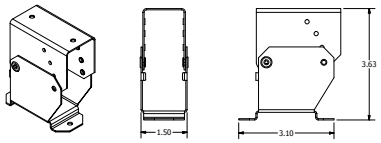
PALLET DIMENSIONS

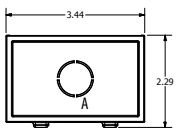
Length	Approx Weight	Fixtures per pallet	Pallet Dims (L X W X H)
L24	4 lb	100	54x46x37
L36	5 lb	80	54x46x37
L48	7.5 lb	64	54x46x37
L96	14 lb	64	98x46x37

THCLX - SHIPS TWO PER ORDER,
UTILIZES A #8 HEX HEAD SCREW AND NUT
FIXTURE SITS 1.3 INCHES FROM STRUCTURE WHEN MOUNTED

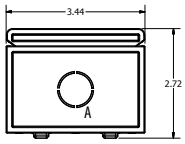


CLXANGBKT - SHIPS TWO PER ORDER
HOLES TO MOUNTING STRUCTURE ARE 0.175" DIA, 2.5" APART
FIXTURE SITS APPROXIMATELY 3.5" FROM STRUCTURE
WHEN MOUNTED HORIZONTAL TO STRUCTURE

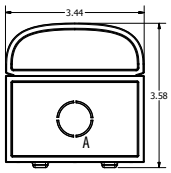




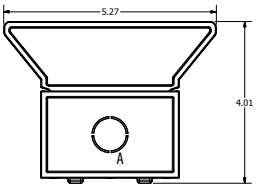
L/LENS



FDL



RDL



WDL

PHOTOMETRICS

See www.lithonia.com.

POWER SENTRY EMERGENCY BATTERY PACKS

		SEF Emergency Lumens	HEF Emergency Lumens
PS1050	Factory installable	1400	1500
E10WLCP	Factory installable	1400	1500
PS1555LCP	Field installable, remote mount only	2000	2100

Note: For emergency lumen output of specific model, please consult factory. One board will be illuminated during emergency operation.

CLX CHARACTERISTICS

Nominal Lumen Package	Length	Wattage								Length	Width	Depth	Comparable Light Source
		Standard efficiency				High efficiency							
		120V	277V	347V	480V	120V	277V	347V	480V	Dimensions are shown in inches			
2500LM	24"	19.9	19.9	25.9	25.9	18.5	18.5	24.5	24.5	24	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
5000LM	24"	41.9	41.9	47.9	47.9	37.9	37.9	43.9	43.9	24	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
3750LM	36"	28.1	28.1	34.1	34.1	27.0	27.0	33.0	33.0	36	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
7500LM	36"	62.9	62.9	68.9	68.9	56.8	56.8	62.8	62.8	36	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
5000LM	48"	35.4	35.4	41.4	41.4	32.9	32.9	38.9	38.9	48	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
10000LM	48"	77.1	77.1	83.1	83.1	70.4	70.4	76.4	76.4	48	3.5	3.75	3 -lamp 32WT8, 2-lamp 54W T5HO, 100W HID
10000LM	96"	70.8	70.8	76.8	76.8	65.8	65.8	71.8	71.8	96	3.5	3.75	3 -lamp 32WT8, 2-lamp 54W T5HO, 100W HID
20000LM	96"	154.2	154.2	160.2	160.2	140.8	140.8	146.8	146.8	96	3.5	3.75	6 - lamp 32WT8, 4 -lamp 54T5HO, 200W HID

AMBIENT TEMPERATURE RATINGS

Driver Package		GZ10			EZ1			Any Driver	
Length	Lumen package	Direct Surface	THCLX/ Suspended	HA Option (Direct or Suspended)	Direct Surface	THCLX	Suspended 18"	Xpoint/ BGTD Direct Surface	PS1050 Suspended
L24	1500LM	40C	40C	N/A	35C	35C	35C	N/A	N/A
	2000LM	40C	40C		35C	35C	35C		
	2500LM	40C	40C		35C	35C	35C		
	3000LM	40C	40C		40C	40C	40C		
	4500LM	40C	40C		35C	35C	40C		
	5000LM	40C	40C		25C	30C	35C		
L36	2250LM	40C	40C		40C	40C	40C		
	3000LM	40C	40C		40C	40C	40C		
	3750LM	40C	40C		40C	40C	40C		
	5250LM	40C	40C		35C	35C	40C		
	6750LM	30C	40C		35C	35C	40C		
	7500LM	30C	40C		25C	30C	35C		
L48	3000LM	40C	40C	50C	40C	40C	40C	35C	25C
	4000LM	40C	40C	50C	40C	40C	40C		
	5000LM	40C	40C	50C	35C	35C	40C		
	7000LM	30C	40C	N/A	35C	35C	40C		
	9000LM	30C	40C		25C	30C	35C		
	10000LM	30C	40C		25C	30C	35C		
L96	6000LM	40C	40C	50C	35C	35C	40C		
	8000LM	30C	40C	50C	35C	35C	40C		
	10000LM	30C	40C	50C	25C	30C	35C		
	14000LM	40C	40C	N/A	35C	35C	40C		
	18000LM	30C	40C		25C	30C	35C		
	20000LM	30C	40C		25C	30C	35C		

CLX OPERATIONAL DATA

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L24	1500LM	SEF	80	1497	1540	1582	1619	10.85
				90	1305	1333	1371	1441	10.85
			HEF	80	1493	1514	1582	1586	10.39
				90	1220	1237	1301	1301	10.39
		2000LM	SEF	80	2066	2125	2183	2235	14.48
				90	1801	1840	1892	1989	14.48
			HEF	80	2060	2089	2183	2189	13.46
				90	1684	1708	1796	1796	13.46
		2500LM	SEF	80	2616	2689	2763	2829	18.41
				90	2279	2329	2394	2517	18.41
			HEF	80	2607	2644	2763	2771	17.42
				90	2132	2161	2273	2273	17.42
		3500LM	SEF	80	3518	3617	3716	3804	25.83
				90	3065	3132	3220	3385	25.83
			HEF	80	3506	3556	3716	3726	25.04
				90	2867	2907	3057	3057	25.04
		4500LM	SEF	80	5040	5182	5325	5451	38.7
				90	4392	4487	4614	4851	38.7
			HEF	80	5024	5096	5325	5339	34.8
				90	4108	4165	4380	4380	34.8
		5000LM	SEF	80	5355	5506	5657	5791	41.48
				90	4667	4767	4902	5153	41.48
			HEF	80	5338	5414	5657	5672	38.11
				90	4364	4425	4653	4653	38.11
	L36	2250LM	SEF	80	2411	2547	2101	2207	16.36
				90	2479	2607	2146	2320	16.36
			HEF	80	2437	2554	1965	2095	15.47
				90	2547	2403	1992	2095	15.47
		3000LM	SEF	80	3221	3388	2730	2868	20.8
				90	3310	3133	2789	3015	20.8
			HEF	80	3167	3319	2553	2722	19.98
				90	3310	3123	2589	2722	19.98
		3750LM	SEF	80	4123	4337	3495	3671	26.47
				90	4236	4010	3570	3859	26.47
			HEF	80	4054	4248	3268	3485	25.09
				90	4236	3997	3314	3485	25.09
		5250LM	SEF	80	5545	5833	4700	4937	39.9
				90	5698	5393	4801	5190	39.9
			HEF	80	5452	5713	4396	4687	34.3
				90	5698	5376	4457	4687	34.3
		6750LM	SEF	80	7081	7448	6001	6303	54.85
				90	7275	6886	6131	6627	54.85
			HEF	80	6962	7294	5613	5984	47.97
				90	7275	6864	5691	5984	47.97
		7500LM	SEF	80	7756	8158	6574	6905	62.6
				90	7969	7543	6716	7260	62.6
			HEF	80	7626	7991	6148	6555	54.02
				90	7969	7519	6234	6555	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L48	3000LM	SEF	80	3019	3104	3190	3265	20.32
				90	2631	2688	2764.	2906.	20.32
			HEF	80	3010	3052	3190	3198	19.01
				90	2461	2495	2624	2624	19.01
		4000LM	SEF	80	4034	4148	4262	4363	27.58
				90	3515	3591	3693	3882	27.58
			HEF	80	4021	4078	4262	4273	24.75
				90	3288	3334	3505	3505	24.75
		5000LM	SEF	80	5047	5189	5332	5458	34.8
				90	4398	4493	4620	4857	34.8
			HEF	80	5031	5102	5332	5346	31.77
				90	4113	4171	4386	4386	31.77
		7000LM	SEF	80	7311	7517	7724	7907	49.05
				90	6371	6509	6692	7036	49.05
			HEF	80	7288	7391	7724	7744	44.67
				90	5959	6042	6353	6353	44.67
		9000LM	SEF	80	9215	9475	9735	9967	63.99
				90	8031	8204	8435	8869	63.99
			HEF	80	9186	9317	9735	9762	58.58
				90	7511	7615	8008	8008	58.58
		10000LM	SEF	80	10299	10590	10880	11139	73.37
				90	8975	9169	9427	9912	73.37
			HEF	80	10266	10412	10880	10910	66.27
				90	8394	8511	8950	8950	66.27
	L96	6000LM	SEF	80	5942	6110	6278	6427	38.15
				90	5178	5290	5439	5719	38.15
			HEF	80	5923	6008	6278	6294	35.54
				90	4843	4911	5164	5164	35.54
		8000LM	SEF	80	7929	8153	8376	8575	52.32
				90	6910	7059	7258	7631	52.32
			HEF	80	7903	8016	8376	8399	48.5
				90	6462	6552	6890	6890	48.5
		10000LM	SEF	80	9808	10085	10362	10608	66.47
				90	8548	8732	8978	9439	66.47
			HEF	80	9777	9916	10362	10390	60.89
				90	7994	8106	8523	8523	60.89
		14000LM	SEF	80	14323	14727	15131	15491	94.78
				90	12482	12752	13111	13784	94.78
			HEF	80	14277	14480	15131	15172	85.96
				90	11674	11836	12447	12447	85.96
		18000LM	SEF	80	18458	18979	19500	19963	128.98
				90	16086	16433	16896	17764	128.98
			HEF	80	18399	18661	19500	19552	116.92
				90	15044	15254	16040	16040	116.92
		20000LM	SEF	80	20386	20962	21537	22048	146.83
				90	17766	18150	18661	19619	146.83
			HEF	80	20321	20610	21537	21595	131.6
				90	16616	16847	17716	17716	131.6

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L24	1500LM	SEF	80	1359	1397	1436	1470	10.85
				90	1184	1210	1244	1308	10.85
			HEF	80	1355	1374	1436	1439	10.39
				90	1107	1123	1181	1181	10.39
		2000LM	SEF	80	1875	1928	1981	2028	14.48
				90	1634	1670	1717	1805	14.48
			HEF	80	1869	1896	1981	1987	13.46
				90	1528	1550	1630	1630	13.46
		2500LM	SEF	80	2374	2441	2508	2567	18.41
				90	2069	2113	2173	2284	18.41
			HEF	80	2366	2400	2508	2514	17.42
				90	1935	1962	2063	2063	17.42
		3500LM	SEF	80	3192	3282	3372	3452	25.83
				90	2782	2842	2922	3072	25.83
			HEF	80	3182	3227	3372	3381	25.04
				90	2602	2638	2774	2774	25.04
		4500LM	SEF	80	4574	4703	4832	4947	38.7
				90	3986	4072	4187	4402	38.7
			HEF	80	4560	4624	4832	4845	34.8
				90	3728	3780	3975	3975	34.8
		5000LM	SEF	80	4860	4997	5134	5256	41.48
				90	4235	4327	4448	4677	41.48
			HEF	80	4844	4913	5134	5148	38.11
				90	3961	4016	4223	4223	38.11
	L36	2250LM	SEF	80	2188	2250	2311	2366	16.36
				90	1907	1948	2003	2106	16.36
			HEF	80	2181	2212	2311	2318	15.47
				90	1783	1808	1901	1901	15.47
		3000LM	SEF	80	2843	2924	3004	3075	20.8
				90	2478	2531	2603	2736	20.8
			HEF	80	2834	2875	3004	3012	19.98
				90	2317	2350	2471	2471	19.98
		3750LM	SEF	80	3639	3742	3845	3936	26.47
				90	3171	3240	3331	3502	26.47
			HEF	80	3628	3679	3845	3855	25.09
				90	2966	3007	3162	3162	25.09
		5250LM	SEF	80	4895	5033	5171	5294	39.9
				90	4265	4357	4480	4710	39.9
			HEF	80	4879	4948	5171	5185	34.3
				90	3989	4045	4253	4253	34.3
		6750LM	SEF	80	6250	6426	6602	6759	54.85
				90	5446	5564	5721	6014	54.85
			HEF	80	6230	6318	6602	6620	47.97
				90	5094	5165	5431	5431	47.97
		7500LM	SEF	80	6846	7039	7232	7404	62.6
				90	5966	6095	6266	6588	62.6
			HEF	80	6824	6921	7232	7252	54.02
				90	5580	5657	5949	5949	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L48	3000LM	SEF	80	2740	2817	2895	2963	20.32
				90	2388	2439	2508	2637	20.32
			HEF	80	2731	2770	2895	2902	19.01
				90	2233	2264	2381	2381	19.01
		4000LM	SEF	80	3661	3764	3868	3959	27.58
				90	3190	3259	3351	3523	27.58
			HEF	80	3649	3701	3868	3878	24.75
				90	2984	3025	3181	3181	24.75
		5000LM	SEF	80	4580	4710	4839	4954	34.8
				90	3992	4078	4193	4408	34.8
			HEF	80	4566	4631	4839	4852	31.77
				90	3733	3785	3980	3980	31.77
		7000LM	SEF	80	6635	6822	7009	7176	49.05
				90	5782	5907	6073	6385	49.05
			HEF	80	6614	6708	7009	7028	44.67
				90	5408	5483	5766	5766	44.67
		9000LM	SEF	80	8363	8599	8835	9045	63.99
				90	7288	7446	7655	8049	63.99
			HEF	80	8336	8455	8835	8859	58.58
				90	6816	6911	7268	7268	58.58
		10000LM	SEF	80	9347	9611	9874	10109	73.37
				90	8145	8321	8556	8995	73.37
			HEF	80	9317	9450	9874	9901	66.27
				90	7618	7724	8122	8122	66.27
	L96	6000LM	SEF	80	5393	5545	5697	5832	38.15
				90	4700	4801	4936	5190	38.15
			HEF	80	5375	5452	5697	5712	35.54
				90	4395	4457	4686	4686	35.54
		8000LM	SEF	80	7196	7399	7602	7782	52.32
				90	6271	6406	6587	6925	52.32
			HEF	80	7173	7275	7602	7622	48.5
				90	5865	5946	6253	6253	48.5
		10000LM	SEF	80	8902	9153	9404	9627	66.47
				90	7757	7925	8148	8567	66.47
			HEF	80	8873	8999	9404	9429	60.89
				90	7255	7356	7735	7735	60.89
		14000LM	SEF	80	12999	13366	13732	14058	94.78
				90	11328	11573	11899	12510	94.78
			HEF	80	12957	13142	13732	13769	85.96
				90	10594	10742	11296	11296	85.96
		18000LM	SEF	80	16751	17224	17697	18117	128.98
				90	14598	14913	15334	16121	128.98
			HEF	80	16698	16936	17697	17744	116.92
				90	13653	13843	14557	14557	116.92
		20000LM	SEF	80	18501	19023	19545	20009	146.83
				90	16123	16471	16935	17805	146.83
			HEF	80	18442	18705	19545	19598	131.6
				90	15079	15290	16078	16078	131.6

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L24	1500LM	SEF	80	1320	1358	1395	1428	10.85
				90	1151	1175	1208	1271	10.85
			HEF	80	1316	1335	1395	1399	10.39
				90	1076	1091	1147	1147	10.39
		2000LM	SEF	80	1822	1874	1925	1971	14.48
				90	1588	1622	1668	1754	14.48
			HEF	80	1816	1842	1925	1930	13.46
				90	1485	1506	1583	1583	13.46
		2500LM	SEF	80	2306	2371	2436	2494	18.41
				90	2010	2053	2111	2219	18.41
			HEF	80	2299	2332	2436	2443	17.42
				90	1880	1906	2004	2004	17.42
		3500LM	SEF	80	3102	3189	3277	3354	25.83
				90	2703	2761	2839	2985	25.83
			HEF	80	3092	3136	3277	3285	25.04
				90	2528	2563	2695	2695	25.04
		4500LM	SEF	80	4444	4570	4695	4807	38.7
				90	3873	3957	4068	4277	38.7
			HEF	80	4430	4493	4695	4708	34.8
				90	3622	3673	3862	3862	34.8
		5000LM	SEF	80	4722	4855	4988	5107	41.48
				90	4115	4204	4322	4544	41.48
			HEF	80	4707	4774	4988	5002	38.11
				90	3848	3902	4103	4103	38.11
	L36	2250LM	SEF	80	2126	2186	2246	2299	16.36
				90	1852	1892	1946	2046	16.36
			HEF	80	2119	2149	2246	2252	15.47
				90	1732	1757	1847	1847	15.47
		3000LM	SEF	80	2762	2840	2918	2988	20.8
				90	2407	2459	2529	2659	20.8
			HEF	80	2754	2793	2918	2926	19.98
				90	2251	2283	2401	2401	19.98
		3750LM	SEF	80	3536	3636	3735	3824	26.47
				90	3081	3148	3237	3403	26.47
			HEF	80	3525	3575	3735	3745	25.09
				90	2882	2922	3073	3073	25.09
		5250LM	SEF	80	4755	4890	5024	5143	39.9
				90	4144	4234	4353	4577	39.9
			HEF	80	4740	4808	5024	5037	34.3
				90	3876	3930	4132	4132	34.3
		6750LM	SEF	80	6072	6243	6415	6567	54.85
				90	5292	5406	5558	5844	54.85
			HEF	80	6053	6139	6415	6432	47.97
				90	4949	5018	5276	5276	47.97
		7500LM	SEF	80	6651	6839	7027	7194	62.6
				90	5796	5922	6088	6401	62.6
			HEF	80	6630	6725	7027	7046	54.02
				90	5421	5497	5780	5780	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L48	3000LM	SEF	80	2662	2737	2812	2879	20.32
				90	2320	2370	2437	2562	20.32
			HEF	80	2654	2691	2812	2820	19.01
				90	2170	2200	2313	2313	19.01
		4000LM	SEF	80	3557	3657	3758	3847	27.58
				90	3100	3167	3256.	3423	27.58
			HEF	80	3546	3596	3758	3768	24.75
				90	2899	2939	3091	3091	24.75
		5000LM	SEF	80	4450	4576	4701	4813	34.8
				90	3878	3962	4073	4283	34.8
			HEF	80	4436	4499	4701	4714	31.77
				90	3627	3678	3867	3867	31.77
		7000LM	SEF	80	6446	6628	6810	6972	49.05
				90	5618	5739	5901	6204	49.05
			HEF	80	6426	6517	6810	6829	44.67
				90	5254	5327	5602	5602	44.67
		9000LM	SEF	80	8126	8355	8584	8788	63.99
				90	7081	7234	7438	7820	63.99
			HEF	80	8100	8215	8584	8607	58.58
				90	6623	6715	7061	7061	58.58
		10000LM	SEF	80	9081	9338	9594	9822	73.37
				90	7914	8085	8313	8740	73.37
			HEF	80	9052	9181	9594	9620	66.27
				90	7402	7505	7892	7892	66.27
	L96	6000LM	SEF	80	5240	5387	5535	5667	38.15
				90	4566	4665	4796	5042	38.15
			HEF	80	5223	5297	5535	5550	35.54
				90	4270	4330	4553	4553	35.54
		8000LM	SEF	80	6991	7189	7386	7561	52.32
				90	6093	6224	6400	6728	52.32
			HEF	80	6969	7068	7386	7406	48.5
				90	5698	5778	6075	6075	48.5
		10000LM	SEF	80	8649	8893	9137	9354	66.47
				90	7537	7700	7917	8323	66.47
			HEF	80	8621	8744	9137	9161	60.89
				90	7049	7147	7516	7516	60.89
		14000LM	SEF	80	12630	12986	13342	13659	94.78
				90	11006	11244	11561	12154	94.78
			HEF	80	12589	12768	13342	13378	85.96
				90	10293	10437	10975	10975	85.96
		18000LM	SEF	80	16276	16735	17194	17602	128.98
				90	14184	14490	14898	15663	128.98
			HEF	80	16223	16454	17194	17240	116.92
				90	13265	13450	14143	14143	116.92
		20000LM	SEF	80	17976	18483	18990	19441	146.83
				90	15665	16004	16454	17300	146.83
			HEF	80	17918	18173	18990	19041	131.6
				90	14651	14855	15621	15621	131.6

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L24	1500LM	SEF	80	1377	1415	1454	1489	10.85
				90	1200	1226	1260	1325	10.85
			HEF	80	1372	1392	1454	1458	10.39
				90	1122	1138	1196	1196	10.39
		2000LM	SEF	80	1900	1953	2007	2055	14.48
				90	1656	1691	1739	1828	14.48
			HEF	80	1894	1921	2007	2012	13.46
				90	1548	1570	1651	1651	13.46
		2500LM	SEF	80	2405	2472	2540	2601	18.41
				90	2095	2141	2201	2314	18.41
			HEF	80	2397	2431	2540	2547	17.42
				90	1960	1987	2090	2090	17.42
		3500LM	SEF	80	3234	3325	3416	3497	25.83
				90	2818	2879	2960	3112	25.83
			HEF	80	3223	3269	3416	3426	25.04
				90	2636	2672	2810	2810	25.04
		4500LM	SEF	80	4634	4765	4895	5012	38.7
				90	4038	4125	4242	4459	38.7
			HEF	80	4619	4685	4895	4908	34.8
				90	3777	3829	4027	4027	34.8
		5000LM	SEF	80	4923	5062	5201	5324	41.48
				90	4290	4383	4506	4738	41.48
			HEF	80	4907	4977	5201	5215	38.11
				90	4012	4068	4278	4278	38.11
	L36	2250LM	SEF	80	2216	2279	2341	2397	16.36
				90	1931	1973	2029	2133	16.36
			HEF	80	2209	2241	2341	2348	15.47
				90	1806	1832	1926	1926	15.47
		3000LM	SEF	80	2880	2962	3043	3115	20.8
				90	2510	2564	2636	2772	20.8
			HEF	80	2871	2912	3043	3051	19.98
				90	2347	2380	2503	2503	19.98
		3750LM	SEF	80	3687	3791	3895	3987	26.47
				90	3213	3282	3375	3548	26.47
			HEF	80	3675	3727	3895	3905	25.09
				90	3005	3047	3204	3204	25.09
		5250LM	SEF	80	4958	5098	5238	5362	39.9
				90	4321	4414	4539	4772	39.9
			HEF	80	4942	5013	5238	5252	34.3
				90	4041	4097	4309	4309	34.3
		6750LM	SEF	80	6331	6510	6688	6847	54.85
				90	5517	5636	5795	6093	54.85
			HEF	80	6311	6401	6688	6706	47.97
				90	5160	5232	5502	5502	47.97
		7500LM	SEF	80	6935	7131	7326	7500	62.6
				90	6044	6174	6348	6674	62.6
			HEF	80	6913	7011	7326	7346	54.02
				90	5652	5731	6027	6027	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L48	3000LM	SEF	80	2776	2854	2932	3002	20.32
				90	2419	2471	2541	2671	20.32
			HEF	80	2767	2806	2932	2940	19.01
				90	2262	2294	2412	2412	19.01
		4000LM	SEF	80	3709	3813	3918	4011	27.58
				90	3232	3302	3395	3569	27.58
			HEF	80	3697	3749	3918	3929	24.75
				90	3023	3065	3223	3223	24.75
		5000LM	SEF	80	4640	4771	4902	5018	34.8
				90	4044	4131	4247	4465	34.8
			HEF	80	4625	4691	4902	4915	31.77
				90	3782	3834	4032	4032	31.77
		7000LM	SEF	80	6721	6911	7101	7269	49.05
				90	5857	5984	6152	6469	49.05
			HEF	80	6700	6795	7101	7120	44.67
				90	5478	5554	5841	5841	44.67
		9000LM	SEF	80	8472	8711	8950	9163	63.99
				90	7383	7543	7755	8154	63.99
			HEF	80	8445	8565	8950	8974	58.58
				90	6905	7001	7362	7362	58.58
		10000LM	SEF	80	9469	9736	10003	10240	73.37
				90	8252	8430	8667	9112	73.37
			HEF	80	9438	9573	10003	10030	66.27
				90	7717	7825	8228	8228	66.27
	L96	6000LM	SEF	80	5463	5617	5771	5908	38.15
				90	4761	4864	5001	5258	38.15
			HEF	80	5445	5523	5771	5787	35.54
				90	4452	4515	4747	4747	35.54
		8000LM	SEF	80	7289	7495	7701	7884	52.32
				90	6353	6490	6672	7015	52.32
			HEF	80	7266	7370	7701	7722	48.5
				90	5941	6024	6334	6334	48.5
		10000LM	SEF	80	9017	9272	9526	9752	66.47
				90	7858	8028	8254	8678	66.47
			HEF	80	8988	9117	9526	9552	60.89
				90	7349	7452	7836	7836	60.89
		14000LM	SEF	80	13168	13540	13911	14241	94.78
				90	11476	11723	12054	12673	94.78
			HEF	80	13126	13313	13911	13949	85.96
				90	10732	10882	11443	11443	85.96
		18000LM	SEF	80	16970	17448	17927	18353	128.98
				90	14788	15108	15533	16331	128.98
			HEF	80	16915	17156	17927	17975	116.92
				90	13831	14024	14746	14746	116.92
		20000LM	SEF	80	18742	19271	19800	20270	146.83
				90	16333	16686	17156	18037	146.83
			HEF	80	18682	18948	19800	19853	131.6
				90	15276	15489	16287	16287	131.6

RRL - RELOC®-Ready Luminaire

- RRL connectors can be used with Quick-Flex®, System 820 and OnePass® systems.
- Load side of connector factory installed to luminaire.
- 4-pole mating connector with push-in terminations allows for simple installation.
- Touch-safe design on both halves meets UL/CSA requirement.
- Wiping contact design allows safe disconnect under load.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example**: RRLA

Series		Wiring instructions	
RRL	RELOC®-ready luminaire	A	Hot conductor wired to position #1 (phase A)
		B	Hot conductor wired to position #2 (phase B)
		C	Hot conductor wired to position #3 (phase C) [1]

Compatible RELOC® Cables for Industrial Luminaires (ordered and shipped separately)

OCS

OCU

OD

DC

PT

Notes

1 C, ABE, and C12S options are not used with Quick-Flex QFC, QSFC, QPT, and QD.

PRODUCT INFORMATION

Advanced plug-in system with two-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. 1, 2, 3 and 4-lamp fixtures. PLR22 (2-circuit) and crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G ground required.

Note: Specifications subject to change without notice.

Wiring

PLR

Advanced 1 or 2-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires		Branch circuits				Dimming		Ground	
			Circuits to which ballast is connected		Emergency circuit connected					
PLR	(blank)	Not required for 22	(blank)	Not required for 22	(blank)	No emergency circuit	LV	Low-voltage dimming	G	Ground
PLR22	1	Black	A	Black wire	ELA	Emergency circuit wired to black wire				
	2	Black and red	B	Red wire	ELB	Emergency circuit wired to red wire				

Typical Applications

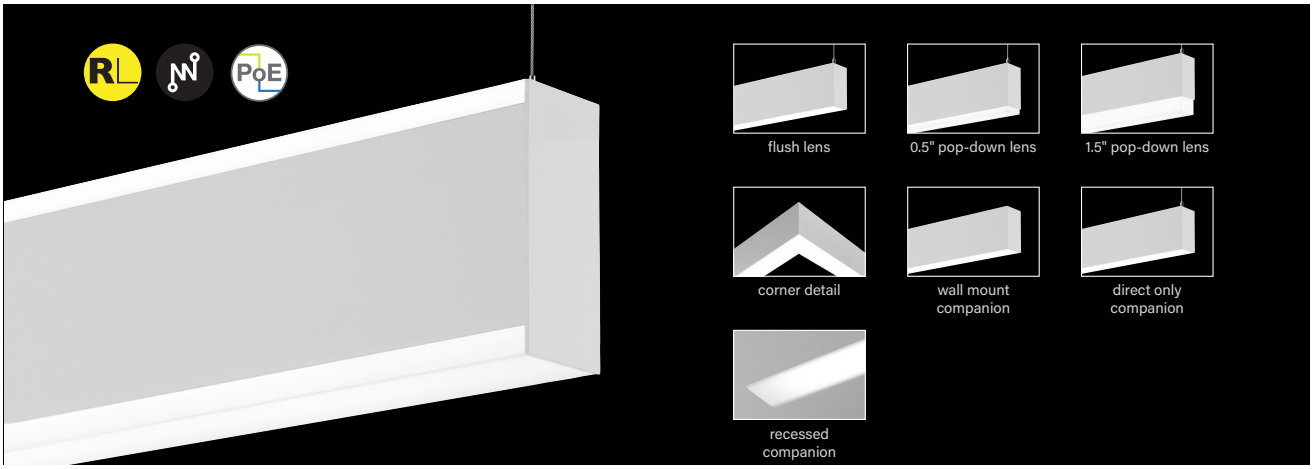
- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits and 2-circuit (PLR 22)
- Multiple circuit with night-lights located along row as desired

L10A

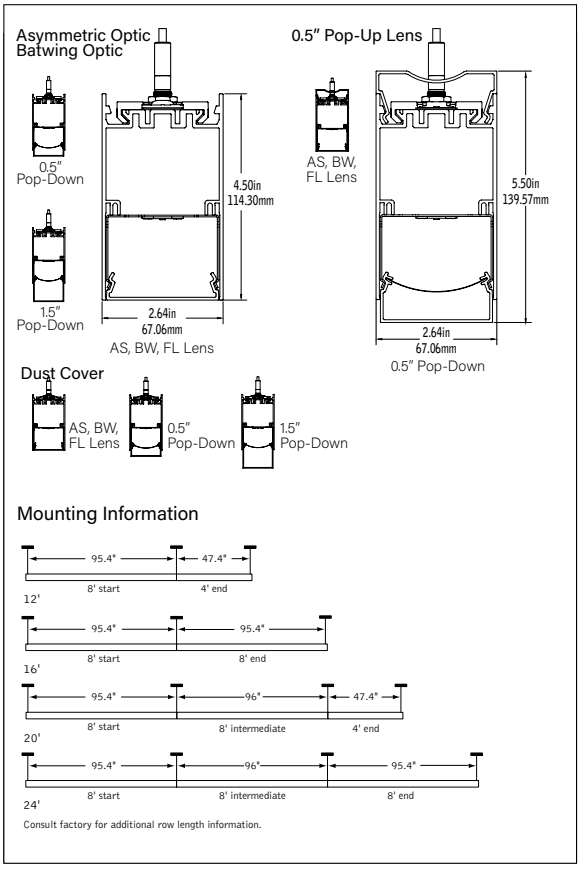
Seem® 2

LED DIRECT/INDIRECT

FOCAL POINT®



DIMENSIONAL DATA



FEATURES

Narrow extruded aluminum 2.5" linear direct/indirect LED with indirect Asymmetric Optic, Batwing Optic, and Pop-lens options.

Frosted acrylic lenses provide uninterrupted illumination, without pixels or shadows.

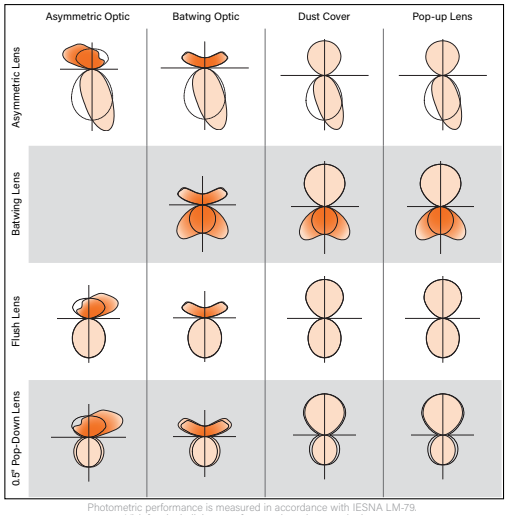
Individual units and continuous runs in 1' increments.

Connected Solutions: Integrates with wired and wireless building lighting control systems.

PoE compatible: Integrates with Power over Ethernet lighting systems via standard, low-voltage wires.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

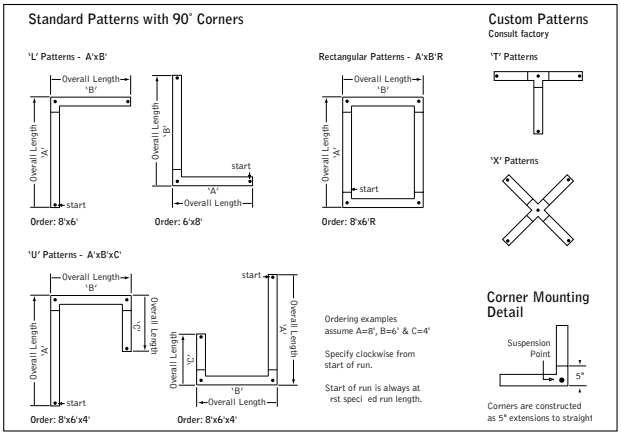
DISTRIBUTIONS



Photometric performance is measured in accordance with IESNA LM-79.
Visit focalpointlights.com for complete photometric data.

fixture: project:

MOUNTING INFORMATION



SPECIFICATIONS

LED System
Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance. Available in 2700K, 3000K, 3500K or 4000K with CRI>80 or CRI>90. 3500K and 4000K with CRI>90 have a cyanosis observation index (COI) of 3.3 or less. LED modules and drivers are replaceable from below. Color accuracy <3 SDCM.

Construction
One piece extruded aluminum housing. Cast aluminum end caps. 8' unit weight: 30 lbs.

Optic
Reflectors fabricated of 20 Ga. steel finished in Matte White powder coat.
Extruded acrylic lens with frosted finish, up to 8' continuous.

Electrical
Luminaires are pre–wired with factory installed branch circuit wiring and over-molded quick connects. Standard 120-277V constant current driver includes 0-10V analog dimming. Power factor > .9. PoE compatible: Integrates with Power over Ethernet lighting systems via standard, low-voltage wires. PoE runs require an independent PoE node and power feed for each luminaire section.

Emergency
Emergency Battery output - 10 watts for 90 minutes. Maximum mounting height: 20 ft.
Emergency Circuit with Connected Solutions (DLM1, LMFS1, LMFSD, NLT1, ENL1, CLM1, NXE1, WLXP) shipped standard with leads to connect UL924 compliant device, by others.

Labels
UL and cUL listed. Suitable for Dry or Damp Locations, indoor use only.

Finish
Polyester powder coat applied over a multi-stage pre–treatment.

Lumen Maintenance
Reported: L70 at >61,000 hours
L90 at >61,000 hours
Calculated: L70 at 257,000 hours
L90 at 69,000 hours
Derived from EPA TM-21 calculator. Based on typical conditions, consult factory for additional data.

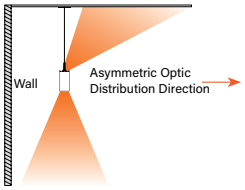
Reliability
At Focal Point, our products are designed to stand the test of time. Each luminaire is engineered using superior components, manufactured with the utmost care and rigorously tested. Contact us for reliability data.

Warranty
LED system rated for operation in ambient environments up to 25°C. 5-year limited warranty.

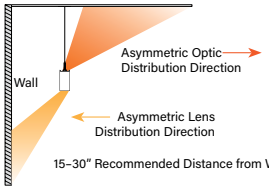
4' PERFORMANCE CHARTS
See page 3 & 4.

FINISH TO BE SELECTED BY ARCHITECT

INDIRECT ASYMMETRIC
Standard Application Example



DIRECT/INDIRECT ASYMMETRIC
Standard Application Example



ORDERING

FSM2BS

Luminaire Series
Seem 2 LED Direct / Indirect — FSM2BS

Shielding
Asymmetric Optic top: Asymmetric Lens bottom — ASAS; Flush Lens bottom — ASFL; 0.5" Pop-down Lens bottom — ASPD05
Asymmetric Optic top: 1.5" Pop-down Lens bottom (Individual Units Only) — ASPD15
Batwing Optic top: Asymmetric Lens bottom — BWAS; Batwing Lens bottom — BWBW; Flush Lens bottom — BWFL; 0.5" Pop-down Lens bottom — BWPD05
Batwing Optic top: 1.5" Pop-down Lens bottom (Individual Units Only) — BWPD15
Dust Cover top: Asymmetric Lens bottom — DCAS; Batwing Lens bottom — DCBW; Flush Lens bottom — DCFL; 0.5" Pop-down Lens bottom — DCPD05
Dust Cover top: 1.5" Pop-down Lens bottom (Individual Units Only) — DCPD15
0.5" Pop-up Lens top: Asymmetric Lens bottom — PUAS; Batwing Lens bottom — PUBW; Flush Lens bottom — PUFL; 0.5" Pop-down Lens bottom — PUPD05

Direct Distribution
125 Lumens per foot (LD1 & L11 Only) — 125DN
250 Lumens per foot — 250DN
375 Lumens per foot — 375DN
500 Lumens per foot — 500DN
625 Lumens per foot — 625DN
750 Lumens per foot — 750DN
875 Lumens per foot — 875DN
1000 Lumens per foot — 1000DN

Indirect Distribution
250 Lumens per foot — 250UP
375 Lumens per foot — 375UP
500 Lumens per foot — 500UP
625 Lumens per foot — 625UP
750 Lumens per foot — 750UP
875 Lumens per foot — 875UP
1000 Lumens per foot — 1000UP
1250 Lumens per foot (Not available with Pop-up Lens.) — 1250UP

Color Temperature
2700K, 80+ CRI or 90+ CRI — 27K or 927K
3000K, 80+ CRI or 90+ CRI — 30K or 930K
3500K, 80+ CRI or 90+ CRI — 35K or 935K
4000K, 80+ CRI or 90+ CRI — 40K or 940K

Circuits & Zones
1 Circuit, non-emergency — 1C
2 non-emergency circuits provide independent control of Direct and Indirect sources (Not available with DLM1, NLT1, CLM1, NXE1) — 2C
Consult Ordering Guide on page 6 for multiple circuiting and zoning options — _C_Z_DL

Voltage
120/277 UNV Volt — UNV
347V (LD1 & L11 only) — 347
Low voltage — LV

Control System & Dimming Level
0-10V - 10% Dimming — LD1
0-10V - 1% Dimming — LH
Low Voltage, PoE compatible (No driver. Not available with EM or EC. LV Voltage only.) — LVN
Lutron Hi-Lume EcoSystem (LDE1) - 1% Dimming — LH1
DALI 1% Dimming (750, 875, 1000 DN or UP, 1250UP consult factory.) — D11
Wattstopper DLM - 1% Dimming**† — DLM1
Wattstopper Fixture Sensor Low Density – 1% Dimming**† (See sensor layout guide) — LMFS1
Wattstopper Fixture Sensor High Density – 1% Dimming**† (See sensor layout guide) — LMFSD
Acuity nLight - 1% Dimming**† (750, 875, 1000 DN or UP, 1250UP consult factory.) — NLT1
Enlighted Smart Sensor - 1% Dimming**† (See sensor layout guide) — ENL1
Encelium CLM Connected Lighting Module - 1% Dimming**† — CLM1
Current NX Enabled – 1% Dimming**† — NXE1
WaveLinx Pro – 1% Dimming**† (See sensor layout guide) — WLXP
**(4' minimum length, with ECD/EM - 7' minimum.)
1 (Not available with pop-down lenses.)
†(Not available with Pop-Up lens.)

Mounting
24" Cable Suspension — C24__
48" Cable Suspension — C48__
96" Cable Suspension — C96__
(Specify canopy color White (WH), Black (BK) or Titanium Sliver (TS). Example: C24WH.) (Specify one of the following in place of "C" J - for 2" canopies at non–feed locations. CS - for sloped ceiling applications.)

Factory Options
(See Ordering Guide for ordering details for DC, EC, EM & ECD.)
Black Cord — BKCD
Daylight Circuit — _DC
Emergency Circuit — _EC
Emergency Battery Pack† — _EM
Emergency Control Device† — _ECD
†(4' minimum. 120/277 Volt only. 5' minimum with Connected Solutions.)

Finish
Black — BK
Titanium Silver — TS
Matte White Housing — WH

Luminaire Length
Specify luminaire/row length in 1' increments (4' minimum. Leave blank for patterns. Smaller increments available, consult factory.) — X' 12'-0"

Pattern Options (4' minimum length)
'L' pattern — A' x B'
'U' pattern — A' x B' x C'
Rectangular pattern (Consult factory for other pattern options) *Not available with Pop-Up or Pop-Down Lens options. **Not available with Pop-Down Lens options. — A' x B' R

QS 10 DAY Options in orange qualify for the Quickship program. 1000' total. Refer to Quickship Guide for complete details including EM/EC options.

4' PERFORMANCE CHART

Direct Distribution	Indirect Distribution	Distribution % (Direct/Indirect)	Total Delivered Lumens	Tested System Watts	Lumens Per Watt (LPW)								
					 ASAS	 ASFL	 ASPD05	 ASPD15	 BWAS	 BWBW	 BWFL	 BWPD05	 BWPD15
125DN	250UP	33/67	1500	14	106	103	100	101	111	109	108	105	105
	375UP	25/75	2000	18	112	110	108	108	118	117	116	113	114
	500UP	20/80	2500	21	117	115	113	113	120	119	118	116	116
	625UP	17/83	3000	25	119	117	115	116	122	121	120	119	119
	750UP	14/86	3500	29	117	116	114	115	121	120	119	118	118
	875UP	13/87	4000	33	118	117	115	116	122	121	120	119	119
	1000UP	11/89	4500	38	119	118	117	117	122	122	121	120	120
	1250UP	9/91	5500	47	120	119	118	118	123	123	122	121	122
250DN	250UP	50/50	2000	18	113	108	104	105	117	114	111	107	109
	375UP	40/60	2500	22	117	113	109	111	122	120	118	114	115
	500UP	33/67	3000	25	120	116	113	114	123	121	119	116	117
	625UP	29/71	3500	29	122	118	115	117	125	123	121	118	119
	750UP	25/75	4000	33	120	117	114	115	123	122	120	117	118
	875UP	22/78	4500	37	120	118	115	116	124	122	121	119	119
	1000UP	20/80	5000	42	121	118	116	117	124	123	122	120	121
	1250UP	17/83	6000	51	121	119	117	118	125	124	123	121	122
375DN	250UP	60/40	2500	22	118	108	106	105	121	118	111	109	108
	375UP	50/50	3000	26	121	112	110	110	125	122	116	114	114
	500UP	43/57	3500	29	123	115	113	113	125	123	118	116	115
	625UP	38/62	4000	33	124	117	115	115	126	124	120	118	118
	750UP	33/67	4500	37	122	116	115	114	125	123	119	117	117
	875UP	30/70	5000	41	122	117	115	115	125	123	120	118	118
	1000UP	27/73	5500	46	122	118	116	116	125	124	121	119	119
	1250UP	23/77	6500	55	122	118	117	117	126	124	122	121	120
500DN	250UP	67/33	3000	27	120	109	106	106	123	119	112	109	108
	375UP	57/43	3500	30	122	113	110	110	126	123	116	113	113
	500UP	50/50	4000	34	124	115	113	113	126	123	117	115	115
	625UP	44/56	4500	37	125	117	115	114	127	124	119	117	117
	750UP	40/60	5000	42	123	116	114	114	125	123	118	116	116
	875UP	36/64	5500	46	123	117	115	115	126	124	119	117	117
	1000UP	33/67	6000	50	123	117	116	116	126	124	120	118	118
	1250UP	29/71	7000	59	123	118	117	117	126	124	121	120	120
625DN	250UP	71/29	3500	32	119	108	104	104	121	117	110	106	106
	375UP	63/37	4000	36	121	111	108	107	124	121	113	111	110
	500UP	56/44	4500	39	123	113	110	110	124	121	115	112	112
	625UP	50/50	5000	42	123	115	112	112	125	122	116	114	114
	750UP	45/55	5500	47	122	114	112	112	124	122	116	114	114
	875UP	42/58	6000	51	122	115	113	113	124	122	117	115	115
	1000UP	38/62	6500	55	122	116	114	114	125	123	118	116	116
	1250UP	33/67	7500	64	122	117	115	115	125	123	119	118	118
750DN	250UP	75/25	4000	37	121	109	104	103	122	118	111	105	105
	375UP	67/33	4500	40	122	112	107	106	125	121	114	109	109
	500UP	60/40	5000	43	123	114	109	109	125	122	115	111	110
	625UP	55/45	5500	47	124	115	111	110	126	123	117	112	112
	750UP	50/50	6000	52	123	115	111	110	125	122	116	113	112
	875UP	46/54	6500	56	123	115	112	111	125	122	117	114	113
	1000UP	43/57	7000	60	123	116	112	112	125	123	118	115	115
	1250UP	38/62	8000	69	123	117	114	114	125	123	119	116	116
875DN	250UP	78/22	4500	42	119	106	103	102	120	116	108	104	104
	375UP	70/30	5000	46	120	109	106	105	122	119	111	108	107
	500UP	64/36	5500	49	121	111	108	107	123	119	112	109	109
	625UP	58/42	6000	53	122	112	109	109	124	121	114	111	111
	750UP	54/46	6500	57	121	112	109	109	123	120	114	111	111
	875UP	50/50	7000	61	121	113	110	110	123	120	115	112	112
	1000UP	47/53	7500	66	121	113	111	111	124	121	116	113	113
	1250UP	41/59	8500	75	122	115	113	112	124	122	117	115	115
1000DN	250UP	80/20	5000	48	118	107	103	103	120	116	108	105	104
	375UP	73/27	5500	51	120	109	106	105	122	118	111	108	107
	500UP	67/33	6000	54	121	111	108	107	122	119	112	109	108
	625UP	62/38	6500	58	122	112	109	109	123	120	114	111	110
	750UP	57/43	7000	63	121	112	109	109	122	119	114	111	110
	875UP	53/47	7500	67	121	113	110	110	123	120	114	112	111
	1000UP	50/50	8000	71	121	113	111	111	123	120	115	113	113
	1250UP	44/56	9000	80	121	114	112	112	123	121	117	114	114

*Based on 3500K, 4' lengths. Lumen Multipliers: Delivered lumens may vary +/- 5%. Actual wattage may vary +/- 5%.

Direct Distribution	Indirect Distribution	Distribution % (Direct/Indirect)	Total Delivered Lumens	Tested System Watts	Lumens Per Watt (LPW)								
					 DCAS	 DCBW	 DCFL	 DCPD05	 DCPD15	 PUAS	 PUBW	 PUFL	 PUPD05
125DN	250UP	33/67	1500	14	112	110	109	106	106	103	101	100	97
	375UP	25/75	2000	18	116	115	114	111	112	109	107	106	104
	500UP	20/80	2500	21	121	120	119	117	117	112	111	110	108
	625UP	17/83	3000	25	123	122	121	120	120	111	110	109	108
	750UP	14/86	3500	29	122	121	120	119	119	112	111	110	109
	875UP	13/87	4000	33	123	122	121	120	120	112	111	111	110
	1000UP	11/89	4500	38	124	123	122	121	121	113	112	112	111
	1250UP	9/91	5500	47	125	124	124	123	123	—	—	—	—
250DN	250UP	50/50	2000	18	118	115	112	108	110	110	108	105	101
	375UP	40/60	2500	22	120	118	116	112	113	114	112	110	106
	500UP	33/67	3000	25	124	122	120	116	118	116	114	112	109
	625UP	29/71	3500	29	125	124	122	119	120	115	113	111	109
	750UP	25/75	4000	33	124	122	121	118	119	115	113	112	110
	875UP	22/78	4500	37	124	123	122	120	120	115	114	112	110
	1000UP	20/80	5000	42	125	124	123	121	121	115	114	113	111
	1250UP	17/83	6000	51	126	125	124	122	123	—	—	—	—
375DN	250UP	60/40	2500	22	122	119	112	109	109	115	112	106	103
	375UP	50/50	3000	26	123	121	115	112	112	118	115	110	107
	500UP	43/57	3500	29	126	124	118	116	116	119	117	112	110
	625UP	38/62	4000	33	127	125	120	119	118	117	115	111	110
	750UP	33/67	4500	37	126	124	120	118	118	117	115	112	110
	875UP	30/70	5000	41	126	124	121	119	119	117	115	112	111
	1000UP	27/73	5500	46	126	125	122	120	120	117	116	113	112
	1250UP	23/77	6500	55	127	126	123	122	122	—	—	—	—
500DN	250UP	67/33	3000	27	123	120	112	109	109	118	115	107	104
	375UP	57/43	3500	30	124	121	115	112	112	120	117	110	108
	500UP	50/50	4000	34	127	124	118	115	115	121	118	112	110
	625UP	44/56	4500	37	128	125	120	117	117	119	117	112	110
	750UP	40/60	5000	42	126	124	119	117	117	118	116	112	110
	875UP	36/64	5500	46	126	124	120	118	118	118	116	112	111
	1000UP	33/67	6000	50	127	125	121	119	119	118	117	113	111
	1250UP	29/71	7000	59	127	126	122	121	121	—	—	—	—
625DN	250UP	71/29	3500	32	122	118	110	107	107	117	114	106	103
	375UP	63/37	4000	36	123	119	112	109	109	119	116	109	106
	500UP	56/44	4500	39	125	122	115	113	112	120	117	111	108
	625UP	50/50	5000	42	126	123	117	115	114	118	116	110	108
	750UP	45/55	5500	47	125	122	117	115	114	118	116	111	109
	875UP	42/58	6000	51	125	123	118	116	116	118	116	111	109
	1000UP	38/62	6500	55	125	123	119	117	117	118	116	112	110
	1250UP	33/67	7500	64	126	124	120	119	118	—	—	—	—
750DN	250UP	75/25	4000	37	123	119	111	106	105	119	115	108	102
	375UP	67/33	4500	40	124	120	113	108	108	120	117	110	105
	500UP	60/40	5000	43	125	122	116	111	111	121	118	111	107
	625UP	55/45	5500	47	126	123	117	113	113	119	117	111	107
	750UP	50/50	6000	52	125	122	117	113	113	119	116	111	108
	875UP	46/54	6500	56	125	123	118	114	114	119	116	112	108
	1000UP	43/57	7000	60	126	123	119	115	115	119	117	112	109
	1250UP	38/62	8000	69	126	124	120	117	117	—	—	—	—
875DN	250UP	78/22	4500	42	121	117	108	105	104	117	113	105	102
	375UP	70/30	5000	46	121	118	110	107	106	118	115	107	104
	500UP	64/36	5500	49	123	120	112	110	109	119	116	109	106
	625UP	58/42	6000	53	124	121	114	111	111	118	115	109	106
	750UP	54/46	6500	57	123	120	114	112	111	118	115	109	107
	875UP	50/50	7000	61	124	121	115	113	113	118	115	109	107
	1000UP	47/53	7500	66	124	122	116	114	114	118	115	110	108
	1250UP	41/59	8500	75	125	123	118	116	116	—	—	—	—
1000DN	250UP	80/20	5000	48	120	116	109	105	104	117	113	106	102
	375UP	73/27	5500	51	121	117	110	107	106	118	114	108	104
	500UP	67/33	6000	54	122	119	112	109	109	119	115	109	106
	625UP	62/38	6500	58	123	120	114	111	111	118	115	109	106
	750UP	57/43	7000	63	123	120	114	111	111	118	115	109	107
	875UP	53/47	7500	67	123	120	115	112	112	118	115	110	107
	1000UP	50/50	8000	71	124	121	116	113	113	118	115	110	108
	1250UP	44/56	9000	80	124	122	117	115	115	—	—	—	—

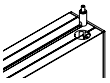
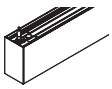
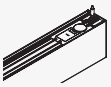
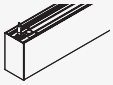
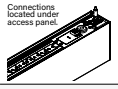
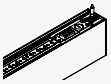
*Based on 3500K, 4' lengths. Lumen Multipliers: Delivered lumens may vary +/- 5%. Actual wattage may vary +/- 5%.

CONNECTED SOLUTIONS

Seem® 2

LED DIRECT/INDIRECT

Focal Point provides flexibility in meeting the needs of each project by integrating with several building lighting control systems. A variety of sensors, drivers and other components can be specified that allow the luminaires to communicate with wired and wireless networks. All zoning can be digitally reconfigured through the application software. Daylight harvesting, occupancy sensing, integration with HVAC systems, and individual controls enable the monitoring and modulating of light levels and temperature in order to save energy, reduce costs and maximize occupants' comfort. All Connected Solutions luminaires require a compatible building control system.†

Connected Solution	Ordering Code	Model #**	Protocol	Compatible Networks*	Occupancy & Daylight	Temperature Reporting	Communication to Luminaire	Drivers
legrand® 	DLM1	LMFC-011	DLM	DLM	Enabled	No	Wired 	**Advance by Signify,** Optotronic by eldoLED
WATTSTOPPER® 	LMFS1	LMFS-601 & LMFI-111	DLM Wireless	DLM	Enabled	No	Wireless	**Advance by Signify**
	LMFSD	LMFS-601						**Optotronic by eldoLED (Dexal)**
COOPER Lighting Solutions 	WLXP	OEM-WAA	WaveLinx Wireless	WaveLinx Pro Trellix	Enabled	No	Wireless (WaveLinx Pro Wireless Area Controller)	**Advance by Signify**
CRESTRON 	D11	Specified Driver	DALI	Crestron Zūm Wireless & SpaceBuilder	Enabled	No	Wired	**eldoLED ECOdrive**
	L11		0-10V					**Advance by Signify**
ENCELIUM 	CLM1	ZBHA-CLM-DIM-ENC	ZigBee	Encelium X Light Management System	Enabled	No	Wireless	**Optotronic by eldoLED** Advance by Signify
enlighted™ A Siemens Company 	ENL1	SU-5E-IOT	Enlighted RF	Enlighted	Integrated	Yes	Wireless	**Advance by Signify**
LUTRON 	LH1	LDE1	EcoSystem	Quantum, Energi Savr Node, Energi TriPak	Enabled	No	Wired	**Lutron Hi-Lume**
nLIGHT 	NLT1	nEPS-60-IO	nLight	nLight	Enabled	No	Wired 	**eldoLED ECOdrive,** eldoLED SOLOdrive
LIGHTING CONTROLS™ 	NXE1	NXFM-LV	NX	NX Distributed Intelligence	Enabled	No	Wired 	**Optotronic by eldoLED**

*Not all compatible networks may be listed. **For performance data and additional control system details please visit the connected solutions manufacturer websites. Primary drivers are listed in **bold.** To specify a particular driver please consult factory.
†Controls systems supplied by others.

Ordering Guide

Bidirectional Linear Circuitry, Zones & Factory Options

FOCAL POINT

HOW TO USE THIS GUIDE

Fill out the worksheet on the following page to specify your requirements for circuitry, zones, and factory options.

Refer to the run chart for standard run configurations, consult factory for custom configurations.

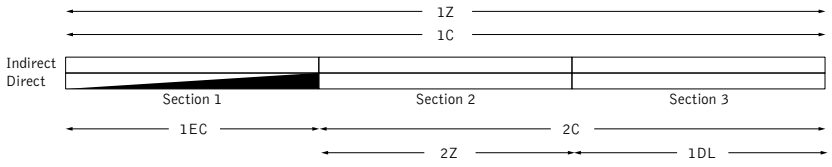
Complete the Totals / Ordering Codes at the bottom of the worksheet and add to your ordering logic on the cut sheet.

Submit the worksheet along with your order.

TOTAL RUN LENGTH: 24ft **JOB NAME:** _____ **FIXTURE TYPE:** _____

	HOUSING SECTION	SECTION LENGTH	LIGHT DISTRIBUTION	SHARED ELECTRICAL FEED, NORMAL POWER			FACTORY OPTIONS			
							SEPARATE ELECTRICAL FEEDS			
				SWITCHING CIRCUIT	DIMMING ZONE	DAYLIGHT ZONE	DAYLIGHT CIRCUIT	EMERGENCY CIRCUIT	ECD	EM
EXAMPLE	1	8	Indirect	1C	1Z					
			Direct					1EC		
	2	8	Indirect	1C	1Z					
			Direct	2C	2Z					
	3	8	Indirect	1C	1Z					
			Direct	2C		1DL				
	Totals / Ordering Codes			2C	2Z	1DL		1EC		

ORDERING: FSM4BS-FL-625UP-125DN-35K- 2C2Z1DL -UNV-LD1-C24- 1EC -WH-24ft



KEY	
C = Switching Circuit Switched Hot / Shared Neutral	**DC = Daylight Circuit** Switched Hot / Separate Neutral
Z = Dimming Zone Dimming Control Wires	**EC = Emergency Circuit** Switched Hot / Separate Neutral
DL = Daylight Zone Daylight Dimming Control Wires	**ECD = Emergency Control Device** Unswitched Hot / Separate Neutral
	EM = Emergency Battery Unswitched Hot / Shared Neutral

DEFAULTS

- Zones and Factory Options illuminate entire sections from 4' to 8' in length.
- EC, EM, and ECD only available for direct distribution.
- One shared or isolated circuit and zone required per housing section.
- Additional electrical feed required for applications greater than three shared circuits and zones.
- Limit of one EM or ECD per housing section.
- Each EC, DC and ECD require an additional electrical feed.
- ECD not available in the same housing section as EC.
- Longer lead times and additional pricing may apply for custom run configurations.

CUSTOM LENGTHS

- If partial illumination of emergency or daylight section is required, indicate in ordering guide and add "partial illumination" in Order Notes. Drawing required.
- Engineering validation required, longer lead times may apply.

Ordering Guide Worksheet

Linear Circuitry, Zones & Factory Options

FOCAL POINT

WORKSHEET

TOTAL RUN LENGTH: _____ **JOB NAME:** _____ **FIXTURE TYPE:** _____

HOUSING SECTION	SECTION LENGTH	LIGHT DISTRIBUTION	SHARED ELECTRICAL FEED, NORMAL POWER			FACTORY OPTIONS			
						SEPARATE ELECTRICAL FEEDS			EM
			SWITCHING CIRCUIT	DIMMING ZONE	DAYLIGHT ZONE	DAYLIGHT CIRCUIT	EMERGENCY CIRCUIT	ECD	
1		Indirect							
		Direct							
2		Indirect							
		Direct							
3		Indirect							
		Direct							
4		Indirect							
		Direct							
5		Indirect							
		Direct							
6		Indirect							
		Direct							
7		Indirect							
		Direct							
8		Indirect							
		Direct							
9		Indirect							
		Direct							
10		Indirect							
		Direct							
11		Indirect							
		Direct							
12		Indirect							
		Direct							
Totals / Ordering Codes			**_C**	**_Z**	**_DL**	**_DC**	**_EC**	**_ECD**	**_EM**

Combine to create Circuits & Zones ordering code

Enter as individual Factory Options

RUN CHART

Run length (ft)	Housing Configuration Section Lengths
9	5 + 4
10	6 + 4
11	7 + 4
12	8 + 4
13	8 + 5
14	8 + 6
15	8 + 7
16	8 + 8
17	8 + 5 + 4
18	8 + 6 + 4
19	8 + 7 + 4
20	8 + 8 + 4

Run length (ft)	Housing Configuration Section Lengths
21	8 + 8 + 5
22	8 + 8 + 6
23	8 + 8 + 7
24	8 + 8 + 8
25	8 + 8 + 5 + 4
26	8 + 8 + 6 + 4
27	8 + 8 + 7 + 4
28	8 + 8 + 8 + 4
29	8 + 8 + 8 + 5
30	8 + 8 + 8 + 6
31	8 + 8 + 8 + 7
32	8 + 8 + 8 + 8

Run length (ft)	Housing Configuration Section Lengths
33	8 + 8 + 8 + 5 + 4
34	8 + 8 + 8 + 6 + 4
35	8 + 8 + 8 + 7 + 4
36	8 + 8 + 8 + 8 + 4
37	8 + 8 + 8 + 8 + 5
38	8 + 8 + 8 + 8 + 6
39	8 + 8 + 8 + 8 + 7
40	8 + 8 + 8 + 8 + 8
41	8 + 8 + 8 + 8 + 5 + 4
42	8 + 8 + 8 + 8 + 6 + 4
43	8 + 8 + 8 + 8 + 7 + 4
44	8 + 8 + 8 + 8 + 8 + 4

Run length (ft)	Housing Configuration Section Lengths
45	8 + 8 + 8 + 8 + 8 + 5
46	8 + 8 + 8 + 8 + 8 + 6
47	8 + 8 + 8 + 8 + 8 + 7
48	8 + 8 + 8 + 8 + 8 + 8

Standard run configurations, consult factory for custom configurations.

Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | 773.247.9494 | focalpointlights.com

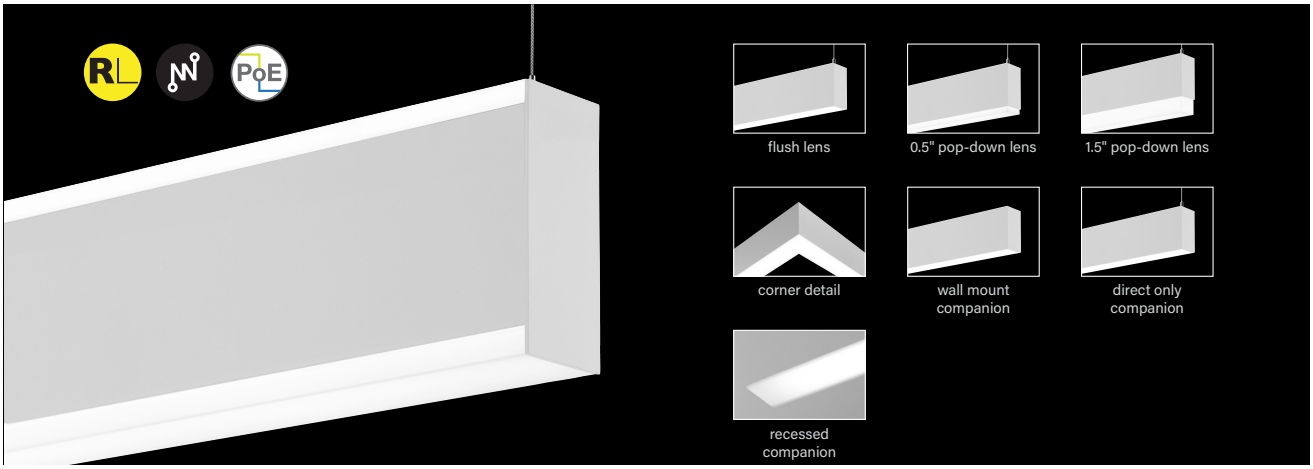
April 2021 E

L10B

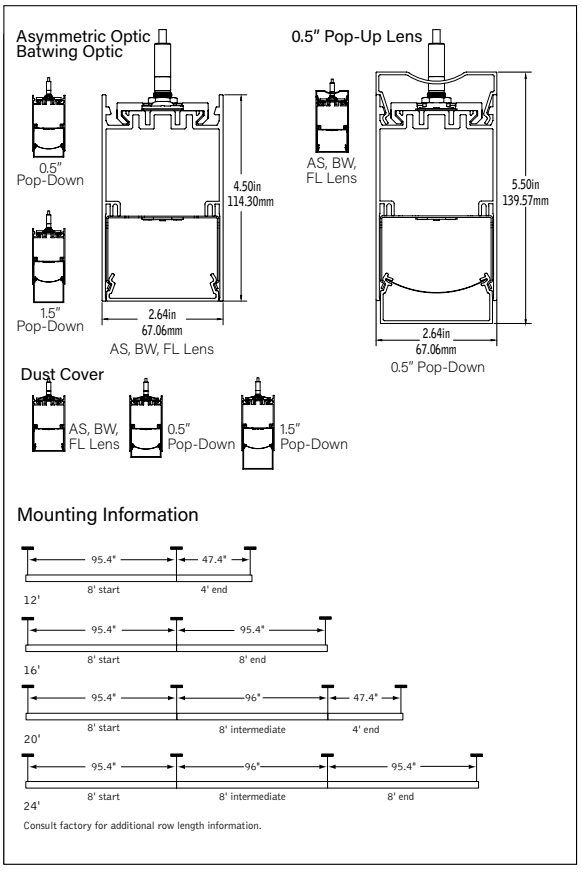
Seem® 2

LED DIRECT/INDIRECT

FOCAL POINT®



DIMENSIONAL DATA



FEATURES

Narrow extruded aluminum 2.5" linear direct/indirect LED with indirect Asymmetric Optic, Batwing Optic, and Pop-lens options.

Frosted acrylic lenses provide uninterrupted illumination, without pixels or shadows.

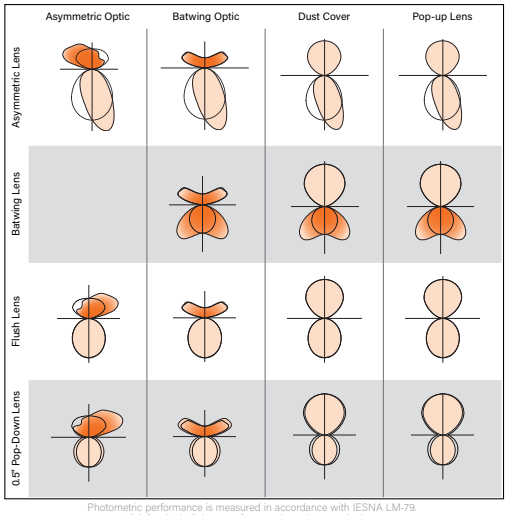
Individual units and continuous runs in 1' increments.

Connected Solutions: Integrates with wired and wireless building lighting control systems.

PoE compatible: Integrates with Power over Ethernet lighting systems via standard, low-voltage wires.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

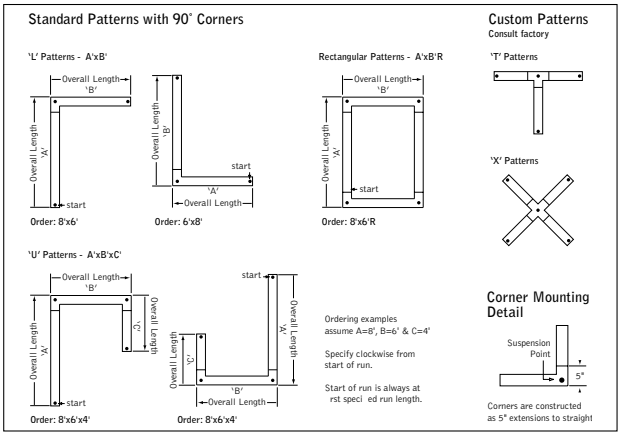
DISTRIBUTIONS



Photometric performance is measured in accordance with IESNA LM-79.
Visit focalpointlights.com for complete photometric data.

fixture: project:

MOUNTING INFORMATION



SPECIFICATIONS

LED System
Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance. Available in 2700K, 3000K, 3500K or 4000K with CRI>80 or CRI>90. 3500K and 4000K with CRI>90 have a cyanosis observation index (COI) of 3.3 or less. LED modules and drivers are replaceable from below. Color accuracy <3 SDCM.

Construction
One piece extruded aluminum housing. Cast aluminum end caps. 8' unit weight: 30 lbs.

Optic
Reflectors fabricated of 20 Ga. steel finished in Matte White powder coat.
Extruded acrylic lens with frosted finish, up to 8' continuous.

Electrical
Luminaires are pre–wired with factory installed branch circuit wiring and over-molded quick connects. Standard 120-277V constant current driver includes 0-10V analog dimming. Power factor > .9. PoE compatible: Integrates with Power over Ethernet lighting systems via standard, low-voltage wires. PoE runs require an independent PoE node and power feed for each luminaire section.

Emergency
Emergency Battery output - 10 watts for 90 minutes. Maximum mounting height: 20 ft.
Emergency Circuit with Connected Solutions (DLM1, LMFS1, LMFSD, NLT1, ENL1, CLM1, NXE1, WLXP) shipped standard with leads to connect UL924 compliant device, by others.

Labels
UL and cUL listed. Suitable for Dry or Damp Locations, indoor use only.

Finish
Polyester powder coat applied over a multi-stage pre–treatment.

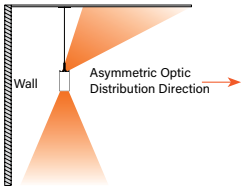
Lumen Maintenance
Reported: L70 at >61,000 hours
L90 at >61,000 hours
Calculated: L70 at 257,000 hours
L90 at 69,000 hours
Derived from EPA TM-21 calculator. Based on typical conditions, consult factory for additional data.

Reliability
At Focal Point, our products are designed to stand the test of time. Each luminaire is engineered using superior components, manufactured with the utmost care and rigorously tested. Contact us for reliability data.

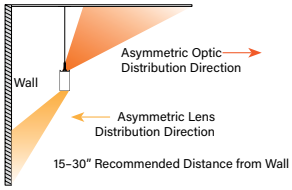
Warranty
LED system rated for operation in ambient environments up to 25°C. 5-year limited warranty.

4' PERFORMANCE CHARTS
See page 3 & 4.

INDIRECT ASYMMETRIC
Standard Application Example



DIRECT/INDIRECT ASYMMETRIC
Standard Application Example



ORDERING

		FSM2BS
Luminaire Series		
Seem 2 LED Direct / Indirect	FSM2BS	
Shielding		
Asymmetric Optic top	Asymmetric Lens bottom ASAS; Flush Lens bottom ASFL; 0.5" Pop-down Lens bottom ASPD05	
Asymmetric Optic top	1.5" Pop-down Lens bottom (Individual Units Only) ASPD15	
Batwing Optic top	Asymmetric Lens bottom BWAS; Batwing Lens bottom BWBW; Flush Lens bottom BWFL; 0.5" Pop-down Lens bottom BWPD05	
Batwing Optic top	1.5" Pop-down Lens bottom (Individual Units Only) BWPD15	
Dust Cover top	Asymmetric Lens bottom DCAS; Batwing Lens bottom DCBW; Flush Lens bottom DCFL; 0.5" Pop-down Lens bottom DCPD05	
Dust Cover top	1.5" Pop-down Lens bottom (Individual Units Only) DCPD15	
0.5" Pop-up Lens top	Asymmetric Lens bottom PUAS; Batwing Lens bottom PUBW; Flush Lens bottom PUFL; 0.5" Pop-down Lens bottom PUPD05	
Direct Distribution		
125 Lumens per foot (LD1 & L11 Only)	125DN	
250 Lumens per foot	250DN	
375 Lumens per foot	375DN	
500 Lumens per foot	500DN	
625 Lumens per foot	625DN	
750 Lumens per foot	750DN	
875 Lumens per foot	875DN	
1000 Lumens per foot	1000DN	
Indirect Distribution		
250 Lumens per foot	250UP	
375 Lumens per foot	375UP	
500 Lumens per foot	500UP	
625 Lumens per foot	625UP	
750 Lumens per foot	750UP	
875 Lumens per foot	875UP	
1000 Lumens per foot	1000UP	
1250 Lumens per foot (Not available with Pop-up Lens.)	1250UP	
Color Temperature		
2700K, 80+ CRI or 90+ CRI	27K or 927K	
3000K, 80+ CRI or 90+ CRI	30K or 930K	
3500K, 80+ CRI or 90+ CRI	35K or 935K	
4000K, 80+ CRI or 90+ CRI	40K or 940K	
Circuits & Zones		
1 Circuit, non-emergency	1C	
2 non-emergency circuits provide independent control of Direct and Indirect sources (Not available with DLM1, NLT1, CLM1, NXE1)	2C	
Consult Ordering Guide on page 6 for multiple Circuiting and zoning options	_C_Z_DL	
Voltage		
120/277 UNV Volt	UNV	
347V (LD1 & L11 only)	347	
Low voltage	LV	
Control System & Dimming Level		
0-10V - 10% Dimming	LD1	
0-10V - 1% Dimming	LH	
Low Voltage, PoE compatible (No driver. Not available with EM or EC. LV Voltage only.)	LVN	
Lutron Hi-Lume EcoSystem (LDE1) - 1% Dimming	LH1	
DALI 1% Dimming (750, 875, 1000 DN or UP, 1250UP consult factory.)	D11	
Wattstopper DLM - 1% Dimming**†	DLM1	
Wattstopper Fixture Sensor Low Density – 1% Dimming**† See sensor layout guide	LMFS1	
Wattstopper Fixture Sensor High Density – 1% Dimming**† See sensor layout guide	LMFSD	
Acuity nLight - 1% Dimming**† (750, 875, 1000 DN or UP, 1250UP consult factory.)	NLT1	
Enlighted Smart Sensor - 1% Dimming**† See sensor layout guide	ENL1	
Encelium CLM Connected Lighting Module - 1% Dimming**†	CLM1	
Current NX Enabled – 1% Dimming**†	NXE1	
WaveLinx Pro – 1% Dimming**† See sensor layout guide	WLXP	
Mounting		
24" Cable Suspension	C24__	
48" Cable Suspension	C48__	
96" Cable Suspension	C96__	
(Specify canopy color White (WH), Black (BK) or Titanium Sliver (TS). Example: C24WH.) (Specify one of the following in place of "C" J - for 2" canopies at non–feed locations. CS - for sloped ceiling applications.)		
Factory Options (See Ordering Guide for ordering details for DC, EC, EM & ECD.)		
Black Cord	BKCD	
Daylight Circuit	_DC	
Emergency Circuit	_EC	
Emergency Battery Pack†	_EM	
Emergency Control Device†	_ECD	
†(4' minimum. 120/277 Volt only. 5' minimum with Connected Solutions.)		
Finish		
Black	BK	
Titanium Silver	TS	
Matte White Housing	WH	
Luminaire Length		
Specify luminaire/row length in 1' increments (4' minimum. Leave blank for patterns. Smaller increments available, consult factory.)	X' 6'-0"	
Pattern Options (4' minimum length)		
'L' pattern	A' x B'	
'U' pattern	A' x B' x C'	
Rectangular pattern (Consult factory for other pattern options) *Not available with Pop-Up or Pop-Down Lens options. **Not available with Pop-Down Lens options.	A' x B' R	

FINISH TO BE SELECTED BY ARCHITECT

QS 10 DAY Options in orange qualify for the Quickship program. 1000' total. Refer to Quickship Guide for complete details including EM/EC options.

4' PERFORMANCE CHART

Direct Distribution	Indirect Distribution	Distribution % (Direct/Indirect)	Total Delivered Lumens	Tested System Watts	Lumens Per Watt (LPW)								
					 ASAS	 ASFL	 ASPD05	 ASPD15	 BWAS	 BWBW	 BWFL	 BWPD05	 BWPD15
125DN	250UP	33/67	1500	14	106	103	100	101	111	109	108	105	105
	375UP	25/75	2000	18	112	110	108	108	118	117	116	113	114
	500UP	20/80	2500	21	117	115	113	113	120	119	118	116	116
	625UP	17/83	3000	25	119	117	115	116	122	121	120	119	119
	750UP	14/86	3500	29	117	116	114	115	121	120	119	118	118
	875UP	13/87	4000	33	118	117	115	116	122	121	120	119	119
	1000UP	11/89	4500	38	119	118	117	117	122	122	121	120	120
	1250UP	9/91	5500	47	120	119	118	118	123	123	122	121	122
250DN	250UP	50/50	2000	18	113	108	104	105	117	114	111	107	109
	375UP	40/60	2500	22	117	113	109	111	122	120	118	114	115
	500UP	33/67	3000	25	120	116	113	114	123	121	119	116	117
	625UP	29/71	3500	29	122	118	115	117	125	123	121	118	119
	750UP	25/75	4000	33	120	117	114	115	123	122	120	117	118
	875UP	22/78	4500	37	120	118	115	116	124	122	121	119	119
	1000UP	20/80	5000	42	121	118	116	117	124	123	122	120	121
	1250UP	17/83	6000	51	121	119	117	118	125	124	123	121	122
375DN	250UP	60/40	2500	22	118	108	106	105	121	118	111	109	108
	375UP	50/50	3000	26	121	112	110	110	125	122	116	114	114
	500UP	43/57	3500	29	123	115	113	113	125	123	118	116	115
	625UP	38/62	4000	33	124	117	115	115	126	124	120	118	118
	750UP	33/67	4500	37	122	116	115	114	125	123	119	117	117
	875UP	30/70	5000	41	122	117	115	115	125	123	120	118	118
	1000UP	27/73	5500	46	122	118	116	116	125	124	121	119	119
	1250UP	23/77	6500	55	122	118	117	117	126	124	122	121	120
500DN	250UP	67/33	3000	27	120	109	106	106	123	119	112	109	108
	375UP	57/43	3500	30	122	113	110	110	126	123	116	113	113
	500UP	50/50	4000	34	124	115	113	113	126	123	117	115	115
	625UP	44/56	4500	37	125	117	115	114	127	124	119	117	117
	750UP	40/60	5000	42	123	116	114	114	125	123	118	116	116
	875UP	36/64	5500	46	123	117	115	115	126	124	119	117	117
	1000UP	33/67	6000	50	123	117	116	116	126	124	120	118	118
	1250UP	29/71	7000	59	123	118	117	117	126	124	121	120	120
625DN	250UP	71/29	3500	32	119	108	104	104	121	117	110	106	106
	375UP	63/37	4000	36	121	111	108	107	124	121	113	111	110
	500UP	56/44	4500	39	123	113	110	110	124	121	115	112	112
	625UP	50/50	5000	42	123	115	112	112	125	122	116	114	114
	750UP	45/55	5500	47	122	114	112	112	124	122	116	114	114
	875UP	42/58	6000	51	122	115	113	113	124	122	117	115	115
	1000UP	38/62	6500	55	122	116	114	114	125	123	118	116	116
	1250UP	33/67	7500	64	122	117	115	115	125	123	119	118	118
750DN	250UP	75/25	4000	37	121	109	104	103	122	118	111	105	105
	375UP	67/33	4500	40	122	112	107	106	125	121	114	109	109
	500UP	60/40	5000	43	123	114	109	109	125	122	115	111	110
	625UP	55/45	5500	47	124	115	111	110	126	123	117	112	112
	750UP	50/50	6000	52	123	115	111	110	125	122	116	113	112
	875UP	46/54	6500	56	123	115	112	111	125	122	117	114	113
	1000UP	43/57	7000	60	123	116	112	112	125	123	118	115	115
	1250UP	38/62	8000	69	123	117	114	114	125	123	119	116	116
875DN	250UP	78/22	4500	42	119	106	103	102	120	116	108	104	104
	375UP	70/30	5000	46	120	109	106	105	122	119	111	108	107
	500UP	64/36	5500	49	121	111	108	107	123	119	112	109	109
	625UP	58/42	6000	53	122	112	109	109	124	121	114	111	111
	750UP	54/46	6500	57	121	112	109	109	123	120	114	111	111
	875UP	50/50	7000	61	121	113	110	110	123	120	115	112	112
	1000UP	47/53	7500	66	121	113	111	111	124	121	116	113	113
	1250UP	41/59	8500	75	122	115	113	112	124	122	117	115	115
1000DN	250UP	80/20	5000	48	118	107	103	103	120	116	108	105	104
	375UP	73/27	5500	51	120	109	106	105	122	118	111	108	107
	500UP	67/33	6000	54	121	111	108	107	122	119	112	109	108
	625UP	62/38	6500	58	122	112	109	109	123	120	114	111	110
	750UP	57/43	7000	63	121	112	109	109	122	119	114	111	110
	875UP	53/47	7500	67	121	113	110	110	123	120	114	112	111
	1000UP	50/50	8000	71	121	113	111	111	123	120	115	113	113
	1250UP	44/56	9000	80	121	114	112	112	123	121	117	114	114

*Based on 3500K, 4' lengths. Lumen Multipliers: Delivered lumens may vary +/- 5%. Actual wattage may vary +/- 5%.

Direct Distribution	Indirect Distribution	Distribution % (Direct/Indirect)	Total Delivered Lumens	Tested System Watts	Lumens Per Watt (LPW)								
					 DCAS	 DCBW	 DCFL	 DCPD05	 DCPD15	 PUAS	 PUBW	 PUFL	 PUPD05
125DN	250UP	33/67	1500	14	112	110	109	106	106	103	101	100	97
	375UP	25/75	2000	18	116	115	114	111	112	109	107	106	104
	500UP	20/80	2500	21	121	120	119	117	117	112	111	110	108
	625UP	17/83	3000	25	123	122	121	120	120	111	110	109	108
	750UP	14/86	3500	29	122	121	120	119	119	112	111	110	109
	875UP	13/87	4000	33	123	122	121	120	120	112	111	111	110
	1000UP	11/89	4500	38	124	123	122	121	121	113	112	112	111
	1250UP	9/91	5500	47	125	124	124	123	123	—	—	—	—
250DN	250UP	50/50	2000	18	118	115	112	108	110	110	108	105	101
	375UP	40/60	2500	22	120	118	116	112	113	114	112	110	106
	500UP	33/67	3000	25	124	122	120	116	118	116	114	112	109
	625UP	29/71	3500	29	125	124	122	119	120	115	113	111	109
	750UP	25/75	4000	33	124	122	121	118	119	115	113	112	110
	875UP	22/78	4500	37	124	123	122	120	120	115	114	112	110
	1000UP	20/80	5000	42	125	124	123	121	121	115	114	113	111
	1250UP	17/83	6000	51	126	125	124	122	123	—	—	—	—
375DN	250UP	60/40	2500	22	122	119	112	109	109	115	112	106	103
	375UP	50/50	3000	26	123	121	115	112	112	118	115	110	107
	500UP	43/57	3500	29	126	124	118	116	116	119	117	112	110
	625UP	38/62	4000	33	127	125	120	119	118	117	115	111	110
	750UP	33/67	4500	37	126	124	120	118	118	117	115	112	110
	875UP	30/70	5000	41	126	124	121	119	119	117	115	112	111
	1000UP	27/73	5500	46	126	125	122	120	120	117	116	113	112
	1250UP	23/77	6500	55	127	126	123	122	122	—	—	—	—
500DN	250UP	67/33	3000	27	123	120	112	109	109	118	115	107	104
	375UP	57/43	3500	30	124	121	115	112	112	120	117	110	108
	500UP	50/50	4000	34	127	124	118	115	115	121	118	112	110
	625UP	44/56	4500	37	128	125	120	117	117	119	117	112	110
	750UP	40/60	5000	42	126	124	119	117	117	118	116	112	110
	875UP	36/64	5500	46	126	124	120	118	118	118	116	112	111
	1000UP	33/67	6000	50	127	125	121	119	119	118	117	113	111
	1250UP	29/71	7000	59	127	126	122	121	121	—	—	—	—
625DN	250UP	71/29	3500	32	122	118	110	107	107	117	114	106	103
	375UP	63/37	4000	36	123	119	112	109	109	119	116	109	106
	500UP	56/44	4500	39	125	122	115	113	112	120	117	111	108
	625UP	50/50	5000	42	126	123	117	115	114	118	116	110	108
	750UP	45/55	5500	47	125	122	117	115	114	118	116	111	109
	875UP	42/58	6000	51	125	123	118	116	116	118	116	111	109
	1000UP	38/62	6500	55	125	123	119	117	117	118	116	112	110
	1250UP	33/67	7500	64	126	124	120	119	118	—	—	—	—
750DN	250UP	75/25	4000	37	123	119	111	106	105	119	115	108	102
	375UP	67/33	4500	40	124	120	113	108	108	120	117	110	105
	500UP	60/40	5000	43	125	122	116	111	111	121	118	111	107
	625UP	55/45	5500	47	126	123	117	113	113	119	117	111	107
	750UP	50/50	6000	52	125	122	117	113	113	119	116	111	108
	875UP	46/54	6500	56	125	123	118	114	114	119	116	112	108
	1000UP	43/57	7000	60	126	123	119	115	115	119	117	112	109
	1250UP	38/62	8000	69	126	124	120	117	117	—	—	—	—
875DN	250UP	78/22	4500	42	121	117	108	105	104	117	113	105	102
	375UP	70/30	5000	46	121	118	110	107	106	118	115	107	104
	500UP	64/36	5500	49	123	120	112	110	109	119	116	109	106
	625UP	58/42	6000	53	124	121	114	111	111	118	115	109	106
	750UP	54/46	6500	57	123	120	114	112	111	118	115	109	107
	875UP	50/50	7000	61	124	121	115	113	113	118	115	109	107
	1000UP	47/53	7500	66	124	122	116	114	114	118	115	110	108
	1250UP	41/59	8500	75	125	123	118	116	116	—	—	—	—
1000DN	250UP	80/20	5000	48	120	116	109	105	104	117	113	106	102
	375UP	73/27	5500	51	121	117	110	107	106	118	114	108	104
	500UP	67/33	6000	54	122	119	112	109	109	119	115	109	106
	625UP	62/38	6500	58	123	120	114	111	111	118	115	109	106
	750UP	57/43	7000	63	123	120	114	111	111	118	115	109	107
	875UP	53/47	7500	67	123	120	115	112	112	118	115	110	107
	1000UP	50/50	8000	71	124	121	116	113	113	118	115	110	108
	1250UP	44/56	9000	80	124	122	117	115	115	—	—	—	—

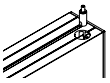
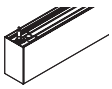
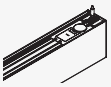
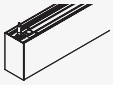
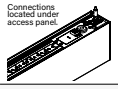
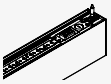
*Based on 3500K, 4' lengths. Lumen Multipliers: Delivered lumens may vary +/- 5%. Actual wattage may vary +/- 5%.

CONNECTED® SOLUTIONS

Seem® 2

LED DIRECT/INDIRECT

Focal Point provides flexibility in meeting the needs of each project by integrating with several building lighting control systems. A variety of sensors, drivers and other components can be specified that allow the luminaires to communicate with wired and wireless networks. All zoning can be digitally reconfigured through the application software. Daylight harvesting, occupancy sensing, integration with HVAC systems, and individual controls enable the monitoring and modulating of light levels and temperature in order to save energy, reduce costs and maximize occupants' comfort. All Connected Solutions luminaires require a compatible building control system.†

Connected Solution	Ordering Code	Model #**	Protocol	Compatible Networks*	Occupancy & Daylight	Temperature Reporting	Communication to Luminaire	Drivers
legrand® 	DLM1	LMFC-011	DLM	DLM	Enabled	No	Wired 	**Advance by Signify,** Optotronic by eldoLED
WATTSTOPPER® 	LMFS1	LMFS-601 & LMFI-111	DLM Wireless	DLM	Enabled	No	Wireless	**Advance by Signify**
	LMFSD	LMFS-601						**Optotronic by eldoLED (Dexal)**
COOPER Lighting Solutions 	WLXP	OEM-WAA	WaveLinx Wireless	WaveLinx Pro Trellix	Enabled	No	Wireless (WaveLinx Pro Wireless Area Controller)	**Advance by Signify**
CRESTRON 	D11	Specified Driver	DALI	Crestron Zūm Wireless & SpaceBuilder	Enabled	No	Wired	**eldoLED ECOdrive**
	L11		0-10V					**Advance by Signify**
ENCELIUM 	CLM1	ZBHA-CLM-DIM-ENC	ZigBee	Encelium X Light Management System	Enabled	No	Wireless	**Optotronic by eldoLED** Advance by Signify
enlighted™ A Siemens Company 	ENL1	SU-5E-IOT	Enlighted RF	Enlighted	Integrated	Yes	Wireless	**Advance by Signify**
LUTRON 	LH1	LDE1	EcoSystem	Quantum, Energi Savr Node, Energi TriPak	Enabled	No	Wired	**Lutron Hi-Lume**
nLIGHT 	NLT1	nEPS-60-IO	nLight	nLight	Enabled	No	Wired 	**eldoLED ECOdrive,** eldoLED SOLOdrive
LIGHTING CONTROLS™ 	NXE1	NXFM-LV	NX	NX Distributed Intelligence	Enabled	No	Wired 	**Optotronic by eldoLED**

*Not all compatible networks may be listed. **For performance data and additional control system details please visit the connected solutions manufacturer websites. Primary drivers are listed in **bold.** To specify a particular driver please consult factory.
†Controls systems supplied by others.

Ordering Guide

Bidirectional Linear Circuitry, Zones & Factory Options

FOCAL POINT

HOW TO USE THIS GUIDE

Fill out the worksheet on the following page to specify your requirements for circuitry, zones, and factory options.

Refer to the run chart for standard run configurations, consult factory for custom configurations.

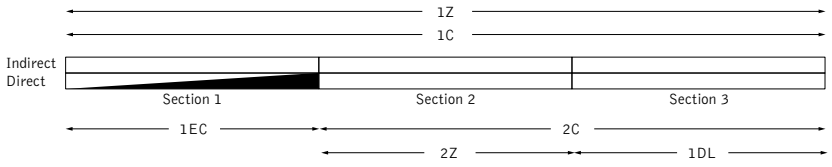
Complete the Totals / Ordering Codes at the bottom of the worksheet and add to your ordering logic on the cut sheet.

Submit the worksheet along with your order.

TOTAL RUN LENGTH: 24ft **JOB NAME:** _____ **FIXTURE TYPE:** _____

	HOUSING SECTION	SECTION LENGTH	LIGHT DISTRIBUTION	SHARED ELECTRICAL FEED, NORMAL POWER			FACTORY OPTIONS			
							SEPARATE ELECTRICAL FEEDS			
				SWITCHING CIRCUIT	DIMMING ZONE	DAYLIGHT ZONE	DAYLIGHT CIRCUIT	EMERGENCY CIRCUIT	ECD	EM
EXAMPLE	1	8	Indirect	1C	1Z					
			Direct					1EC		
	2	8	Indirect	1C	1Z					
			Direct	2C	2Z					
	3	8	Indirect	1C	1Z					
			Direct	2C		1DL				
	Totals / Ordering Codes			2C	2Z	1DL		1EC		

ORDERING: FSM4BS-FL-625UP-125DN-35K- 2C2Z1DL -UNV-LD1-C24- 1EC -WH-24ft



KEY	
C = Switching Circuit Switched Hot / Shared Neutral	**DC = Daylight Circuit** Switched Hot / Separate Neutral
Z = Dimming Zone Dimming Control Wires	**EC = Emergency Circuit** Switched Hot / Separate Neutral
DL = Daylight Zone Daylight Dimming Control Wires	**ECD = Emergency Control Device** Unswitched Hot / Separate Neutral
	EM = Emergency Battery Unswitched Hot / Shared Neutral

DEFAULTS

- Zones and Factory Options illuminate entire sections from 4' to 8' in length.
- EC, EM, and ECD only available for direct distribution.
- One shared or isolated circuit and zone required per housing section.
- Additional electrical feed required for applications greater than three shared circuits and zones.
- Limit of one EM or ECD per housing section.
- Each EC, DC and ECD require an additional electrical feed.
- ECD not available in the same housing section as EC.
- Longer lead times and additional pricing may apply for custom run configurations.

CUSTOM LENGTHS

- If partial illumination of emergency or daylight section is required, indicate in ordering guide and add "partial illumination" in Order Notes. Drawing required.
- Engineering validation required, longer lead times may apply.

Ordering Guide Worksheet

Linear Circuitry, Zones & Factory Options

FOCAL POINT

WORKSHEET

TOTAL RUN LENGTH: _____ **JOB NAME:** _____ **FIXTURE TYPE:** _____

HOUSING SECTION	SECTION LENGTH	LIGHT DISTRIBUTION	SHARED ELECTRICAL FEED, NORMAL POWER			FACTORY OPTIONS			
						SEPARATE ELECTRICAL FEEDS			EM
			SWITCHING CIRCUIT	DIMMING ZONE	DAYLIGHT ZONE	DAYLIGHT CIRCUIT	EMERGENCY CIRCUIT	ECD	
1		Indirect							
		Direct							
2		Indirect							
		Direct							
3		Indirect							
		Direct							
4		Indirect							
		Direct							
5		Indirect							
		Direct							
6		Indirect							
		Direct							
7		Indirect							
		Direct							
8		Indirect							
		Direct							
9		Indirect							
		Direct							
10		Indirect							
		Direct							
11		Indirect							
		Direct							
12		Indirect							
		Direct							
Totals / Ordering Codes			**_C**	**_Z**	**_DL**	**_DC**	**_EC**	**_ECD**	**_EM**

Combine to create Circuits & Zones ordering code

Enter as individual Factory Options

RUN CHART

Run length (ft)	Housing Configuration Section Lengths	Run length (ft)	Housing Configuration Section Lengths	Run length (ft)	Housing Configuration Section Lengths	Run length (ft)	Housing Configuration Section Lengths
9	5 + 4	21	8 + 8 + 5	33	8 + 8 + 8 + 5 + 4	45	8 + 8 + 8 + 8 + 8 + 5
10	6 + 4	22	8 + 8 + 6	34	8 + 8 + 8 + 6 + 4	46	8 + 8 + 8 + 8 + 8 + 6
11	7 + 4	23	8 + 8 + 7	35	8 + 8 + 8 + 7 + 4	47	8 + 8 + 8 + 8 + 8 + 7
12	8 + 4	24	8 + 8 + 8	36	8 + 8 + 8 + 8 + 4	48	8 + 8 + 8 + 8 + 8 + 8
13	8 + 5	25	8 + 8 + 5 + 4	37	8 + 8 + 8 + 8 + 5		
14	8 + 6	26	8 + 8 + 6 + 4	38	8 + 8 + 8 + 8 + 6		
15	8 + 7	27	8 + 8 + 7 + 4	39	8 + 8 + 8 + 8 + 7		
16	8 + 8	28	8 + 8 + 8 + 4	40	8 + 8 + 8 + 8 + 8		
17	8 + 5 + 4	29	8 + 8 + 8 + 5	41	8 + 8 + 8 + 8 + 5 + 4		
18	8 + 6 + 4	30	8 + 8 + 8 + 6	42	8 + 8 + 8 + 8 + 6 + 4		
19	8 + 7 + 4	31	8 + 8 + 8 + 7	43	8 + 8 + 8 + 8 + 7 + 4		
20	8 + 8 + 4	32	8 + 8 + 8 + 8	44	8 + 8 + 8 + 8 + 8 + 4		

Standard run configurations, consult factory for custom configurations.

Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | 773.247.9494 | focalpointlights.com

April 2021 E

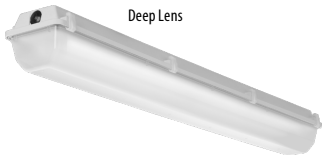
Catalog Number	
Notes	
Type	L11

Low-Profile Enclosed and Gasketed Industrial

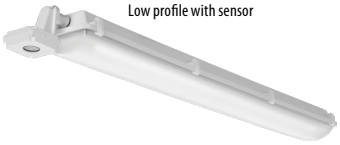
FEM LED

SURFACE/ SUSPENDED/WALL MOUNT

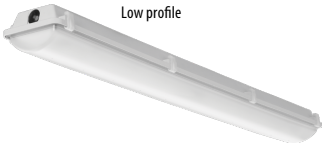
Deep Lens



Low profile with sensor



Low profile



FEATURES & SPECIFICATIONS

INTENDED USE — A general purpose and energy-efficient surface-mounted or suspended LED fixture, suitable for wet, damp and/or cold locations. For vapor-tight demanding environments where moisture or dust is a concern and where relatively low fixture mounting heights and wide fixture spacing are common. Not for use or installation in direct outdoor sunlight. Must be installed under canopy or covered ceiling. For direct sunlight installations, please refer to the FEX product family. Typical applications include industrial facilities, parking garages, retail malls, multi-purpose rooms, garden centers, and food processing. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** Click here for Acrylic-Polycarbonate Compatibility table for suitable use.

Certain airborne contaminants may adversely affect the functioning of LEDs and other electronic components, depending on various factors such as concentrations of the contaminants, ventilation, and temperature at the end-user location. Click here for a list of substances that may not be suitable for interaction with LEDs and other electronic components.

CONSTRUCTION — One-piece 5VA fiberglass housing with integral perimeter channel utilizing continuous poured-in-place NEMA 4X gasket. Approved for through wiring. Captive polymeric latches are standard. Stainless steel latches (#316) available as an option for food processing or more demanding applications.

Power connection is easily accomplished through pre-drilled holes.

OPTICS — Injection molded, acrylic lens (.080" thick) provides high impact-resistance comparable to 100% DR. A UV stabilized polycarbonate diffuser is available (.080" thick) in clear or frosted for additional impact strength where vandal protection is desired.

Expected service life of 60,000 hours at 80% lumen maintenance (L80); predicted life of more than 100,000 hours.

ELECTRICAL — Utilizes high-efficiency LEDs mounted to core circuit boards. High-efficiency drivers operate 120-277 (MVOLT) and 347-480 (HVOLT) offered with 0-10 volt dimming, dims to 10%. Standard Luminaire Surge Protection Level: 6kV/3kA Surge Rated per ANSI C82.77-5-2015.

INSTALLATION — A pair of stainless steel surface mount brackets (SMB) are included (unless another mounting option is chosen) allowing for surface (ceiling) or suspension mount applications using included bail with aircraft cable or chain. Optional pair of dual pendant mount brackets (DPMB) are available for surface (ceiling) or suspension mount applications using either 3/8" threaded rod or included bail with aircraft cable or chain. Optional pair of angle mounting brackets (ANGBKT) for wall mount applications.

LISTINGS — CSA Certified to UL and C-UL Standards. Suitable for wet location. IP65,IP66, IP67 rated. NSF Splash Zone 2 and Non-Food Zone rated. NEMA 4X rated. Sensors maintain IP65 and IP66 only. See chart on page 5 for Ambient Temperatures.

DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN ACT — Product with the BAA option is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT regulations.
Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

Stock configurations are offered for shorter lead times:

Standard Part Number	Stock Part Number
FEM L48 4000LM LPAFL MD MVOLT GZ10 40K 80CRI	**FEM L48 4L MVOLT**
FEM L48 4000LM LPAFL MD MVOLT GZ10 50K 80CRI	**FEM L48 4L MVOLT 5K**

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

FEM LED Low-Profile Enclosed and Gasketed

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: FEM L48 4000LM IMAFL WD MVOLT GZ10 40K 80CRI

Series	Length	Nominal Lumens	Diffuser	Distribution	Voltage	Driver	Color temperature	CRI
FEM	L24 24" ‡	2000LM 2,000 lumens	IMAFL Acrylic, lineal ribbed frosted lens	MD Medium	MVOLT 120-277V	GZ10 0 - 10V dimming	30K 3000K	80CRI 80 CRI
		3000LM 3,000 lumens	IMACD Acrylic, clear deep lens	WD Wide	HVOLT 347-480V ‡		35K 3500K	90CRI 90 CRI
		4000LM 4,000 lumens	IMAFD Acrylic, deep frosted lens	PGD Parking garage	120 120V		40K 4000K	
		6000LM 6,000 lumens	LPAFL Acrylic, low profile frosted lens		277 277V		50K 5000K	
			LPACL Acrylic, low profile clear lens		347 347V			
	L48 48" ‡	3000LM 3,000 lumens	LPPCL Polycarbonate, low profile clear lens		480 480V			
		4000LM 4,000 lumens	LPPFL Polycarbonate, low profile frosted lens					
		6000LM 6,000 lumens						
		8000LM 8,000 lumens						
		10000LM 10,000 lumens						
		12000LM 12,000 lumens						
	L96 96" ‡	9000LM 9,000 lumens						
		12000LM 12,000 lumens						
		15000LM 15,000 lumens						
		18000LM 18,000 lumens						
		20000LM 20,000 lumens						
		24000LM 24,000 lumens						

Options

Emergency:

E10WMCP	EM Self-diagnostics battery pack, MVOLT, 10W, Constant Power Certified in the California Title 20 Modernized Appliance Efficiency Database (MAEDBS) ‡
BE6WCP	Cold Weather EM battery pack, 120/277V, 6W, Constant Power Certified in the California Title 20 Modernized Appliance Efficiency Database (MAEDBS) ‡
BGTD	Generator transfer device

Other Options:

ANGBKT	Angle bracket shipped with fixture ‡
BAA	Buy America(n) Act Compliant
DPMB	Dual pendant mounting bracket ‡
SPD	Surge protection device, additional 10kV/6kA
STSL	Stainless steel latches
TRS	Tamper Resistant Torx® T10 screws
WLF	Wet location fitting (two outboard, top (L24 - 20 inches off-center, L48 - 48 inches off-center, L96 - 95.7 inches off-center) ‡
WLFEND	Wet location fitting (one end) ‡
WLFEND2	Wet location fitting (both ends) ‡
WLFPMP	Wet location pendant monopoint ‡

Cord Sets: ‡

CPSB16YWLBH	Brad Harrsion Mini-Change® cordset with straight blade plug, 16 gauge, 3 conductors, 6ft, yellow ‡
CPSB16YWL12FTBH	Brad Harrsion Mini-Change® cordset with straight blade plug, 16 gauge, 3 conductors, 12ft, yellow ‡
CRSB16YWLBH	Brad Harrsion Mini-Change® receptacle ‡
CNP16WWL	Cord only (no plug), 16 gauge, 3 conductors, white, 6ft, wet location ‡
CNP16WWL12FT	Cord only (no plug), 16 gauge, 3 conductors, white, 6ft, wet location ‡
CNP164CWWL	Cord only (no plug), 16 gauge, 4 conductors, white, 6ft, wet location (for use when unswitched circuit is required for battery pack) ‡

Individual Controls: ‡

SBOR10	360° Low mount sensor, (8-15' mounting heights), outdoor PIR, ON/OFF occupancy (LINK) (formerly MSI10NWL)
SBOR10 HL 3V	360° Low mount sensor, (8-15' mounting heights), outdoor PIR, occupancy controlled dimming (bi-level) (LINK) (formerly MSI102L3VWL)
SBOR10 P	360° Low mount sensor, (8-15' mounting heights), outdoor PIR, ON/OFF photocell (LINK) (formerly MSI10NWL DSCNWL)

nLight Wireless: ‡

NLTAIR2 RSBOR10	nLight® Air Generation 2 enabled, 360° low mount sensor, (8-15' heights) (LINK)
NLTAIR2 RIO	nLight® Air Generation 2 enabled, fixture embedded network interface, 0-10V dimming output (LINK)

NOTE: ‡ indicates option chosen has ordering restrictions. Please reference ordering restrictions chart, page 3. Options are sorted alphanumerically.

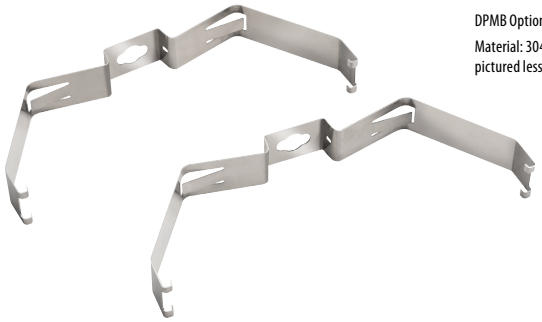
Accessories: *Order as separate catalog number.*

MHCH 36	3 foot (36 inches) jack chain (pair)
MHHK120	10 foot (120 inches) single leg air craft cable (ships as pair)
MHHK120SS	10 foot (120 inches) single leg air craft cable, stainless steel (ships as pair)
RK1 T10BIT W/PIN U	Hex-base driver bit, Torx TX10, for tamper resistant screws with center reject pin
FEMDPMB	Dual pendant mounting bracket (ships as a pair) ‡
FEMANGBKT	Angle bracket (ships as pair) ‡
FEMSMB	Surface mount bracket (ships as pair) ‡

See Accessories and ordering restrictions on next page.

‡ Option Value Ordering Restrictions	
Option value	**Restriction**
ANGBKT, FEMANGBKT	For wall mount applications. If mounted in an upward orientation, fixture will be damp location listed only.
BE6WCP	Utilizes Bodine BSL36 Cold-Pak emergency driver. Not available with L24 length. Order with CNP164CWWL when unswitched hot is required for battery. Not available with 347V,480V,HVOLT.
CNP16WWL, CNP16WWL12FT	Not available with BE6WCP or E10WMCP.
CNP164CWWL	Available with BE6WCP or E10WMCP only. **Not NEMA4X rated**.
Cord Sets	**Not NEMA4X rated**.
CPSB16YWLBH, CPSB16YWL12FTBH	Not available with BE6WCP or E10WMCP.
CRSB16YWLBH	Not available with BE6WCP or E10WMCP.
E10WMCP	Utilizes Power Sentry, PS1055MCP battery pack. Order with CNP164CWWL when unswitched hot is required for battery. Not available with 347V,480V,HVOLT.
DPMB, FEMDPMB	For surface (ceiling) or suspension mount applications using either 3/8" threaded rod or included bail with aircraft cable or chain.
FEMSMB	Ships standard with fixture (unless another mounting option is chosen). For surface (ceiling) or suspension mount applications using included bail with aircraft cable or chain.
HVOLT	When ordered with L24, available with 6000LM only. When ordered with L48, not available with 3000LM or 4000LM.
Individual Controls	**Not NEMA4X rated. IP65 and IP66 rated.**
L24	Not available with BE6WCP.
L48	Not available with WLFPMP.
L96	Not available with WLFPMP
nLight® Wireless	**Not NEMA4X rated. IP65 and IP66 rated.**
WLF	If cord is ordered, cord will exit from the end of the fixture. **Not NEMA4X rated**.
WLFEND	If cord is ordered, cord will exit from the end of the fixture. **Not NEMA4X rated**. Available with cord or sensor option. Choose only one.
WLFEND2	Not available with sensor or cord options. **Not NEMA4X rated**.
WLFPMP	Available only with L24. **Not NEMA4X rated.**

MOUNTING OPTIONS



DPMB Option or FEMDPMB Accessory

Material: 304 Stainless Steel

pictured less bail wire

CS88L12/CS88R options

OPERATIONAL DATA (80 CRI*, MD**, MVOLT***)

Length	Package	Input Wattage	CCT	Frosted Lens' Lumens (LPW)				Clear Lens' Lumens (LPW)		
				IMAFL	IMAFD	LPAFL	LPPFL	IMACD	LPACL	LPPCL
L24	2000LM	13.4	30K	1962 (147)	2083 (156)	2076 (155)	1861 (139)	2112 (158)	2105 (158)	1890 (142)
			35K	2002 (150)	2126 (159)	2118 (159)	1899 (142)	2155 (161)	2147 (161)	1929 (144)
			40K	2099 (157)	2228 (167)	2220 (166)	1991 (149)	2259 (169)	2251 (169)	2022 (151)
			50K	2122 (159)	2252 (169)	2244 (168)	2013 (151)	2284 (171)	2276 (170)	2044 (153)
	3000LM	19.9	30K	2869 (144)	3046 (153)	3035 (153)	2721 (137)	3088 (155)	3077 (155)	2764 (139)
			35K	2927 (147)	3108 (156)	3096 (156)	2777 (140)	3151 (158)	3139 (158)	2820 (142)
			40K	3069 (154)	3258 (164)	3246 (163)	2911 (146)	3303 (166)	3291 (166)	2956 (149)
			50K	3102 (156)	3293 (166)	3281 (165)	2942 (148)	3339 (168)	3327 (167)	2988 (150)
	4000LM	26.0	30K	3676 (142)	3903 (150)	3889 (150)	3487 (134)	3957 (152)	3943 (152)	3541 (136)
			35K	3751 (145)	3982 (153)	3968 (153)	3558 (137)	4037 (156)	4023 (155)	3613 (139)
			40K	3932 (152)	4174 (161)	4159 (160)	3730 (144)	4232 (163)	4217 (162)	3788 (146)
			50K	3975 (153)	4219 (163)	4204 (162)	3770 (145)	4278 (165)	4263 (164)	3829 (148)
	6000LM	39.2	30K	5287 (135)	5613 (143)	5593 (143)	5015 (128)	5691 (145)	5671 (145)	5093 (130)
			35K	5395 (138)	5727 (146)	5707 (145)	5117 (130)	5806 (148)	5786 (147)	5196 (132)
			40K	5655 (144)	6004 (153)	5982 (153)	5364 (137)	6087 (155)	6065 (155)	5447 (139)
			50K	5717 (146)	6069 (155)	6047 (154)	5422 (138)	6153 (157)	6131 (156)	5506 (140)
L48	3000LM	18.0	30K	2689 (149)	2855 (158)	2844 (158)	2551 (141)	2894 (160)	2884 (160)	2590 (144)
			35K	2743 (152)	2912 (161)	2902 (161)	2602 (144)	2953 (164)	2942 (163)	2643 (146)
			40K	2876 (159)	3053 (169)	3042 (169)	2728 (151)	3095 (172)	3084 (171)	2770 (154)
			50K	2907 (161)	3086 (171)	3075 (170)	2758 (153)	3129 (173)	3118 (173)	2800 (155)
	4000LM	23.8	30K	3543 (149)	3762 (158)	3748 (157)	3361 (141)	3814 (160)	3800 (160)	3413 (143)
			35K	3615 (152)	3838 (161)	3824 (161)	3429 (144)	3891 (163)	3877 (163)	3482 (146)
			40K	3790 (159)	4023 (169)	4009 (168)	3595 (151)	4079 (171)	4064 (171)	3650 (153)
			50K	3831 (161)	4067 (171)	4052 (170)	3634 (153)	4123 (173)	4109 (173)	3690 (155)
	6000LM	37.8	30K	5284 (140)	5609 (149)	5589 (148)	5012 (133)	5687 (151)	5667 (150)	5090 (135)
			35K	5391 (143)	5723 (152)	5703 (151)	5114 (135)	5802 (154)	5782 (153)	5193 (138)
			40K	5651 (150)	6000 (159)	5978 (158)	5361 (142)	6083 (161)	6061 (161)	5444 (144)
			50K	5713 (151)	6065 (161)	6043 (160)	5419 (144)	6149 (163)	6127 (162)	5503 (146)
	8000LM	50.5	30K	6952 (138)	7380 (146)	7354 (146)	6594 (131)	7482 (148)	7456 (148)	6696 (133)
			35K	7093 (141)	7530 (149)	7503 (149)	6728 (133)	7634 (151)	7607 (151)	6832 (135)
			40K	7435 (147)	7894 (156)	7865 (156)	7053 (140)	8003 (159)	7975 (158)	7162 (142)
			50K	7516 (149)	7979 (158)	7950 (158)	7129 (141)	8090 (160)	8061 (160)	7240 (144)
	10000LM	62.0	30K	8646 (140)	9179 (148)	9146 (148)	8201 (132)	9306 (150)	9273 (150)	8328 (134)
			35K	8822 (142)	9365 (151)	9332 (151)	8368 (135)	9495 (153)	9461 (153)	8497 (137)
			40K	9248 (149)	9817 (158)	9782 (158)	8772 (142)	9953 (161)	9918 (160)	8908 (144)
			50K	9348 (151)	9924 (160)	9888 (160)	8867 (143)	10061 (162)	10026 (162)	9004 (145)
	12000LM	75.0	30K	10406 (139)	11047 (147)	11007 (147)	9871 (132)	11200 (149)	11160 (149)	10024 (134)
			35K	10617 (141)	11271 (150)	11231 (150)	10071 (134)	11427 (152)	11387 (152)	10227 (136)
			40K	11130 (148)	11816 (157)	11773 (157)	10557 (141)	11979 (160)	11937 (159)	10721 (143)
			50K	11251 (150)	11944 (159)	11901 (159)	10672 (142)	12109 (161)	12066 (161)	10837 (144)
L96	9000LM	53.4	30K	7962 (149)	8452 (158)	8422 (158)	7552 (141)	8570 (160)	8539 (160)	7669 (144)
			35K	8124 (152)	8624 (161)	8593 (161)	7706 (144)	8743 (164)	8713 (163)	7825 (146)
			40K	8516 (159)	9040 (169)	9008 (169)	8078 (151)	9166 (172)	9133 (171)	8203 (154)
			50K	8608 (161)	9138 (171)	9106 (170)	8165 (153)	9265 (173)	9232 (173)	8292 (155)
	12000LM	75.5	30K	10570 (140)	11221 (149)	11181 (148)	10026 (133)	11377 (151)	11337 (150)	10182 (135)
			35K	10785 (143)	11449 (152)	11408 (151)	10230 (135)	11608 (154)	11567 (153)	10388 (138)
			40K	11306 (150)	12002 (159)	11959 (158)	10724 (142)	12168 (161)	12125 (161)	10890 (144)
			50K	11428 (151)	12132 (161)	12089 (160)	10840 (144)	12300 (163)	12257 (162)	11008 (146)
	15000LM	94.3	30K	13399 (142)	14225 (151)	14174 (150)	12710 (135)	14422 (153)	14371 (152)	12907 (137)
			35K	13671 (145)	14513 (154)	14461 (153)	12968 (138)	14714 (156)	14662 (156)	13169 (140)
			40K	14331 (152)	15214 (161)	15160 (161)	13594 (144)	15425 (164)	15370 (163)	13805 (146)
			50K	14487 (154)	15379 (163)	15324 (163)	13741 (146)	15592 (165)	15537 (165)	13954 (148)
	18000LM	103.4	30K	15901 (154)	16881 (163)	16820 (163)	15083 (146)	17114 (165)	17054 (165)	15317 (148)
			35K	16224 (157)	17223 (167)	17161 (166)	15389 (149)	17462 (169)	17400 (168)	15627 (151)
			40K	17007 (164)	18055 (175)	17990 (174)	16132 (156)	18305 (177)	18240 (176)	16382 (158)
			50K	17192 (166)	18251 (176)	18185 (176)	16307 (158)	18503 (179)	18438 (178)	16560 (160)
	20000LM	125.5	30K	17549 (140)	18630 (148)	18564 (148)	16646 (133)	18888 (150)	18822 (150)	16904 (135)
			35K	17906 (143)	19008 (151)	18940 (151)	16984 (135)	19272 (154)	19204 (153)	17247 (137)
			40K	18770 (150)	19927 (159)	19855 (158)	17804 (142)	20202 (161)	20131 (160)	18080 (144)
			50K	18974 (151)	20143 (160)	20070 (160)	17997 (143)	20421 (163)	20349 (162)	18276 (146)
	24000LM	149.5	30K	21142 (141)	22445 (150)	22364 (150)	20055 (134)	22756 (152)	22675 (152)	20365 (136)
			35K	21571 (144)	22900 (153)	22818 (153)	20461 (137)	23217 (155)	23135 (155)	20779 (139)
			40K	22613 (151)	24006 (161)	23920 (160)	21450 (143)	24339 (163)	24253 (162)	21782 (146)
			50K	22858 (153)	24266 (162)	24179 (162)	21682 (145)	24602 (165)	24516 (164)	22018 (147)

* For 90CRI, reduce lumen output by 17.1%
** For WD reduce output by 4.7%, PGD reduce output by 5.4%
*** For HVOLT use scale factor in HVOLT SCALE FACTOR TABLE

CSA LISTED AMBIENT RATING*

		Standard** (surface)"	Standard** (suspended)"	E10WMCP (surface)	E10WMCP (suspended)	BE6WCP (surface)	BE6WCP (suspended)
L24	2000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	3000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	4000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	6000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
L48	3000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	4000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	6000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	8000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	10000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	12000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
L96	9000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	12000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	15000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	18000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	20000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C
	24000LM	35°C	50°C	5°C - 25°C	5°C - 35°C	-20°C - 25°C	-20°C - 35°C

*Minimum Ambient is -30°C unless noted, when the fixture is suspended at least 12" from the ceiling.
**All options not specifically listed in this table are considered standard

HVOLT SCALE FACTOR

	Factor
2000LM	0.814
3000LM	0.814
4000LM	0.814
6000LM	0.835
8000LM	0.845
9000LM	0.850
10000LM	0.850
12000LM	0.845
15000LM	0.860
18000LM	0.880
20000LM	0.845
24000LM	0.865

CONFIGURATION WEIGHTS

	Standard	w/ Sensor	w/ Battery
L24	8	9	9
L48	11	12	12
L96	23	24	24

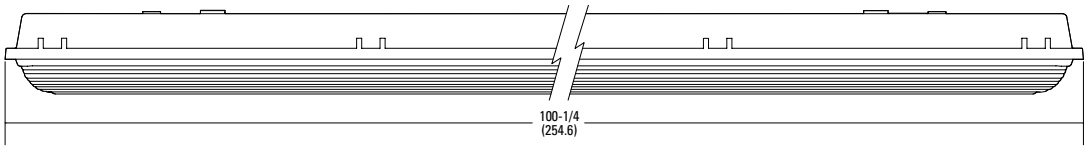
NUMBER OF BOARDS AND DRIVERS

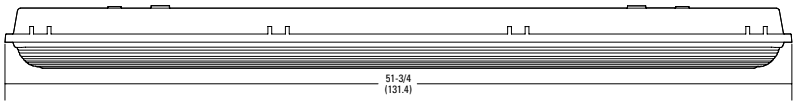
Lumen package	Fixture length	Number of boards	Number of drivers
2000LM	L24	1	1
3000LM		1	1
4000LM		1	1
6000LM		1	1
3000LM	L48	2	1
4000LM		2	1
6000LM		2	1
8000LM		2	1
10000LM		2	1
12000LM		2	1
9000LM	L96	4	1
12000LM		4	2
15000LM		4	2
18000LM		4	2
20000LM		4	2
24000LM		4	2

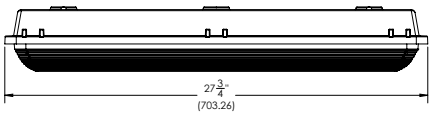
DIMENSIONS

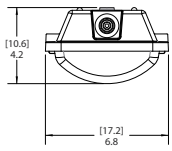
Specifications subject to change without notice.
All dimensions are inches (centimeters) unless otherwise indicated.

Weight (may vary with options or accessories)
FEM L48: 11.9 lbs (5.397kg)
FEM L96: 24.3 lbs (11.022kg)

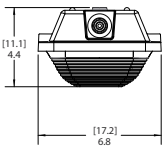




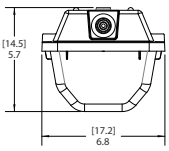




Diffuser Type:
LPAFL
LPACL
LPPFL
LPPCL



Diffuser Type:
IMAFL

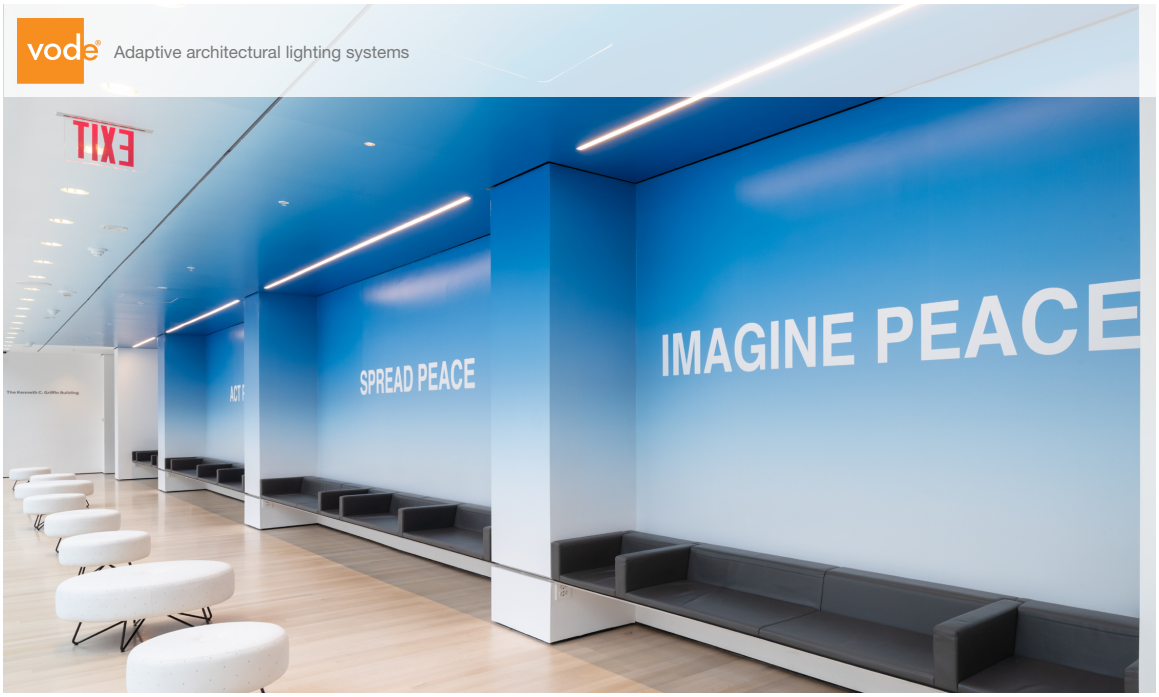


Diffuser Type:
IMAFD
IMACD

PHOTOMETRICS

See www.lithonia.com for photometry reports.

L12



Spec Guide

ZipOne | 707

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

Accent or task lighting for under cabinet, cove and reveal accent.

ZipOne: direct or indirect, task and cove light.

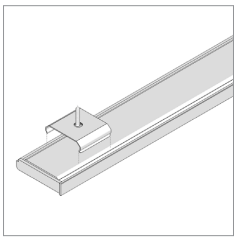
Benefits & Features

Micro Profile, Robust design
Flat profile. 0.30" (7mm) x 1.14" (29mm).

Superior Light Quality & Performance
Output up to 1193 lm/ft (3913 lm/m) (HO), 122 lm/W (HO). 80 or 90 CRI & tunable white (2200K-5000K) available.

Versatile Mounting Options, Easy Installation
Magnet with tape-on ferrous strip or low profile clip allow for mounting to almost any surface.

Better Optics & Beam Control
100° beam distribution with EdgeSoft™ lens for excellent cutoff and glare control.



Clip

Magnet

Build Your Specification

707-Z1	SL				0

System & Rail Type
707-Z1 ZipOne

System Type
SL Standard Linear

System Length
Specify overall system length in ft/in or M/mm.

*Corner and Shapes Available **See Guide** for details.*

Rail Length
24 24" (610mm)
36 36" (914mm)
48 48" (1219mm)
60 60" (1524mm)
72 72" (1829mm)
96 96" (2438mm)
ZZ Other rail length or layout (please specify)

*See **Rail Length Chart** for more details.*

Mounting
C Clip
T Magnet with Tape-On Metal Strip
ZZ Other (please specify)

MATCH LENGTHS INDICATED ON PLAN

Arm/Cord Length
0 None

Power Location
PP Portable Power

Remote Power
RP10 10' (3.048m) Wire Harness
RP25 25' (7.62m) Wire Harness
RP50 50' (15.24m) Wire Harness
RP75 75' (22.86m) Wire Harness
RP100 100' (30.48m) Wire Harness

HIDE REMOTE POWER PACK WITHIN CUBBOARD.

Power Type

Portable Power
WP Wall Plug with On/Off Switch [2]

Flexible 1 to 1 Power
AE eldoLED 0-10V, 1.0% Dimming
AT eldoLED 0-10V, 0.1% Dimming
AD eldoLED DALI, 0.1% Dimming
AX eldoLED DMX, 100-0% Dimming
AH Hi-lume 1% EcoSystem, Soft On / Fade to Black Technology, LDE1
AH2 Hi-lume 1% 2-wire LTEA2W (120V forward phase only)

Optimized Power
Add '**O**' to power type
example: AE**O**, AT**O**...etc. [3]

VodeNODE
Add '**N**' to power type for Flexible 1 to 1 Power
Add '**ON**' to power type for Optimized Power
example: AE**N**, AT**N**, AE**ON**, AD**ON**...etc. [4]

ZZ Other (please specify)

*See **Power Guide** for driver features & limitations.*

Voltage
1 120V
2 120V - 277V
4 120V - 240V
X Not Yet Specified

Emergency Power
0 No Emergency Power
ZZ Emergency Power *(specify requirements)*

	Z			A2	

LED Type
Z Zipper Board

Lumen Output
LO Low Output
SO Standard Output
HO High Output
ZZ Other (please specify)

*See **IES Files** page for details.*
*See **Power Guide** for driver features & limitations.*

Color Temperature

80+ CRI
27 2700K
30 3000K
35 3500K
40 4000K

90+ CRI
279 2700K
309 3000K
359 3500K
409 4000K

ZZ Tunable White Available
See Guide for details.

Optics
A2 100° Asymmetric

Sensors
0 None
ZZ Other (please specify) [5]

AL	

Finish
AL Clear Anodized

Options
3 3.5" (89mm) Fixture Cord
18 18" (457mm) Fixture Cord
36 36" (914mm) Fixture Cord
9 9' 18/3 Cord and Plug [6]

NOTES & LIMITATIONS
[1] *WP is only available with Low Output (LO) and 120V - 240V in 36" and 48" Rail Lengths.*
[2] *Wall plug (WP) version is 120V - 240V.*
[3] *Optimized Power is not available with Lutron Hi-lume 1% EcoSystem (AHO) Power Type.*
[4] *VodeNODE enclosure is not available with Hi-lume 1% 2-wire (AH2) Power Type.*
[5] *Sensors are available please contact Vode for more information.*
[6] *9' 18/3 Cord and Plug only available with Remote Power (RP).*
Contact factory for Chicago Plenum.

*Standard 5 Year Limited Warranty. See details **here**. Contact factory for options on Limited Warranties up to 20 years.*

Listed to UL standards for damp location by a Nationally Recognized Testing Laboratory (NRTL) recognized by OSHA. Certain limitations exist for each Certification. Contact factory for verification.

Applications

Museum and Residential

MoMA, New York, NY

MoMA, New York, NY

Boatswain's Way, Chelsea, MA

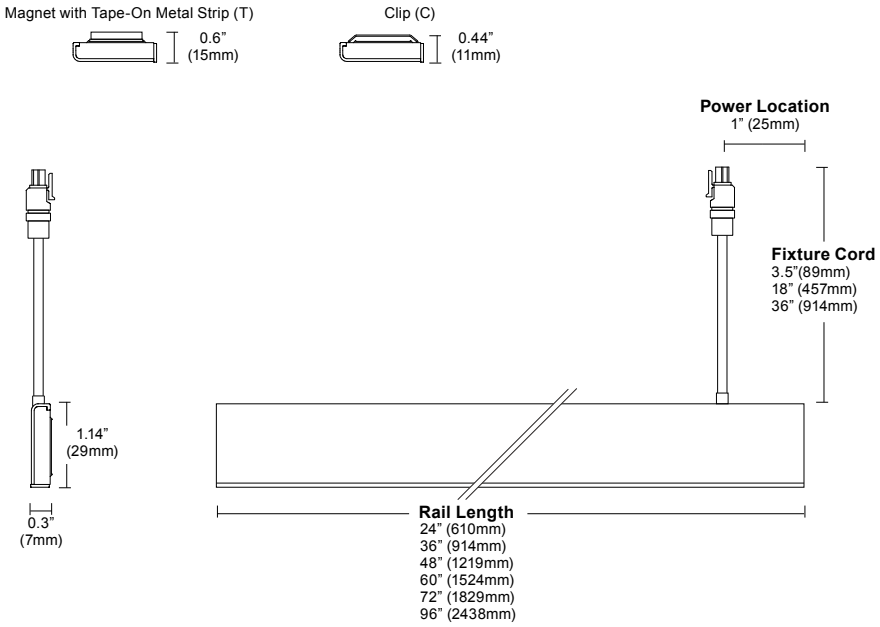
Structure

Rail Lengths	24” (610mm) - 96” (2438mm). Modified lengths available. *See **Rail Length Chart** for more details.*
Rail Dimensions	0.3” (7mm) x 1.14” (29mm). x length.
Construction	Extruded and machined 6063 aluminum.
Mounting	Various permanent and portable mounting options.
System Run Length	24” (610mm) minimum. Unlimited maximum.
Operating Temperature	32°F to 104°F (0°C to 40°C).
Humidity	0-95%, non-condensing. Suitable for damp locations.
System Weight	0.26lbs per ft (0.12kg per 305mm). Power supply and housing not included.

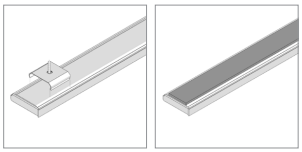
Materials

LED Board Construction	Aluminum core PCB, black LCP connectors, RoHS compliant.
Lens	High-impact extruded acrylic glass (PMMA).
Power Cable	Ø4mm, 18/2 AWG, Plenum (CMP) rated semi-rigid PVC or FEP, flame tested UL-910 *(PVC free in 2020)* .
Cable Connectors	Unfilled black nylon, rated UL 94 V-0, halogen free, PVC or FEP overmold, RoHS compliant *(PVC free in 2020).*
Remote Linear Power Housing (RLP)	20.7” x 2.375” x 2.53”, 0.054” formed Galvanized Steel.
Remote Brick Power Housing (RBP)	4.32” x 3.37” x .078” Galvanized Steel mounting plate.

Dimensions



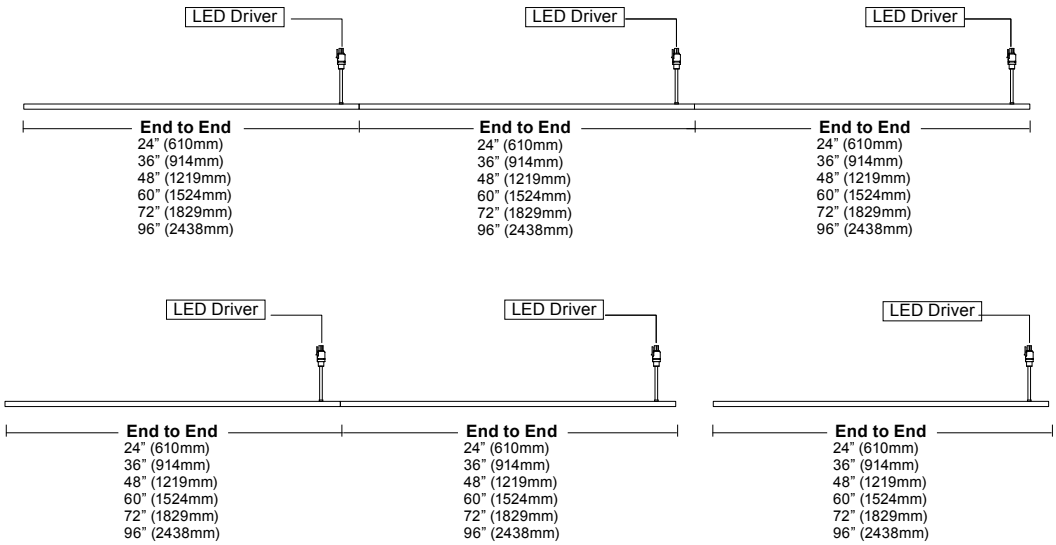
Mounting Options



Clip

Magnet with Tape-On Metal Strip

Layout

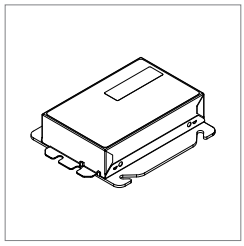


Power and Controls

Power Type	Class 2 (<60V output) constant current driver.
Dimming Controls	Dimming (0.1%, 1%), 0-10V, DALI, DMX, Lutron Hi-lume 1% are available. *See **Power Guide** for details.*
Input Voltage	120V - 277V, 50/60hz.
Power Location	Portable power or remote power. Maximum remote distance up to 100’ (30.5m) *depending* on driver selection. *See **Power Guide** for details.*

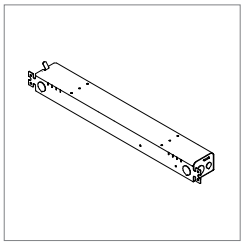
Remote power is locating the power supply away from the fixture. Remote power comes in two housing styles: brick style and linear style. Consult ***Power Guide*** to determine which type you will receive. Portable power is a wall plug with on/off switch.

Remote Brick Power Housing



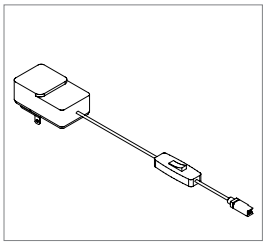
Supplied for some remote power applications. One remote power supply housing is supplied for each rail. Provided driver mounting plate fits standard 4” metal, square J-Boxes with a minimum volume of 21 in^3 (J-Box not provided).
See ***Tech Sheet*** for details.

Remote Linear Power Housing



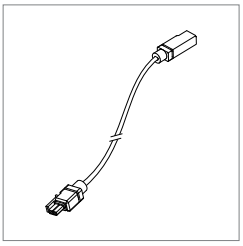
One remote power supply housing is supplied with each power supply. All Vode linear remote drivers come in a 0.054” (0.8mm) formed galvanized steel power supply housing with five (5) knockouts: (4) 1-1/8”, (1) 7/8“ and (1) 9/16”. Accommodates standard linear power supplies.
See ***Tech Sheet*** for details.

Wall Plug with On/Off Switch



Wall plug is only available in Low Output and 100V - 240V in 3” and 48” Rail Lengths.

Wire Harness

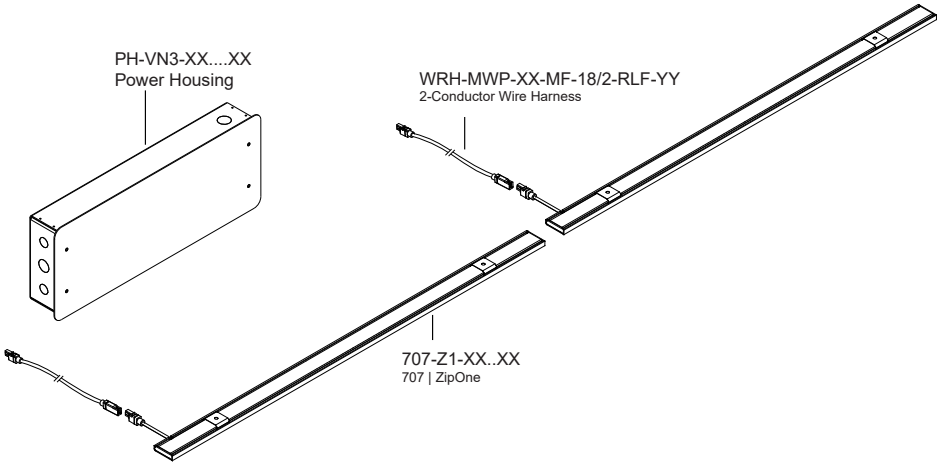


Wire harness connects driver to rail section. Lengths of 10’ (3.0m) & 25’ (7.6m) with snap-lock connectors for quick and easy installation. Multiple harnesses may be combined for lengths up to 100’ (30.5m).
See ***Tech Sheet*** for details.

Power and Controls

Flexible 1 to 1 power

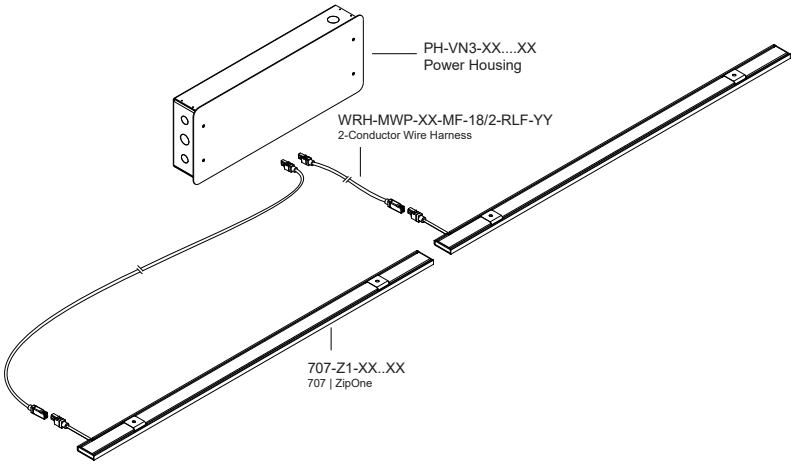
For Flexible 1 to 1 Power, Vode supplies one single output driver per fixture, allowing each fixture to be controlled independently. Direct/Indirect fixtures are supplied with two single output drivers, allowing the direct and indirect lighting to be controlled independently. Consult ***Power Guide*** to determine which type you will receive.



Optimized Power

To optimize power, Vode configures specifications with drivers that have 2 or 4 outputs. Depending on system configurations and power requirements, up to 4 fixtures can be powered from a 4-output driver. Consult ***Power Guide*** to determine which type you will receive.

IMPORTANT: Each fixture will still require individual wire harnesses, as shown below.

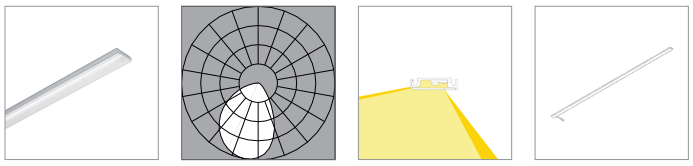


Note: Drawings not to scale, for reference only.

Performance | Zipper Board Optics

Zipper Board Optics design has 72 diodes per foot (305mm).

100° Asymmetric (A2)



L80 >60,000 hours

	80 CRI (80min., 84 avg.)				90 CRI (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	98	101	103	103	85	87	89	90
Lumens per foot (305mm)	397	410	418	418	342	353	361	364
Watts per foot (305mm)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Standard Output (SO)								
Efficacy - Lumens per Watt	122	126	129	129	106	109	111	113
Lumens per foot (305mm)	795	820	836	836	685	707	721	728
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.5	6.5	6.6	6.5
High Output (HO)								
Efficacy - Lumens per Watt	122	125	128	128	105	108	110	112
Lumens per foot (305mm)	1192	1229	1255	1255	1027	1060	1082	1092
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

L13A

Rev: 2022/12/30

CP6000 Sequence™ Mini

Vertical Suspension

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

VISA LIGHTING

VisaLighting.com/products/Sequence-Mini

Type: Project: Location:

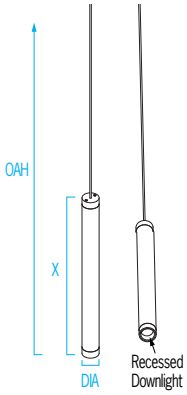
DIMENSIONS[10]

OAH MUST BE SPECIFIED

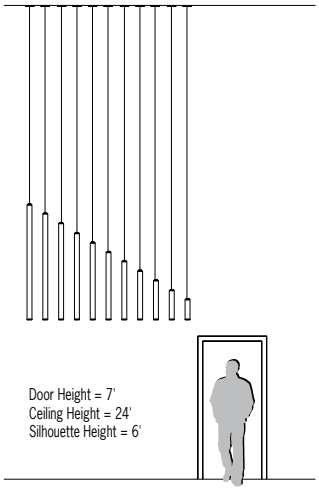
DIA = Diameter OAH = Overall Height X = Body Length WT = Weight

OAH is the distance (in inches) from the bottom of the fixture to the ceiling plane. Example - OAH(192) indicates an overall fixture height of 192"

DIA	2-1/4"	(57 mm)
OAH	96"	(2438 mm)
MIN OAH	X + 3"	(X + 76 mm)
X	12" – 72"	(305 mm – 1829 mm)
WT	1 lb – 6 lbs	(454 g – 2722 g)



RELATIVE SCALE DRAWING



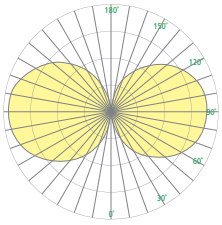
ETL Listed

5 Year Warranty

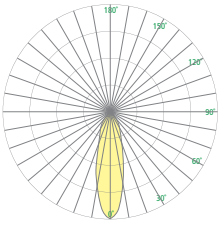
FEATURES

- Varying lengths, from 12" to 72", in 6" increments
- Optional downlight, 0-10V dimmable (controls by others), with narrow, medium, or wide optical distribution
- Endcaps machined from raw 2.25"DIA Aluminum billet
- Remote Driver Enclosure (**RMD**) is available for all lengths. Round canopy is 5-1/4" diameter and 1/2" deep.
- Driver in canopy (**SDC**) is available for lengths 24" and longer. Round canopy is 6-3/8" diameter and 1-1/2" deep.
- Canopy for both (**RMD**) or (**SDC**) mounts over 4x4 junction box (by others) with provided hardware and is painted white
- Suspended via black, white, or grey cloth braided power cord. Overall height (OAH) can be field adjusted to a shorter length during installation
- Matte white acrylic body
- No VOC powder coat finish or low VOC clear coat on metal finishes
- ETL listed for damp locations. Not suited for exterior applications

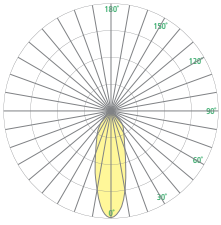
PHOTOMETRICS



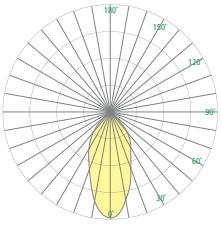
Bodylight



Downlight Optic NRW 27° Beam



Downlight Optic MED 33° Beam



Downlight Optic WIDE 48° Beam

CP6000 Sequence Mini (cont.)

Vertical Suspension

VISA LIGHTING

Fill in shaded boxes using information listed below

CP6000 – [ ] [ ] [ ] [ ] – [ ] [ ] [ ] [ ] [ ] [ ] [ ]

MODEL	LENGTH[1]	BODYLIGHT[2]	OPTIONAL DOWNLIGHT[3]	OPTIONAL DOWNLIGHT OPTIC[4]	VOLTAGE[5]	OPTIONAL DIMMING CONTROL[6]	FINISH	CORD COLOR[7]	DRIVER[8]	OPTION[9]	OAH[10]
	12 48 18 54 24 60 30 66 36 72 42	L30K L35K L40K	LOW HIGH	MED NRW WIDE	MVOLT 347V	DALI	See last page for finish order codes	BSC WSC GSC	SDC RMD	DCC	See page 1

Custom lengths available from 12" to 72" in length in 1" nominal increments; contact factory

Required for downlight option

Dimmable 0-10V to 1% if option not selected. **DALI not available with SDC or 347V**

SDC not available with 347V or DALI option; SDC not available on 12" and 18" lengths

FINISHES TO BE SELECTED BY ARCHITECT

BODYLIGHT SOURCE (Select one length[1] and one source[2])

Minimum 80CRI, within 3-step MacAdam

Bodylight Source[2]	L30K	L35K	L40K	Power (Watts) (Body)
CCT	3000K	3500K	4000K	
Length[1]	Delivered Lumens (Body)			
12"	650	700	700	7
18"	1000	1100	1100	10
24"	1400	1500	1600	14
30"	1800	1900	2000	17
36"	2200	2300	2500	21
42"	2600	2800	2900	24
48"	3000	3200	3300	28
54"	3400	3600	3800	31
60"	3800	4000	4200	35
66"	4200	4500	4700	39
72"	4600	4900	5100	42

Bodylight and downlight are separately switched and controlled/dimmed

LUMEN MAINTENANCE RATING

Bodylight	L80 (reported)	>72,000 hrs
Downlight	L80 (reported)	>55,000 hrs

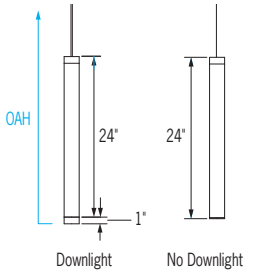
OPTIONAL DOWNLIGHT[3] AND OPTIC[4]

Fixture bottom is solid if no downlight is specified. Downlight adds an extra 1" to overall length. CCT matches bodylight selection Minimum 80CRI, within 3-stem MacAdam

	Delivered Lumens		Power (Watts)
	L30K/L35K	L40K	
LOW	800	850	8
HIGH	1500	1600	17

Downlight Optic	
NRW	27° Beam
MED	33° Beam
WIDE	48° Beam

DIMENSIONS WITH DOWNLIGHT CP6000 – 24" EXAMPLE



Downlight adds an extra 1" to overall height (OAH)

VOLTAGE[5] (Select one)

MVOLT	120-277V, 50/60 Hz
347V	50/60 Hz Not available with DALI or SDC options

Options continued on Page 3

CP6000 Sequence Mini (cont.)

Vertical Suspension

DIMMING CONTROL OPTION[6]

0-10V dimming to 1% is included unless DALI option is selected

⚠ Option availability may be interdependent with Voltage, Source or Other Options

DALI	Dimming control capability (to 5%) via DALI 1.0 protocol (not available with 347V or SDC option)

CORD COLOR[7] (Select one)

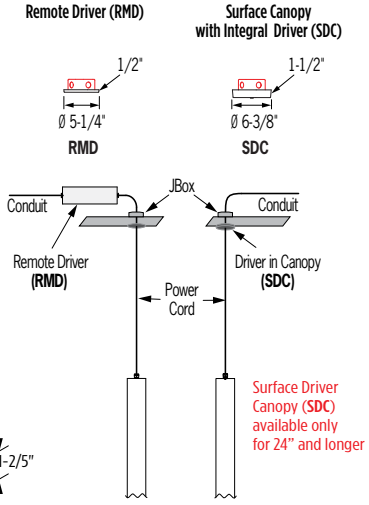
BSC	Black linen braided over power cord
WSC	White linen braided over power cord
GSC	Gray linen braided over power cord

DRIVER[8] (Select one)

⚠ Availability may be interdependent with Voltage, Source or Other Options

SDC	Surface canopy with integral driver; canopy is painted white (not available with 347V or DALI option; not available on 12" and 18" lengths)
RMD	Remote driver enclosure, has knockouts for conduit connection, may be recess mounted with insulation contact (type IC); canopy is painted white

DRIVER DETAIL

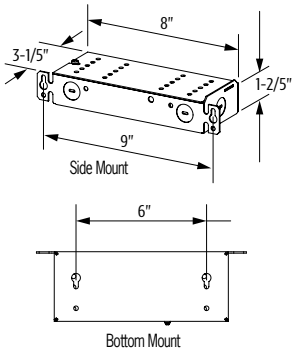


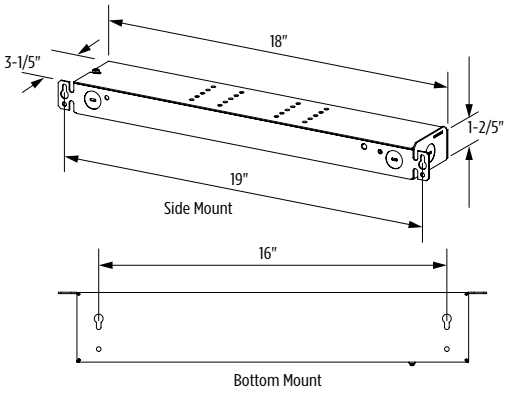
REMOTE DRIVER (**RMD**) INFORMATION

8" **RMD** box is used for 24" to 72" lengths

18" **RMD** box is used for any of these lengths: 12" & 18" lengths, DALI dimming, 347V

8" Box Dimensions





Remote driver boxes have knockouts for conduit connections

CP6000 Sequence Mini (cont.)

Vertical Suspension

VISA LIGHTING

OPTION[9]

⚠ Option availability may be interdependent with Other Options

DCC	Damp clear coat for metal finishes (required for 5 year warranty when used in damp locations)

Maximum Recommended Remote Wiring Distance from **RMD** to fixture canopy

- 12GA 190 ft
- 14GA 120 ft
- 16GA 75 ft
- 18GA 45 ft
- 20GA 30 ft

SEQUENCE PRODUCT FAMILY

Wall Units	• CB5201 — 34 In Indoor Wall • CB5203 — 45 In Indoor Wall	**Outdoor 8" Diameter Pendants**	• OP2252 — 8 In x 2 Ft Canopy • OP2253 — 8 In x 3 Ft Canopy • OP2254 — 8 In x 4 Ft.Canopy • OP2262 — 8 In x 2 Ft Catenary • OP2263 — 8 In x 3 Ft Catenary • OP2264 — 8 In x 4 Ft Catenary
4" Diameter Pendants	• CP2020 — 4 In x 2 Ft • CP2022 — 4 In x 3 Ft • CP2024 — 4 In x 4 Ft • CP2026 — 4 In x 5 Ft • CP2028 — 4 In x 6 Ft • CP2030 — 4 In x 8 Ft	**Outdoor Wall Units**	• OW5201 — 34 In Outdoor Wall • OW5203 — 45 In Outdoor Wall
8" Diameter Pendants	• CP2036 — 8 In x 2 Ft • CP2038 — 8 In x 3 Ft • CP2040 — 8 In x 4 Ft • CP2042 — 8 In x 5 Ft • CP2044 — 8 In x 6 Ft • CP2046 — 8 In x 8 Ft	**4" Indoor Sequence Square**	• CP5820 — 4 in x 2 ft • CP5822 — 4 in x 3 ft • CP5824 — 4 in x 4 ft • CP5826 — 4 in x 5 ft • CP5828 — 4 in x 6 ft • CP5830 — 4 in x 8 ft
12" Diameter Pendants	• CP2052 — 12 In x 2 Ft • CP2054 — 12 In x 3 Ft • CP2056 — 12 In x 4 Ft • CP2058 — 12 In x 5 Ft • CP2060 — 12 In x 6 Ft • CP2062 — 12 In x 8 Ft	**8" Indoor Sequence Square**	• CP5836 — 8 in x 2 ft • CP5838 — 8 in x 3 ft • CP5840 — 8 in x 4 ft • CP5842 — 8 in x 5 ft • CP5844 — 8 in x 6 ft • CP5846 — 8 in x 8 ft
Outdoor 4" Diameter Pendants	• OP2222 — 4 In x 3 Ft Canopy • OP2223 — 4 In x 4 Ft Canopy • OP2224 — 4 In x 5 Ft Canopy • OP2232 — 4 In x 3 Ft Catenary • OP2233 — 4 In x 4 Ft Catenary • OP2234 — 4 In x 5 Ft Catenary	**Vertical Sequence Mini**	• CP6000 — 2 in; various lengths
		Horizontal Sequence Mini	• CP6002 — 2 in; various lengths

SUGGESTED VARIATIONS

- Custom lengths/lumen outputs
- Alternative downlight bezel and end cap color
- Multi-fixture clusters via custom multi-point canopies
- Angled mounting via additional hang cable

See Visalighting.com/Sequence, Visalighting.com/Sequence-Square and Visalighting.com/Sequence-Mini for more information

CP6000 Sequence Mini (cont.)

VISA LIGHTING

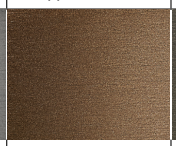
FINISHES

Specify color code when ordering. For accurate color matching, individual paint and finish samples are available upon request.
For more information about our finishes visit visalighting.com/finishes

Powder Coat Paint Finishes (Standard)

						
AGGY Agate Grey	**ALGN** Alpine Green	**BJBG** Baja Beige	**BMAT** Bronze Matte	**BRNZ** Bronze	**BSIL** Blade Silver	**CVBL** Cove Blue
						
DEOR Deoro Gold	**GLWT** Glacier White	**GSIL** Graphite Siver	**HRGR** Harbor Grey	**JTBK** Jet Black	**OCBL** Ocean Blue	**SHGR** Shoreline Grey
						
SBGN Sagebrush Green	**SLGR** Slate Grey	**SSTP** Sierra Taupe	**TRCN** Terracotta Canyon	**TRWT** Traffic White	**VBLK** Velvet Black	**VNRD** Vineyard Red

Alternative Metal Finishes (Premium)

			
BBA Brushed Brass Alternative	**BCA** Brushed Chrome Alternative	**BUA** Brushed Copper Alternative	**BZA** Brushed Bronze Alternative
			
OBA Oil-Rubbed Bronze Alternative	**PRA** Pewter Alternative	**RBA** Rustic Brass Alternative	**SNA** Satin Nickel Alternative

Metal Finish (Premium)


BA Brushed Aluminum

L13B

Rev: 2022/12/30

CP6000 Sequence™ Mini

Vertical Suspension

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

VISA LIGHTING

VisaLighting.com/products/Sequence-Mini

Type: Project: Location:

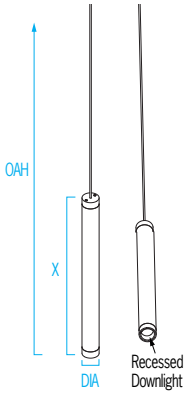
DIMENSIONS[10]

OAH MUST BE SPECIFIED

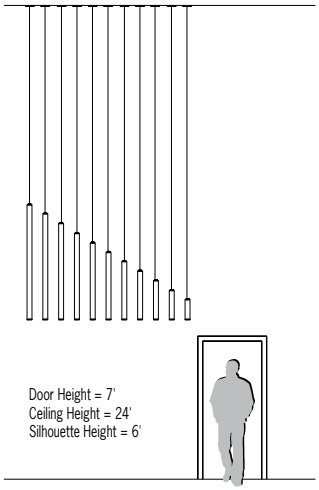
DIA = Diameter OAH = Overall Height X = Body Length WT = Weight

OAH is the distance (in inches) from the bottom of the fixture to the ceiling plane. Example - OAH(192) indicates an overall fixture height of 192"

DIA	2-1/4"	(57 mm)
OAH	96"	(2438 mm)
MIN OAH	X + 3"	(X + 76 mm)
X	12" – 72"	(305 mm – 1829 mm)
WT	1 lb – 6 lbs	(454 g – 2722 g)



RELATIVE SCALE DRAWING



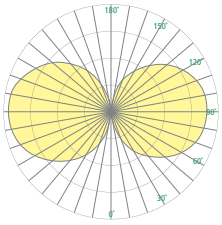
ETL Listed

5 Year Warranty

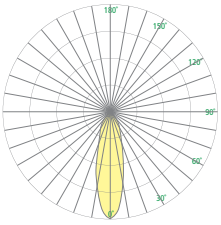
FEATURES

- Varying lengths, from 12" to 72", in 6" increments
- Optional downlight, 0-10V dimmable (controls by others), with narrow, medium, or wide optical distribution
- Endcaps machined from raw 2.25"DIA Aluminum billet
- Remote Driver Enclosure (**RMD**) is available for all lengths. Round canopy is 5-1/4" diameter and 1/2" deep.
- Driver in canopy (**SDC**) is available for lengths 24" and longer. Round canopy is 6-3/8" diameter and 1-1/2" deep.
- Canopy for both (**RMD**) or (**SDC**) mounts over 4x4 junction box (by others) with provided hardware and is painted white
- Suspended via black, white, or grey cloth braided power cord. Overall height (OAH) can be field adjusted to a shorter length during installation
- Matte white acrylic body
- No VOC powder coat finish or low VOC clear coat on metal finishes
- ETL listed for damp locations. Not suited for exterior applications

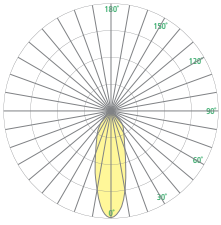
PHOTOMETRICS



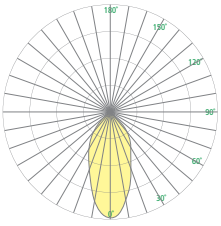
Bodylight



Downlight Optic NRW 27° Beam



Downlight Optic MED 33° Beam



Downlight Optic WIDE 48° Beam

CP6000 Sequence Mini (cont.)

Vertical Suspension

VISA LIGHTING

Fill in shaded boxes using information listed below

CP6000 – [ ] [ ] [ ] [ ] – [ ] [ ] [ ] [ ] [ ] [ ] [ ]

MODEL	LENGTH[1]	BODYLIGHT[2]	OPTIONAL DOWNLIGHT[3]	OPTIONAL DOWNLIGHT OPTIC[4]	VOLTAGE[5]	OPTIONAL DIMMING CONTROL[6]	FINISH	CORD COLOR[7]	DRIVER[8]	OPTION[9]	OAH[10]
	12 48 18 54 **24** 60 30 66 36 72 42	L30K **L35K** L40K	LOW HIGH	MED NRW **WIDE**	**MVOLT** 347V	DALI	See last page for finish order codes	BSC WSC GSC	SDC RMD	DCC	See page 1

Custom lengths available from 12" to 72" in length in 1" nominal increments; contact factory

Required for downlight option

Dimmable 0-10V to 1% if option not selected. **DALI not available with SDC or 347V**

SDC not available with 347V or DALI option; SDC not available on 12" and 18" lengths

FINISHES TO BE SELECTED BY ARCHITECT

BODYLIGHT SOURCE (Select one length[1] and one source[2])

Minimum 80CRI, within 3-step MacAdam

Bodylight Source[2]	L30K	L35K	L40K	Power (Watts) (Body)
CCT	3000K	3500K	4000K	
Length[1]	Delivered Lumens (Body)			
12"	650	700	700	7
18"	1000	1100	1100	10
24"	1400	1500	1600	14
30"	1800	1900	2000	17
36"	2200	2300	2500	21
42"	2600	2800	2900	24
48"	3000	3200	3300	28
54"	3400	3600	3800	31
60"	3800	4000	4200	35
66"	4200	4500	4700	39
72"	4600	4900	5100	42

Bodylight and downlight are separately switched and controlled/dimmed

LUMEN MAINTENANCE RATING

Bodylight	L80 (reported)	>72,000 hrs
Downlight	L80 (reported)	>55,000 hrs

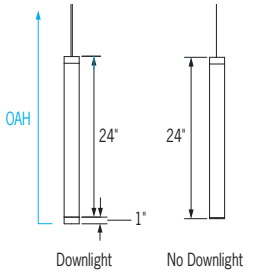
OPTIONAL DOWNLIGHT[3] AND OPTIC[4]

Fixture bottom is solid if no downlight is specified. Downlight adds an extra 1" to overall length. CCT matches bodylight selection Minimum 80CRI, within 3-stem MacAdam

	Delivered Lumens		Power (Watts)
	L30K/L35K	L40K	
LOW	800	850	8
HIGH	1500	1600	17

Downlight Optic	
NRW	27° Beam
MED	33° Beam
WIDE	48° Beam

DIMENSIONS WITH DOWNLIGHT CP6000 – 24" EXAMPLE



Downlight adds an extra 1" to overall height (OAH)

VOLTAGE[5] (Select one)

MVOLT	120-277V, 50/60 Hz
347V	50/60 Hz Not available with DALI or SDC options

Options continued on Page 3

CP6000 Sequence Mini (cont.)

Vertical Suspension

DIMMING CONTROL OPTION[6]

0-10V dimming to 1% is included unless DALI option is selected

⚠ Option availability may be interdependent with Voltage, Source or Other Options

DALI	Dimming control capability (to 5%) via DALI 1.0 protocol (not available with 347V or SDC option)

CORD COLOR[7] (Select one)

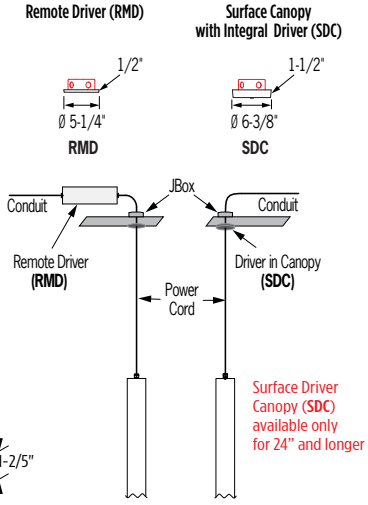
BSC	Black linen braided over power cord
WSC	White linen braided over power cord
GSC	Gray linen braided over power cord

DRIVER[8] (Select one)

⚠ Availability may be interdependent with Voltage, Source or Other Options

SDC	Surface canopy with integral driver; canopy is painted white (not available with 347V or DALI option; not available on 12" and 18" lengths)
RMD	Remote driver enclosure, has knockouts for conduit connection, may be recess mounted with insulation contact (type IC); canopy is painted white

DRIVER DETAIL

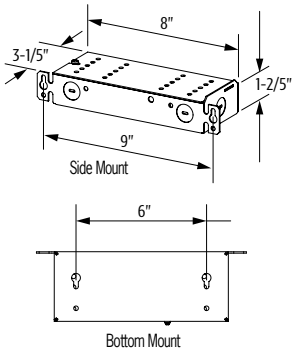


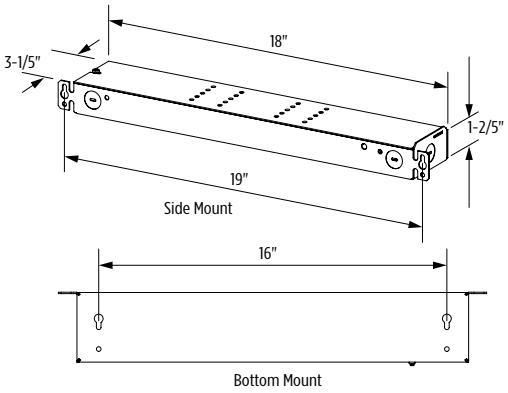
REMOTE DRIVER (**RMD**) INFORMATION

8" **RMD** box is used for 24" to 72" lengths

18" **RMD** box is used for any of these lengths: 12" & 18" lengths, DALI dimming, 347V

8" Box Dimensions





Remote driver boxes have knockouts for conduit connections

CP6000 Sequence Mini (cont.)

Vertical Suspension

VISA LIGHTING

OPTION[9]

⚠ Option availability may be interdependent with Other Options

DCC	Damp clear coat for metal finishes (required for 5 year warranty when used in damp locations)

Maximum Recommended Remote Wiring Distance from **RMD** to fixture canopy

- 12GA 190 ft
- 14GA 120 ft
- 16GA 75 ft
- 18GA 45 ft
- 20GA 30 ft

SEQUENCE PRODUCT FAMILY

Wall Units	• CB5201 — 34 In Indoor Wall • CB5203 — 45 In Indoor Wall	**Outdoor 8" Diameter Pendants**	• OP2252 — 8 In x 2 Ft Canopy • OP2253 — 8 In x 3 Ft Canopy • OP2254 — 8 In x 4 Ft.Canopy • OP2262 — 8 In x 2 Ft Catenary • OP2263 — 8 In x 3 Ft Catenary • OP2264 — 8 In x 4 Ft Catenary
4" Diameter Pendants	• CP2020 — 4 In x 2 Ft • CP2022 — 4 In x 3 Ft • CP2024 — 4 In x 4 Ft • CP2026 — 4 In x 5 Ft • CP2028 — 4 In x 6 Ft • CP2030 — 4 In x 8 Ft	**Outdoor Wall Units**	• OW5201 — 34 In Outdoor Wall • OW5203 — 45 In Outdoor Wall
8" Diameter Pendants	• CP2036 — 8 In x 2 Ft • CP2038 — 8 In x 3 Ft • CP2040 — 8 In x 4 Ft • CP2042 — 8 In x 5 Ft • CP2044 — 8 In x 6 Ft • CP2046 — 8 In x 8 Ft	**4" Indoor Sequence Square**	• CP5820 — 4 in x 2 ft • CP5822 — 4 in x 3 ft • CP5824 — 4 in x 4 ft • CP5826 — 4 in x 5 ft • CP5828 — 4 in x 6 ft • CP5830 — 4 in x 8 ft
12" Diameter Pendants	• CP2052 — 12 In x 2 Ft • CP2054 — 12 In x 3 Ft • CP2056 — 12 In x 4 Ft • CP2058 — 12 In x 5 Ft • CP2060 — 12 In x 6 Ft • CP2062 — 12 In x 8 Ft	**8" Indoor Sequence Square**	• CP5836 — 8 in x 2 ft • CP5838 — 8 in x 3 ft • CP5840 — 8 in x 4 ft • CP5842 — 8 in x 5 ft • CP5844 — 8 in x 6 ft • CP5846 — 8 in x 8 ft
Outdoor 4" Diameter Pendants	• OP2222 — 4 In x 3 Ft Canopy • OP2223 — 4 In x 4 Ft Canopy • OP2224 — 4 In x 5 Ft Canopy • OP2232 — 4 In x 3 Ft Catenary • OP2233 — 4 In x 4 Ft Catenary • OP2234 — 4 In x 5 Ft Catenary	**Vertical Sequence Mini**	• CP6000 — 2 in; various lengths
		Horizontal Sequence Mini	• CP6002 — 2 in; various lengths

SUGGESTED VARIATIONS

- Custom lengths/lumen outputs
- Alternative downlight bezel and end cap color
- Multi-fixture clusters via custom multi-point canopies
- Angled mounting via additional hang cable

See Visalighting.com/Sequence, Visalighting.com/Sequence-Square and Visalighting.com/Sequence-Mini for more information

CP6000 Sequence Mini (cont.)

VISA LIGHTING

FINISHES

Specify color code when ordering. For accurate color matching, individual paint and finish samples are available upon request.
For more information about our finishes visit visalighting.com/finishes

Powder Coat Paint Finishes (Standard)

						
AGGY Agate Grey	**ALGN** Alpine Green	**BJBG** Baja Beige	**BMAT** Bronze Matte	**BRNZ** Bronze	**BSIL** Blade Silver	**CVBL** Cove Blue
						
DEOR Deoro Gold	**GLWT** Glacier White	**GSIL** Graphite Siver	**HRGR** Harbor Grey	**JTBK** Jet Black	**OCBL** Ocean Blue	**SHGR** Shoreline Grey
						
SBGN Sagebrush Green	**SLGR** Slate Grey	**SSTP** Sierra Taupe	**TRCN** Terracotta Canyon	**TRWT** Traffic White	**VBLK** Velvet Black	**VNRD** Vineyard Red

Alternative Metal Finishes (Premium)

			
BBA Brushed Brass Alternative	**BCA** Brushed Chrome Alternative	**BUA** Brushed Copper Alternative	**BZA** Brushed Bronze Alternative
			
OBA Oil-Rubbed Bronze Alternative	**PRA** Pewter Alternative	**RBA** Rustic Brass Alternative	**SNA** Satin Nickel Alternative

Metal Finish (Premium)


BA Brushed Aluminum

L13C

Rev: 2022/12/30

CP6000 Sequence™ Mini

Vertical Suspension

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

VISA LIGHTING

VisaLighting.com/products/Sequence-Mini

Type: Project: Location:

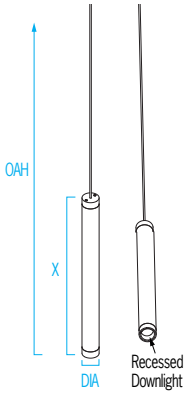
DIMENSIONS[10]

OAH MUST BE SPECIFIED

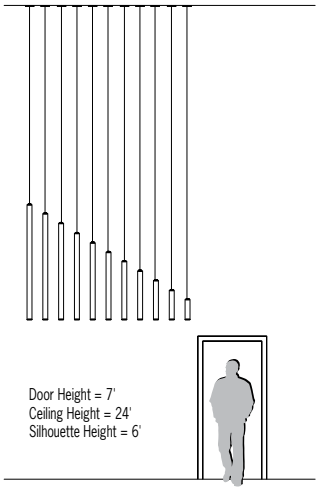
DIA = Diameter OAH = Overall Height X = Body Length WT = Weight

OAH is the distance (in inches) from the bottom of the fixture to the ceiling plane. Example - OAH(192) indicates an overall fixture height of 192"

DIA	2-1/4"	(57 mm)
OAH	96"	(2438 mm)
MIN OAH	X + 3"	(X + 76 mm)
X	12" – 72"	(305 mm – 1829 mm)
WT	1 lb – 6 lbs	(454 g – 2722 g)



RELATIVE SCALE DRAWING



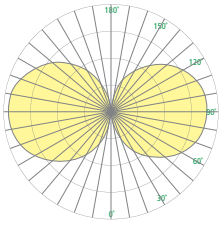
ETL Listed

5 Year Warranty

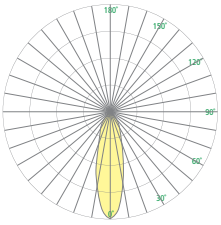
FEATURES

- Varying lengths, from 12" to 72", in 6" increments
- Optional downlight, 0-10V dimmable (controls by others), with narrow, medium, or wide optical distribution
- Endcaps machined from raw 2.25"DIA Aluminum billet
- Remote Driver Enclosure (**RMD**) is available for all lengths. Round canopy is 5-1/4" diameter and 1/2" deep.
- Driver in canopy (**SDC**) is available for lengths 24" and longer. Round canopy is 6-3/8" diameter and 1-1/2" deep.
- Canopy for both (**RMD**) or (**SDC**) mounts over 4x4 junction box (by others) with provided hardware and is painted white
- Suspended via black, white, or grey cloth braided power cord. Overall height (OAH) can be field adjusted to a shorter length during installation
- Matte white acrylic body
- No VOC powder coat finish or low VOC clear coat on metal finishes
- ETL listed for damp locations. Not suited for exterior applications

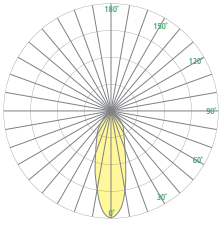
PHOTOMETRICS



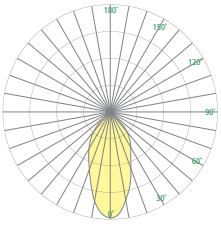
Bodylight



Downlight Optic NRW 27° Beam



Downlight Optic MED 33° Beam



Downlight Optic WIDE 48° Beam

CP6000 Sequence Mini (cont.)

Vertical Suspension

VISA LIGHTING

Fill in shaded boxes using information listed below

CP6000 – [ ] [ ] [ ] [ ] – [ ] [ ] [ ] [ ] [ ] [ ] [ ]

MODEL	LENGTH[1]	BODYLIGHT[2]	OPTIONAL DOWNLIGHT[3]	OPTIONAL DOWNLIGHT OPTIC[4]	VOLTAGE[5]	OPTIONAL DIMMING CONTROL[6]	FINISH	CORD COLOR[7]	DRIVER[8]	OPTION[9]	OAH[10]
	12 48 18 54 24 60 30 66 36 72 42	L30K L35K L40K	LOW HIGH	MED NRW WIDE	MVOLT 347V	DALI	See last page for finish order codes	BSC WSC GSC	SDC RMD	DCC	See page 1

Custom lengths available from 12" to 72" in length in 1" nominal increments; contact factory

Required for downlight option

Dimmable 0-10V to 1% if option not selected. **DALI not available with SDC or 347V**

SDC not available with 347V or DALI option; SDC not available on 12" and 18" lengths

FINISHES TO BE SELECTED BY ARCHITECT

BODYLIGHT SOURCE (Select one length[1] and one source[2])

Minimum 80CRI, within 3-step MacAdam

Bodylight Source[2]	L30K	L35K	L40K	Power (Watts) (Body)
CCT	3000K	3500K	4000K	
Length[1]	Delivered Lumens (Body)			
12"	650	700	700	7
18"	1000	1100	1100	10
24"	1400	1500	1600	14
30"	1800	1900	2000	17
36"	2200	2300	2500	21
42"	2600	2800	2900	24
48"	3000	3200	3300	28
54"	3400	3600	3800	31
60"	3800	4000	4200	35
66"	4200	4500	4700	39
72"	4600	4900	5100	42

Bodylight and downlight are separately switched and controlled/dimmed

LUMEN MAINTENANCE RATING

Bodylight	L80 (reported)	>72,000 hrs
Downlight	L80 (reported)	>55,000 hrs

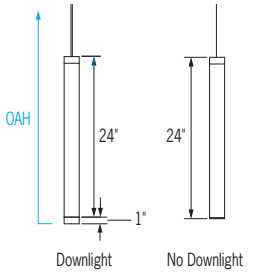
OPTIONAL DOWNLIGHT[3] AND OPTIC[4]

Fixture bottom is solid if no downlight is specified. Downlight adds an extra 1" to overall length. CCT matches bodylight selection Minimum 80CRI, within 3-stem MacAdam

	Delivered Lumens		Power (Watts)
	L30K/L35K	L40K	
LOW	800	850	8
HIGH	1500	1600	17

Downlight Optic	
NRW	27° Beam
MED	33° Beam
WIDE	48° Beam

DIMENSIONS WITH DOWNLIGHT CP6000 – 24" EXAMPLE



Downlight adds an extra 1" to overall height (OAH)

VOLTAGE[5] (Select one)

MVOLT	120-277V, 50/60 Hz
347V	50/60 Hz Not available with DALI or SDC options

Options continued on Page 3

CP6000 Sequence Mini (cont.)

Vertical Suspension

DIMMING CONTROL OPTION[6]

0-10V dimming to 1% is included unless DALI option is selected

⚠ Option availability may be interdependent with Voltage, Source or Other Options

DALI	Dimming control capability (to 5%) via DALI 1.0 protocol (not available with 347V or SDC option)

CORD COLOR[7] (Select one)

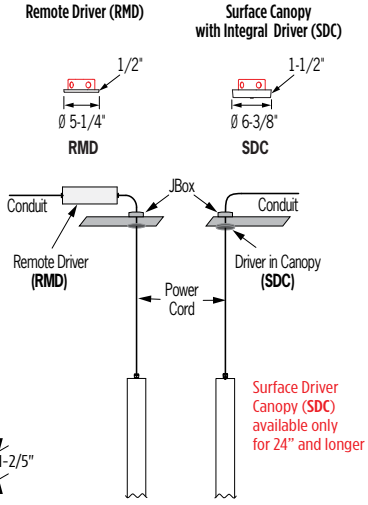
BSC	Black linen braided over power cord
WSC	White linen braided over power cord
GSC	Gray linen braided over power cord

DRIVER[8] (Select one)

⚠ Availability may be interdependent with Voltage, Source or Other Options

SDC	Surface canopy with integral driver; canopy is painted white (not available with 347V or DALI option; not available on 12" and 18" lengths)
RMD	Remote driver enclosure, has knockouts for conduit connection, may be recess mounted with insulation contact (type IC); canopy is painted white

DRIVER DETAIL

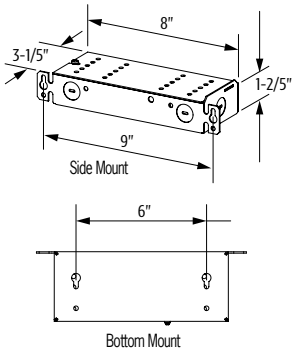


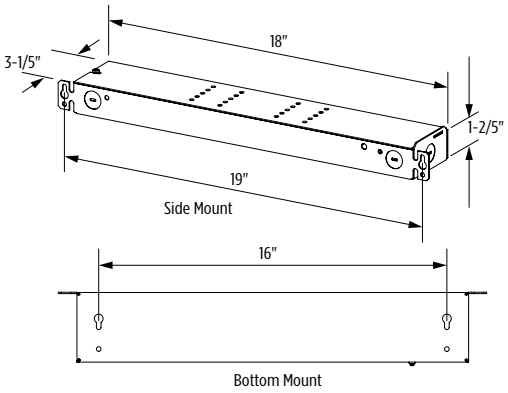
REMOTE DRIVER (**RMD**) INFORMATION

8" **RMD** box is used for 24" to 72" lengths

18" **RMD** box is used for any of these lengths: 12" & 18" lengths, DALI dimming, 347V

8" Box Dimensions





Remote driver boxes have knockouts for conduit connections

CP6000 Sequence Mini (cont.)

Vertical Suspension

VISA LIGHTING

OPTION[9]

⚠ Option availability may be interdependent with Other Options

DCC	Damp clear coat for metal finishes (required for 5 year warranty when used in damp locations)

Maximum Recommended Remote Wiring Distance from **RMD** to fixture canopy

- 12GA 190 ft
- 14GA 120 ft
- 16GA 75 ft
- 18GA 45 ft
- 20GA 30 ft

SEQUENCE PRODUCT FAMILY

Wall Units	• CB5201 — 34 In Indoor Wall • CB5203 — 45 In Indoor Wall	**Outdoor 8" Diameter Pendants**	• OP2252 — 8 In x 2 Ft Canopy • OP2253 — 8 In x 3 Ft Canopy • OP2254 — 8 In x 4 Ft.Canopy • OP2262 — 8 In x 2 Ft Catenary • OP2263 — 8 In x 3 Ft Catenary • OP2264 — 8 In x 4 Ft Catenary
4" Diameter Pendants	• CP2020 — 4 In x 2 Ft • CP2022 — 4 In x 3 Ft • CP2024 — 4 In x 4 Ft • CP2026 — 4 In x 5 Ft • CP2028 — 4 In x 6 Ft • CP2030 — 4 In x 8 Ft	**Outdoor Wall Units**	• OW5201 — 34 In Outdoor Wall • OW5203 — 45 In Outdoor Wall
8" Diameter Pendants	• CP2036 — 8 In x 2 Ft • CP2038 — 8 In x 3 Ft • CP2040 — 8 In x 4 Ft • CP2042 — 8 In x 5 Ft • CP2044 — 8 In x 6 Ft • CP2046 — 8 In x 8 Ft	**4" Indoor Sequence Square**	• CP5820 — 4 in x 2 ft • CP5822 — 4 in x 3 ft • CP5824 — 4 in x 4 ft • CP5826 — 4 in x 5 ft • CP5828 — 4 in x 6 ft • CP5830 — 4 in x 8 ft
12" Diameter Pendants	• CP2052 — 12 In x 2 Ft • CP2054 — 12 In x 3 Ft • CP2056 — 12 In x 4 Ft • CP2058 — 12 In x 5 Ft • CP2060 — 12 In x 6 Ft • CP2062 — 12 In x 8 Ft	**8" Indoor Sequence Square**	• CP5836 — 8 in x 2 ft • CP5838 — 8 in x 3 ft • CP5840 — 8 in x 4 ft • CP5842 — 8 in x 5 ft • CP5844 — 8 in x 6 ft • CP5846 — 8 in x 8 ft
Outdoor 4" Diameter Pendants	• OP2222 — 4 In x 3 Ft Canopy • OP2223 — 4 In x 4 Ft Canopy • OP2224 — 4 In x 5 Ft Canopy • OP2232 — 4 In x 3 Ft Catenary • OP2233 — 4 In x 4 Ft Catenary • OP2234 — 4 In x 5 Ft Catenary	**Vertical Sequence Mini**	• CP6000 — 2 in; various lengths
		Horizontal Sequence Mini	• CP6002 — 2 in; various lengths

SUGGESTED VARIATIONS

- Custom lengths/lumen outputs
- Alternative downlight bezel and end cap color
- Multi-fixture clusters via custom multi-point canopies
- Angled mounting via additional hang cable

See Visalighting.com/Sequence, Visalighting.com/Sequence-Square and Visalighting.com/Sequence-Mini for more information

CP6000 Sequence Mini (cont.)

VISA LIGHTING

FINISHES

Specify color code when ordering. For accurate color matching, individual paint and finish samples are available upon request.
For more information about our finishes visit visalighting.com/finishes

Powder Coat Paint Finishes (Standard)

AGGY Agate Grey	**ALGN** Alpine Green	**BJBG** Baja Beige	**BMAT** Bronze Matte	**BRNZ** Bronze	**BSIL** Blade Silver	**CVBL** Cove Blue
DEOR Deoro Gold	**GLWT** Glacier White	**GSIL** Graphite Siver	**HRGR** Harbor Grey	**JTBK** Jet Black	**OCBL** Ocean Blue	**SHGR** Shoreline Grey
SBGN Sagebrush Green	**SLGR** Slate Grey	**SSTP** Sierra Taupe	**TRCN** Terracotta Canyon	**TRWT** Traffic White	**VBLK** Velvet Black	**VNRD** Vineyard Red

Alternative Metal Finishes (Premium)

BBA Brushed Brass Alternative	**BCA** Brushed Chrome Alternative	**BUA** Brushed Copper Alternative	**BZA** Brushed Bronze Alternative
OBA Oil-Rubbed Bronze Alternative	**PRA** Pewter Alternative	**RBA** Rustic Brass Alternative	**SNA** Satin Nickel Alternative

Metal Finish (Premium)

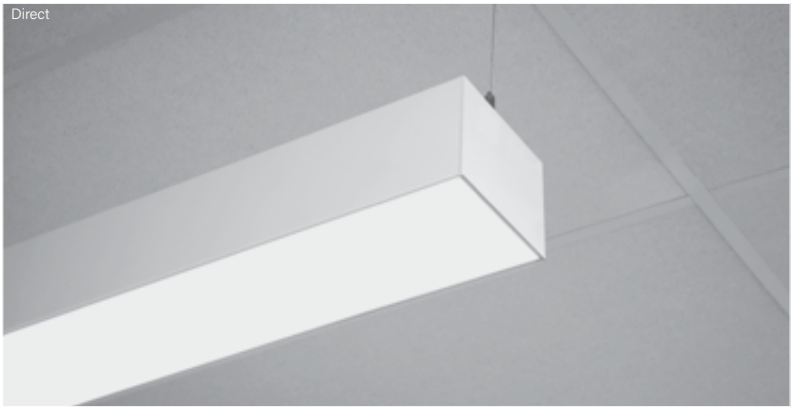
BA Brushed Aluminum

TYPE L14

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE®
Better Lighting

High Performance 6" Aperture (HP-6) Pendant



Signal White is standard finish

High Performance 6" Aperture is a patented, linear LED luminaire family. HP-6 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

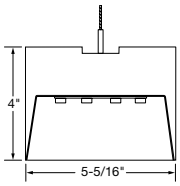
This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Red List Declared** status.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

Note: see page 6 for all aesthetic options

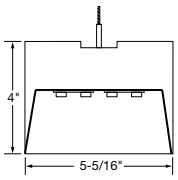
CROSS SECTIONS

Direct



Flush Downlight Diffuser (standard)

Enhanced Output Direct



Flush Downlight Diffuser (standard)

GET MORE WITH TAILORED LIGHTING

- Tailored Length
- Tailored Angle
- Tailored Color
- Tailored Output
- Tailored Control

ALSO AVAILABLE IN

Recessed (**R**)

Wall Mount (**WM**)

Surface Mount (**SM**)

Option Available

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 6" Aperture (HP-6) Pendant

Clear Form

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	○ 6 ○ 6 EO - Enhanced Output	◉ P - Pendant	◉ D - Direct	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT AND LED TYPE

Light Output (Flush)

D Output	EO D Ouput
○ S - Standard (386 lm/ft)	○ H - High (1561 lm/ft)
○ B - Boosted (485 lm/ft)	○ V - Very High (2007 lm/ft)
○ H - High (733 lm/ft)	○ X - Extremely High (2271 lm/ft)
○ V - Very High (942 lm/ft)	○ TL - Tailored:_____lm/ft*
○ TL - Tailored:_____lm/ft*	

* Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

OUTPUT AND LED TYPE

LED CRI/CCT
○ 830 - 80 CRI, 3000K
○ 835 - 80 CRI, 3500K
○ 840 - 80 CRI, 4000K
○ 930 - 90 CRI, 3000K
○ 935 - 90 CRI, 3500K
○ 940 - 90 CRI, 4000K
○ 8TW - 80 CRI, Tunable White
○ 9TW - 90 CRI, Tunable White

MECHANICAL OPTIONS

Downlight Optics	Reflector System
◉ F - Flush (standard)	◉ 96LG - 96 Low Gloss White

ELECTRICAL OPTIONS

Voltage	Circuiting [1]
○ 120 - 120 Voltage	○ SC - Single Circuit* One single circuit in a run
○ 277 - 277 Voltage	○ MC - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required
○ 347 - 347 Voltage	* Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS

Driver Selection

0-10V Driver Options
- ○ FC-10% - 0-10V 10% (standard)
- ○ FC-1% - 0-10V 1%
- ○ OTi-10% - EldoLED OTi, 0-10V 10% [2]
- ○ OTi-1% - EldoLED OTi, 0-10V 1% [2]
- ○ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%
- ○ 10V-TW-10% - EldoLED OTi, 0-10V 10% *(Tunable White)* [2]

DALI Driver Options
- ○ FC-DALI-1% - DALI 1%
- ○ DXL-DALI-1% - EldoLED Dexal, 1%
- ○ ELD-DALI-0% - EldoLED SOLOdrive, 0.1%
- ○ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*

DMX Driver Options
- ○ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [3]
- ○ ELD-DMX - EldoLED POWERdrive, 0.1%
- ○ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options
- ○ LUT-ES1 - Lutron, Ecosystem 1%
- ○ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method	Ceiling Hardware Type
○ FA50 - Fully Adjustable 50" (standard)	○ C1 - 15/16" T-Bar
○ FA100 - Fully Adjustable 100"	○ C2 - 9/16" T-Bar
○ FA150 - Fully Adjustable 150"	○ C3 - Screw Slot
○ FA200 - Fully Adjustable 200"	○ C4 - Hard Ceiling
○ FA250 - Fully Adjustable 250"	○ C1T - 15/16" Tegular
○ FA300 - Fully Adjustable 300"	○ C2T - 9/16" Tegular
○ FM - Flexible Mounting [4]	

COORDINATE FINAL MOUNTING REQUIRMENTS WITH SLATTED ROOF SYSTEM/ARCHITECTURAL ELEMENTS

OTHER OPTIONS

Endcap Style	Finish	Emergency Style (Optional) (See page 5 Backup Battery table) Clear Selection	Integrated Sensor (Optional) Clear Selection	Special Options (Optional) Clear Selection
◉ FE - Flat Endcap (standard)	○ SW - Signal White (standard) ○ FB - Finelite Black ○ SA - Satin Aluminum ○ #### - RAL Color Code [5] _____ ARCHITECT TO SELECT FINISH	○ LGD18W - Legrand 18W Brand Battery Back-up ○ LGD10W - Legrand 10W Brand Battery Back-up ○ EM/GEN - Emergency to Generator ○ NL - Night Light ○ BSL722 - Bodine Battery Back up ○ BSL310LP - Bodine Battery Back up Low Profile ○ GTD - Generator Transfer Device ○ ALCR - Automatic Load Control Relay	○ OBO - Occupancy ○ OBD - Daylight ○ W601 - Wattstopper [6] Wireless Sensor ○ OBE - Enlighted [7] ○ VOCC - Lutron Vive Wireless Sensor (VDO) [8] ○ VRF - Lutron Vive Radio Only [8]	○ CP - Chicago Plenum [9] ○ RLA - Red List Approved ○ RLD - Red List Declared

[1] Contact factory for switching options
[2] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO, FC-1% - DTO)
[3] B & V outputs only
[4] Direct only
[5] 20 business days lead time for color
[6] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.
[7] Enlighted components installed by Finelite, provided by others
[8] Lutron Vive Ingrated Sensors require a DALI driver
[9] Only available with C1, C2, and C3 mounting hardware with Finelite Gridbox

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 6" Aperture (HP-6) Pendant

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
10V-TW-10%	EldoLED OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
10V-TW-10%-DTO	EldoLED OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OTi-10%	EldoLED OTi, 0-10V 10% Dimming (Linear)
OTi-10%-DTO	EldoLED OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OTi-1%	EldoLED OTi, 0-10V 1% Dimming (Linear)
OTi-1%-DTO	EldoLED OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
DXL-DALI-1%	EldoLED Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 6" Aperture (HP-6) Pendant

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system, plug-together wiring, standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16" (±1/32"). 12' maximum section length.

MITERED CORNERS: Fully illuminated 90° corners have internal secondary diffusers to ensure against light leaks. Custom angles are available (90° minimum on inside corners.) Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Lumen packages available for **HP-6 D**: Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). **HP-6 EO D**: High (**H**), Very High (**V**), and Extremely High (**X**). For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION : 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**) downlight diffuser. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Die-formed 24-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint.

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 100%-10% standard. Dimming to 1% available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS:
- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime.:** 100,000 hours
- **FineTune DMX:** 1%

LUTRON TUNABLE WHITE DRIVER OPTION: LUT-TW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE: 50" Fully Adjustable (**FA**) plated steel aircraft cable with safety stop hardware standard. The Flexible Mounting Bracket (**FM**) adjusts the suspension points to accommodate existing architecture. Suspension points adjust up to 2' in from the end of 8' or 12' fixture lengths and up to 1' in on shorter lengths. Consult factory for tailored lighting options.

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 6" Aperture (HP-6) Pendant

SPECIFICATIONS

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTune DMX system is specified, a DMX to RJ45 adapter is provided.

OTHER OPTIONS

ENDCAPS: Flat diecast aluminum endcaps (**FE**) add 1/4" to each end of luminaire.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery		
	Legrand 18W	**Legrand 10W/ Bodine BSL310LP**
HP6-P-D		
Min. Housing Length	6'	4'
EM Lumen Output	1885	1220
EM Section Illum.	2'	2' or 4'
HP6-EO-P-D		
Min. Housing Length	6'*	4'
EM Lumen Output	2007	1193
EM Section Illum.	2'	4'

Bodine GTD and Legrand ALCR Min. Length	
Configuration	**Min Length**
Generator	D-2'
Generator + OCC	D-2'
Daylight	D-2'
Generator + Daylight	D-2'

TUNABLE WHITE ELECTRICAL OPTIONS[1]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**) and Satin Aluminum (**SA**) are standard. Optional Adders: 179 RAL colors[2].

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These fixtures are rated for Damp Location. Chicago Plenum options available for C1, C2, or C3 suspension using our GridBox. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Red List Declared) to your part number.

WEIGHT[3]: D - 3.6 lb/ft; EO D - 3.75 lb/ft

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

[1] Consult Finelite for Generator Transfer Device and Battery Backup fit
[2] 20 business days lead time for color
[3] Excludes Battery Backup and Generator Transfer Device weight

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

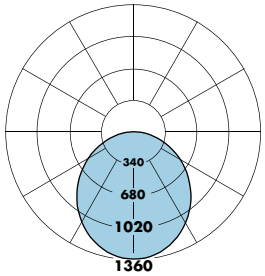
FINELITE® Better Lighting

High Performance 6" Aperture (HP-6) Pendant

Direct Photometry - 4' Luminaire 3500K

HP6-P-D-4'-V-835
Downlight: Flush Diffuser

Efficacy: 100 lm/W
Total luminaire output: 3769 lumens (942 lm/ft)
37.6 watts (9.4 W/ft)
Peak Candela Value: 1360 @ 0º
CRI: 80 / CCT: 3500K
ITL LM79 Report 86098



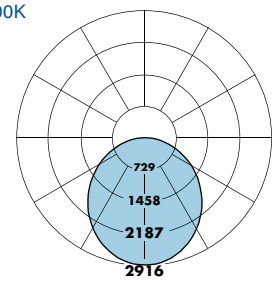
CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	FLUX
0	1360	1360	1360	1360	1360	
5	1353	1353	1353	1354	1354	129
15	1301	1293	1299	1300	1294	366
25	1193	1183	1192	1189	1185	547
35	1043	1034	1039	1036	1034	649
45	865	858	862	859	856	663
55	668	662	665	661	662	593
65	465	460	461	460	459	456
75	263	261	261	260	261	277
85	81	80	80	79	81	89
90	0	0	0	0	0	

Enhanced Output Direct Photometry - 4' Luminaire 3500K

HP6 EO-P-D-4'-V-835
Downlight: Flush Diffuser

Efficacy: 110 lm/W
Total luminaire output: 8026 lumens (2007 lm/ft)
73.2 watts (18.3 W/ft)
Peak Candela Value: 2915 @ 0º
CRI: 80 / CCT: 3500K
ITL LM79 Report 89078



CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	FLUX
0	2915	2915	2915	2915	2915	
5	2092	2900	2900	2901	2900	276
15	2781	2765	2783	2784	2774	783
25	2542	2527	2544	2544	2535	1169
35	2218	2197	2217	2213	2208	1383
45	1833	1819	1832	1829	1285	1410
55	1414	1404	1413	1409	1408	1261
65	981	974	979	978	979	968
75	559	555	554	553	556	589
85	174	167	167	170	167	187
90	0	0	0	0	0	

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

HP-6 D				HP-6 EO D		
S [1]	B [1]	H [1]	V [2]	H	V	X
1543	1940	2931	3769	6242	8026	9082

Light Output, 3500K, 80 CRI (Lumens Per Foot)

HP-6 D				HP-6 EO D		
S [1]	B [1]	H [1]	V [2]	H	V	X
386	485	733	942	1561	2007	2271

Power, 3500K (Watts Per Foot)

HP-6 D				HP-6 EO D		
S [1]	B [1]	H [1]	V [2]	H	V	X
3.7	4.7	7.2	9.4	14.0	18.3	21.1

Efficacy, 3500K, 80 CRI (Lumens Per Watt)

HP-6 D				HP-6 EO D		
S [1]	B [1]	H [1]	V [2]	H	V	X
105	104	102	100	111	110	108

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 86098
[3] Based on ITL report: 89078

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 2931 lm x 0.789 = 2313 lm

Total Light Output per Foot: 733 lm/ft x 0.789 = 578 lm/ft.

watts/foot: 7.2 W/ft.

$$\textbf{Efficacy} = \frac{578\ \frac{\text{lm}}{\text{ft.}}}{7.2\ \frac{\text{W}}{\text{ft.}}} = 80\ \text{lm/W}$$

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

0-10V Tunable White

Finelite's award-winning, contractor friendly Tunable White luminaires are available at low cost, with powerful and simple 0-10V tuning and intensity controls.

TUNABLE WHITE FEATURES

- CCT range: 2700K - 6500K
- Dimming Range: 100% to 10%
- CRI Options: 80 CRI or 90 CRI

LUMINAIRE FAMILY MODIFICATIONS/RESTRICTIONS

	Section Lengths										
Direct	**2'**	**3'**	**4'**	**5'**	**6'**	**7'**	**8'**	**9'**	**10'**	**11'**	**12'**
Output S,B,H,V Single Circuit	Rows can be comprised of 2'-12' sections. Tailored lengths available.										
Integral Battery Backup (BSL310LP)							✓		✓		✓

EN/GEN sections available for all body lengths

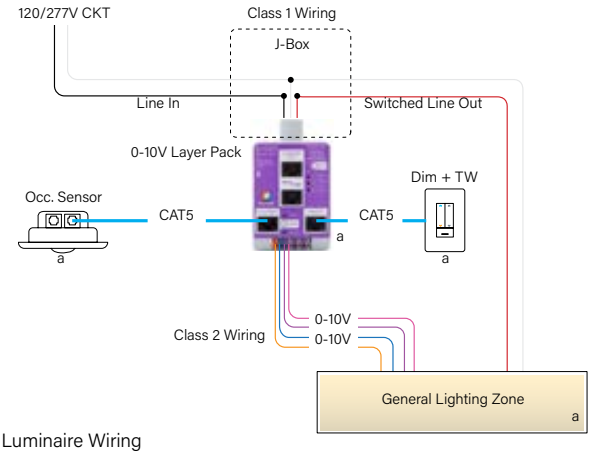
PHOTOMETRY

Apply a power adjustment factor to calculate wattage usage

POWER	CONVERSION FACTOR
	1.1X

(Example: a 50 watt luminaire in static white would draw 55 watts using 0-10V Tunable White)

WIRING DIAGRAM - DIMMABLE TO 10%

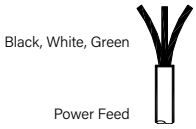


Luminaire Wiring

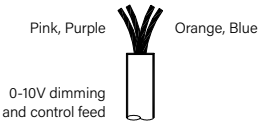
- **Purple** (+) / **Pink** (-) control wires are for intensity control
- **Orange** (+) / **Blue** (-) control wires are for Tunable White control

Note:
Load or Dim to Off options available.

DUAL FEED DETAIL



WIRING LEGEND		
Black	Hot	Line Voltage
White	Neutral	Line Voltage
Green	Ground	



WIRING LEGEND		
Pink	Dimming	0-10V DC
Purple	Dimming	0-10V DC
Orange	TW	0-10V DC
Blue	TW	0-10V DC

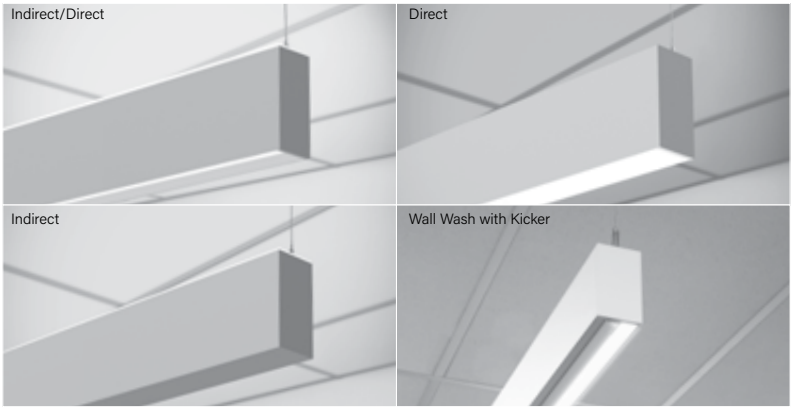
Tunable White LUMINAIRES

TYPE L15

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant



Signal White is standard finish

Note: see page 6 for all aesthetic options

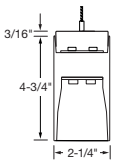
High Performance 2" Aperture is a patented, linear LED luminaire family. HP-2 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Red List Declared** status.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

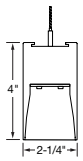
CROSS SECTIONS

Indirect/Direct
Top Glow Diffuser (standard)



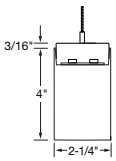
Flush Downlight Diffuser (standard)

Direct

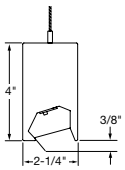


Flush Downlight Diffuser (standard)

Indirect
Top Glow Diffuser (standard)

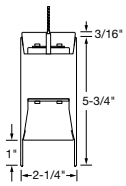


Wall Wash Direct



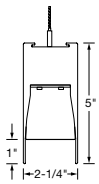
Kicker (standard)

Regressed Indirect/Direct
Top Glow Diffuser (standard)



Flat Diffuser with 1" Regressed (standard)

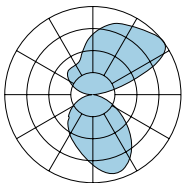
Regressed Direct



Flat Diffuser with 1" Regressed (standard)

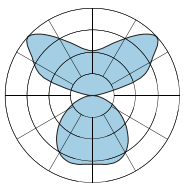
OPTIC OPTIONS

Asymmetric & Asymmetric Top Glow (**ASY / ASY-TG**)



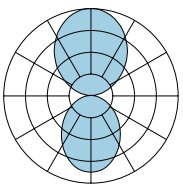
Downlight Asymmetric Optic (**DAO**)

Widespread & Widespread Top Glow (**WSO / WSO-TG**)



Downlight Spread Optic (**DSO**)

Standard Uplight Flush Optic (**F**)



Standard Downlight Flush Optic (**F**)

ALSO AVAILABLE IN

Recessed (**R**)

Wall Mount (**WM**)

Surface Mount (**SM**)

Option Available

Also available in Indigo-Clean. See Indigo-Clean Tech Sheet

Protected by one or more US Patents: 8915613; D702,391; D702,390; D700,732

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

Clear Form

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	◉ 2	○ P - Pendant ○ P RG - Pendant Regressed [1] (Wall Wash not available)	○ D - Direct ○ WW-D - Wall Wash Direct ○ ID - Indirect/Direct ○ I - Indirect	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT and LED TYPE

Uplight Output ID & I Only (Flush)	Downlight Output ID & D Only (Flush)
○ S - Standard (393 lm/ft)	○ S - Standard (322 lm/ft)
○ B - Boosted (494 lm/ft)	○ B - Boosted (405 lm/ft)
○ H - High (747 lm/ft)	○ H - High (612 lm/ft)
○ V - Very High (961 lm/ft)	◉ V - Very High (786 lm/ft)
○ TL - Tailored:_____lm/ft*	○ TL - Tailored: _____.m/ft*

Lumen provided above are for Flush lens only, see pg. 13 for WW lumens. 2ft. luminaires can only have one output only, **S** or **B**. No dual circuit or separate uplight/downlight. Uplight and downlight can be specified with different outputs and dual circuit on luminaires 3ft and longer.
* Specify Tailored lm/ft of outputs between Standard (**S**) and Very High (**V**). Consult factory for tailored lumen output outside of this range.

OUTPUT and LED TYPE

LED CRI/CCT
○ 830 - 80 CRI, 3000K
○ 835 - 80 CRI, 3500K
○ 840 - 80 CRI, 4000K
○ 930 - 90 CRI, 3000K
○ 935 - 90 CRI, 3500K
○ 940 - 90 CRI, 4000K
○ 8TW - 80 CRI, Tunable White
○ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Uplight	Downlight	Reflector System
○ TG - Top Glow (standard)	○ F - Flush (standard) [2]	◉ 96LG - 96 Low Gloss White
○ F - Flush	○ BG - Bottom Glow [2]	○ SW - Signal White for Wall Wash only
○ WSO - Widespread Optic	○ DL - 1" Drop Down Lens [2]	
○ WSOTG - Widespread Optic with Top Glow	○ RG-D - Flat Diffuser with 1" Regress [2,3]	
○ ASY-L - Asymmetric Left Optic	○ RG WCB - White Cross Blade Baffle [2,3]	
○ ASY-R - Asymmetric Right Optic	○ RG-LHE - Hollowed Ellipse Louver [2,3]	
○ ASYTG-L - Asymmetric Left Optic with Top Glow	○ RG-LHC - Hex Louver [2,3]	
○ ASYTG-R - Asymmetric Right Optic with Top Glow	○ DSO - Downlight Spread Optic [2,4]	
	○ DAO-L - Downlight Asymmetric Optic Left [2,4]	
	○ DAO-R - Downlight Asymmetric Optic Right [2,4]	
	○ K - Kicker for Wall Wash only (standard) [5]	
	○ FO - Fully Open for Wall Wash only	

ELECTRICAL OPTIONS

Voltage
○ 120 - 120 Voltage
○ 277 - 277 Voltage
○ 347 - 347 Voltage

ELECTRICAL OPTIONS

Circuiting [6]

- ○ SC - Single Circuit* — One single circuit in a run
- ○ DC - Dual Circuit* — Independent control of up and down separately in an I/D style fixture
- ○ MC - Multi-Circuit* — More than one switch leg or zone (not 'DC' indepedent control of up and down separately for an I/D style fixture). Factory shop drawings required

* Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

Driver Selection [7]

0-10V Driver Options
- ○ FC-10% - 0-10V 10% (standard)
- ○ FC-1% - 0-10V 1%
- ○ OTi-10% - EldoLED OTi, 0-10V 10% [8]
- ○ OTi-1% - EldoLED OTi, 0-10V 1% [8]
- ○ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%
- ○ 10V-TW-10% - EldoLED OTi, 0-10V 10% *(Tunable White)* [8]

DALI Driver Options
- ○ FC-DALI-1% - DALI 1%
- ○ DXL-DALI-1% - EldoLED Dexal, 1%
- ○ ELD-DALI-0% - EldoLED SOLOdrive, DALI 0.1%
- ○ ELD-DALI-TW - EldoLED Dual Drive Light Shape, 1% *(Tunable White)*

DMX Driver Options
- ○ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [9]
- ○ ELD-DMX - EldoLED POWERdrive, 0.1%
- ○ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options
- ○ LUT-ES1 - Lutron, Ecosystem 1%
- ○ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method

- ○ FA50 - Fully Adjustable 50" (standard)
- ○ FA100 - Fully Adjustable 100"
- ○ FA150 - Fully Adjustable 150"
- ○ FA200 - Fully Adjustable 200"
- ○ FA250 - Fully Adjustable 250"
- ○ FA300 - Fully Adjustable 300"
- ○ FM - Flexible Mounting [10]

COORDINATE FINAL MOUNTING REQUIRMENTS WITH SLATTED ROOF SYSTEM/ARCHITECTURAL ELEMENTS

MOUNTING OPTIONS

Ceiling Hardware Type

- ○ C1 - 15/16" T-Bar
- ○ C2 - 9/16" T-Bar
- ○ C3 - Screw Slot
- ○ C4 - Hard Ceiling
- ○ C1T - 15/16" Tegular
- ○ C2T - 9/16" Tegular

Endcap Style

- ○ FE - Flat Endcap (standard)
- ○ DE - 1" Drop Endcap [11]
- ○ OE - Open Endcap [12]

Finish

- ○ SW - Signal White (standard)
- ○ FB - Finelite Black
- ○ SA - Satin Aluminum
- ○ #### - RAL Color Code [13]

FINISH TO BE SELECTED BY ARCHITECT

OTHER OPTIONS

Emergency Style (Optional)

See page 5 Backup Battery table

Clear Selection

- ○ LGD18W - Legrand 18W Brand Battery Back-up
- ○ LGD10W - Legrand 10W Brand Battery Back-up
- ○ EM/GEN - Emergency to Generator
- ○ NL - Night Light
- ○ BSL310LP - Bodine Battery Back up Low Profile
- ○ GTD - Generator Transfer Device
- ○ ALCR - Automatic Load Control Relay

Integrated Sensor (Optional) [14]

Clear Selection

- ○ OBO - Occupancy [1,2]
- ○ OBD - Daylight [2]
- ○ W601 - Wattstopper Wireless Sensor [15]
- ○ OBE - Enlighted [2,16]
- ○ REE - Remote Enlighted [17]
- ○ VOCC - Lutron Vive Wireless Sensor (VDO) [1,19]
- ○ VRF - Lutron Vive Radio Only [1,19]

Special Options (Optional)

Clear Selection

- ○ CP - Chicago Plenum [18]
- ○ RLA - Red List Approved
- ○ RLD - Red List Declared

[1] Not available with Indirect
[2] Not available with Wall Wash
[3] D & ID Regressed only
[4] Not available with Regressed or Curves
[5] Kicker standard in Signal White. Customer Custom color kickers have a surcharge
[6] Contact factory for switching options
[7] For Indirect/Direct lengths 3' and greater, separate dimming for uplight and downlight available
[8] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO, FC-1% - DTO)
[9] B & V outputs only
[10] Direct only
[11] 1" Drop Down Lens downlight only
[12] Available with Hollowed Ellipse Louver (LHE) only
[13] 20 business days lead time for color
[14] Minimum fixture length: Direct and Indirect with a sensor is 3ft. Indirect/Direct with a sensor is 4ft.
[15] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.
[16] Enlighted components installed by Finelite, provided by others
[17] Enlighted for Wall Wash luminaires. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor
[18] Only available with C1, C2, and C3 mounting hardware with Finelite Gridbox
[19] Lutron Vive Ingrated Sensors require a DALI driver

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
10V-TW-10%	EldoLED OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
10V-TW-10%-DTO	EldoLED OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OTi-10%	EldoLED OTi, 0-10V 10% Dimming (Linear)
OTi-10%-DTO	EldoLED OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OTi-1%	EldoLED OTi, 0-10V 1% Dimming (Linear)
OTi-1%-DTO	EldoLED OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
DXL-DALI-1%	EldoLED Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (LHE), Hex Louver (LHC), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS[1]: Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, Regressed Diffuser, or White Cross Blade Baffle [3]. Corners not available with Wall Wash (**WW**), Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**) or 1" Drop Down Lens. Contact factory for Double miters using the White Cross Blade Baffle. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). 2' can only have one driver. 2' cannot have different lumen packages for uplight and downlight, cannot be dual circuit, and cannot be **H** or **V** output. For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

UPLIGHT OPTION[4]: Patented Top Glow frost white diffuser standard. 12' maximum diffuser length. 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination options include: Flush frost white snap-in diffuser, 73% transmissive, 99% diffusion; Widespread Optic (**WSO**) and Widespread Optic with Top Glow (WSOTG); WSO enables increased luminaire spacing with improved ceiling uniformity. Asymmetric optic directs light in a specific direction. **ASY-L** distributes light to the left, **ASY-R** distributed light to the right of the luminaire. Consult factory for more tailored lumen outputs.

DOWNLIGHT OPTION[5]: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), Bottom Glow (**BG**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**)[7], Hollowed Ellipse Louver (**LHE**)[7], Hex Louver (**LHC**)[7], Downlight Spread Optic (**DSO**) [6], Downlight Asymmetric Optic (**DAO**) [6], and Regressed downlight diffusers (**RG**)[7]. 1" Drop Down Lens made of highly efficient acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Spread & Downlight Asymmetric Optics are extruded lenses with a subtle ribbed appearance providing a batwing or asymmetric distribution for improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint. The standard Semi-Specular Aluminum (**SSA**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed controlling uplight and downlight together (power and dimming). Specify dual feeds for independent control of uplight and downlight. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 100%-10% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.

- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **ExpectedDdriver Lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS:

- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.

- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected Driver Lifetime.:** 100,000 hours
- **FineTune DMX:** 1%

LUTRON TUNABLE WHITE DRIVER OPTION: LUT-TW (0.1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE: 50" Fully Adjustable (**FA**) plated steel aircraft cable with safety stop hardware standard. The Flexible Mounting Bracket (FM) adjusts the suspension points to accommodate existing architecture. Suspension points adjust up to 2' in from the end of 8' or 12' fixture lengths and up to 1' in on shorter lengths. Consult factory for tailored lighting options.

[1] Not available with Wall Wash
[2] Indirect/Direct and Direct only
[3] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[4] Pendant Indirect/Direct, Pendant Regressed Indirect/Direct, and Pendant Indirect only
[5] Pendant Indirect/Direct, Pendant Regressed Indirect/Direct, Pendant Direct, and Pendant Regressed Direct only
[6] Not available with Regressed or Curves
[7] Pendant Regressed Indirect/Direct & Pendant Regressed Direct only

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

SPECIFICATIONS

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTune DMX system is specified, a DMX to RJ45 adapter is provided.

OTHER OPTIONS

ENDCAPS: Flat diecast aluminum endcaps (**FE**) add 1/4" to each end of luminaire. 1" Drop Down Lens Endcap (**DE**)[7] includes diffuse element to continue luminance of drop lens. Open Endcap (**OE**) is for use with the Hollowed Ellipse Louver (**LHE**); following the curve of the louver.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery		
	Legrand 18W	**Legrand 10W/ Bodine BSL310LP**
HP2-P-D		
Min. Housing Length	8'*	4'**
EM Lumen Output	1608	956
EM Section Illuminated	2'	2' or 4'
HP2-P-WW-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	1500	891
EM Section Illuminated	4'	4'

* Minimum fixture housing length for battery pack approved without sensor
** Exception: 5' not available, 6'+ okay

Backup Battery		
	Legrand 18W	**Legrand 10W/ Bodine BSL310LP**
HP2-P-ID		
Min. Housing Length	12'	8'
EM Lumen Output	1608	956
EM Section Illuminated	2'	2' or 4'
HP2-P-I		
Min. Housing Length	8'*	4'*
EM Lumen Output	1874	956
EM Section Illuminated	2'	2' or 4'

* Minimum fixture housing length for battery pack approved without sensor

Bodine GTD and Legrand ALCR Min. Length	
Configuration	**Min Length**
Generator	D-4'; ID-6'
Generator + OCC	D-6'; ID-8'
Daylight	D-4'; ID-6'
Generator + Daylight	D-6'; ID-8'

TUNABLE WHITE ELECTRICAL OPTIONS[8]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options. Minimum fixture length: Direct and Indirect with a sensor is 3ft. Indirect/Direct with a sensor is 4ft.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (**RAL 9005**) with semi gloss fine texture (**FB**), and Satin Aluminum (**SA**) are standard. Optional Adder: 179 RAL colors[9] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These luminaires are rated for Damp Location. Chicago Plenum options available for C1, C2, or C3 suspension using our GridBox. HP-2 can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – RLA (Red List Approved) or – RLD (Red List Declared) to your part number.

WEIGHT[10]: ID - 2.9 lb/ft; D - 2.3 lb/ft; I - 2.3 lb/ft; WW - 2.9 lb/ft

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

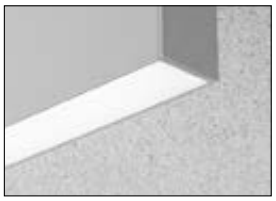
[8] Consult Finelite for Generator Transfer Device and Battery Back up fit
[9] 20 business days lead time for color
[10] Excludes Battery Back up and Generator Transfer Device weight

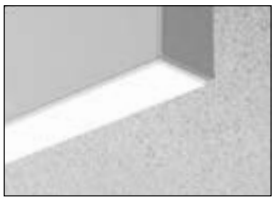
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

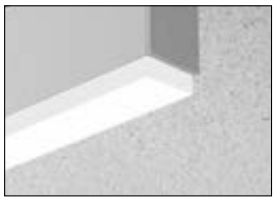
FINELITE® Better Lighting

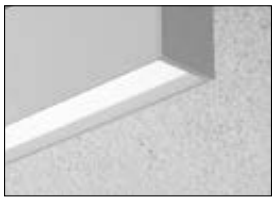
High Performance 2" Aperture (HP-2) Pendant

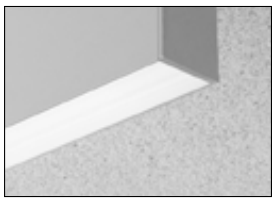
AESTHETIC OPTIONS

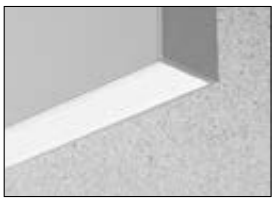

Flush Diffuser (**F**)

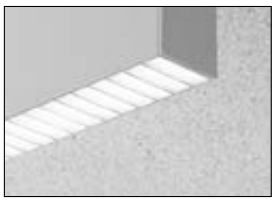

Bottom Glow Diffuser (**BG**)

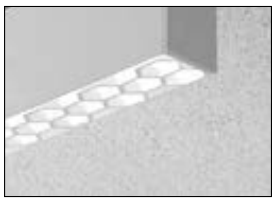

1" Drop Down Lens (**DL**)

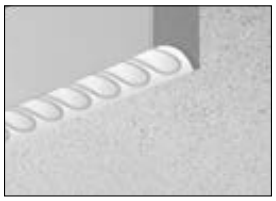

Flat Diffuser with 1" Regressed (**RG-D**)


Downlight Asymmetric Optic (**DAO**) [1]
Externally flush


Downlight Spread Optic (**DSO**) [1]
Externally flush


White Cross Blade Baffle [1] (**RG-WCB**)


Hex Louver [2] (**RG-LHC**)


Hollowed Ellipse Louver [2] (**RG-LHE**)


Kicker (**K**) - Wall Wash only

[1] With a subtle ribbed appearance providing specialized distribution
[2] Regressed only. Not available with Wall Wash

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

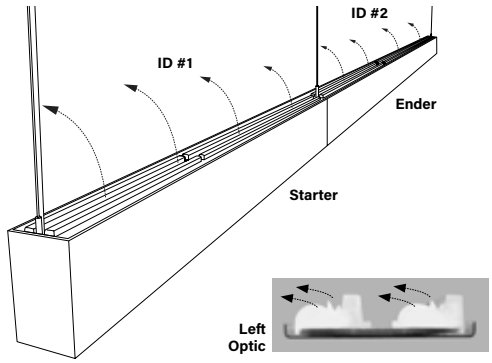
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

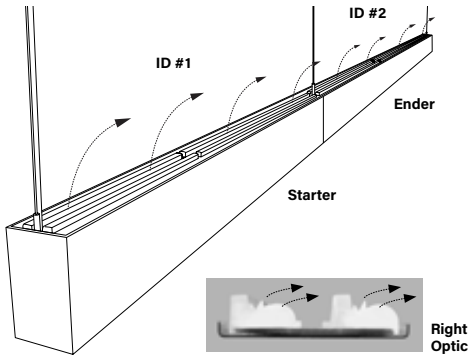
ASYMMETRIC OPTIONS

Use this tool to understand how to specify Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify ASY-L distributes light to the left or ASY-R distributes light to the right.

Asymmetric Left Optic (ASY-L)



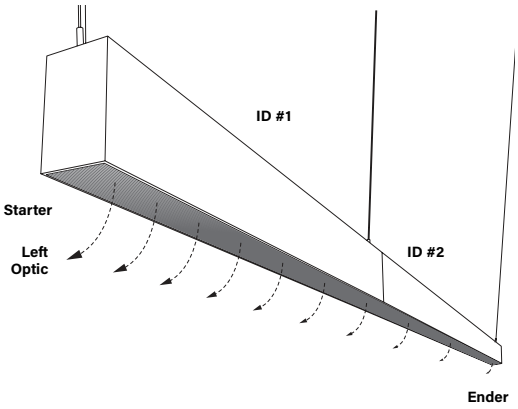
Asymmetric Right Optic (ASY-R)



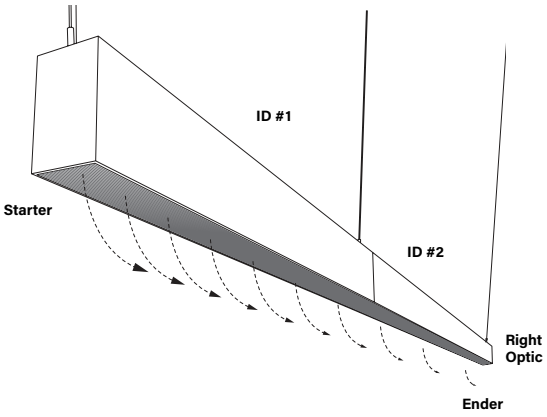
DOWNLIGHT ASYMMETRIC OPTIONS

Use this tool to understand how to specify Downlight Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify DAO-L distributes light to the left or DAO-R distributes light to the right.

Downlight Asymmetric Optic Left (DAO-L)



Downlight Asymmetric Optic Right (DAO-R)



PREINSTALLED LABEL

For DAO, Preinstalled label on diffuser shows direction of light. Remove after installation.

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

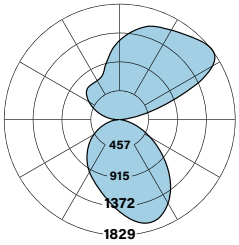
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

Indirect/Direct Photometry - 4' Luminaire 3500K

HP2-P-ID-4'-V-V-835-ASY-R-DAO-R
Uplight: Asymmetric Right Optic
Downlight: Downlight Asymmetric Optic - Right

Distribution: 53% Up (**V**) / 47% Down (**V**)
Efficacy: 112 lm/W
Uplight: 4301 lumens (1075 lumens/foot)
Downlight: 3742 lumens (936 lumens/foot)
Total luminaire output: 8043 lumens (2011 lm/ft)
72 watts (18 W/ft)
Peak Candela Value: 1829 @ 127.5°
CRI: 80 / CCT: 3500K
ITL LM79 Report REP-051921-01



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	3292 [↑53% I 47%↓]	3745 [↑59% I 41%↓]	4877 [↑69% I 31%↓]	5833 [↑74% I 26%↓]
↓B [1]	3686 [↑48% I 52%↓]	4139 [↑53% I 47%↓]	5271 [↑63% I 36%↓]	6227 [↑69% I 31%↓]
↓H [1]	4671 [↑38% I 62%↓]	5124 [↑43% I 57%↓]	6256 [↑54% I 46%↓]	7211 [↑60% I 40%↓]
↓V [2]	5503 [↑32% I 68%↓]	5955 [↑37% I 63%↓]	7087 [↑47% I 53%↓]	8043 [↑53% I 47%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	823	936	1219	1458
↓B [1]	922	1035	1318	1557
↓H [1]	1168	1281	1564	1803
↓V [2]	1376	1489	1772	2011

Power, 3500K (Watts Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.0	8.0	10.4	12.5
↓B [1]	8.0	9.0	11.4	13.5
↓H [1]	10.4	11.4	13.8	15.9
↓V [2]	12.5	13.5	15.9	18.0

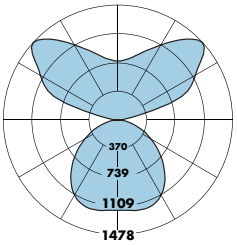
Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	117	117	117	116
↓B [1]	115	116	116	116
↓H [1]	112	113	113	113
↓V [2]	110	111	111	112

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 89456, 94139

HP2-P-ID-4'-V-V-835-WSO-DSO
Uplight: Widespread Optic
Downlight: Downlight Spread Optic

Distribution: 55% Up (**V**) / 45% Down (**V**)
Efficacy: 101 lm/W
Uplight: 4018 lumens (1105 lumens/foot)
Downlight: 3273 lumens (818 lumens/foot)
Total luminaire output: 7291 lumens (1823 lm/ft)
72 watts (18 W/ft)
Peak Candela Value: 1457 @ 135°
CRI: 80 / CCT: 3500K
ITL LM79 Report 89456 and 94139



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	2985 [↑55% I 45%↓]	3408 [↑60% I 40%↓]	4465 [↑70% I 30%↓]	5358 [↑75% I 25%↓]
↓B [1]	3329 [↑49% I 51%↓]	3752 [↑55% I 45%↓]	4809 [↑65% I 35%↓]	5702 [↑70% I 30%↓]
↓H [1]	4191 [↑39% I 61%↓]	4614 [↑45% I 55%↓]	5671 [↑55% I 45%↓]	6564 [↑61% I 39%↓]
↓V [2]	4918 [↑33% I 67%↓]	5341 [↑38% I 62%↓]	6398 [↑49% I 51%↓]	7291 [↑55% I 45%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	746	852	1116	1340
↓B [1]	832	938	1202	1426
↓H [1]	1048	1154	1418	1641
↓V [2]	1230	1335	1600	1823

Power, 3500K (Watts Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.1	8.0	10.5	12.6
↓B [1]	8.0	9.0	11.4	13.5
↓H [1]	10.4	11.4	13.8	15.9
↓V [2]	12.5	13.4	15.9	18.0

Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	106	107	107	107
↓B [1]	104	105	105	105
↓H [1]	101	102	103	103
↓V [2]	99	99	101	101

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 89456, 94139

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 4465 lm x 0.789 = 3523 lm
Total Light Output per Foot: 1116 lm/ft x 0.789 = 881 lm/ft.
watts/foot: 10.5 W/ft.

$$\textbf{Efficacy} = \frac{881\ \frac{\text{lm}}{\text{ft.}}}{10.5\ \frac{\text{W}}{\text{ft.}}} = 84\ \text{lm/W}$$

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

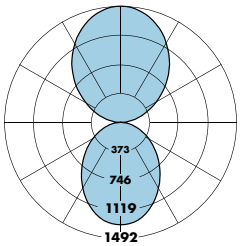
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

Indirect/Direct Photometry - 4' Luminaire 3500K

HP2-P-ID-V-V-835-F-F
Uplight: Flush Diffuser / **Downlight:** Flush Diffuser

Distribution: 55% Up (**V**) / 45% Down (**V**)
Efficacy: 95 lm/W
Uplight: 3813 lumens (953 lumens/foot)
Downlight: 3175 lumens (794 lumens/foot)
Total luminaire output: 6988 lumens (1747 lm/ft)
73.8 watts (18.5 W/ft)
Peak Candela Value: 1492 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85132



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	2861 (↑55% I 45%↓)	3262 (↑60% I 40%↓)	4265 (↑70% I 30%↓)	5113 (↑75% I 25%↓)
↓B [1]	3195 (↑49% I 51%↓)	3596 (↑55% I 45%↓)	4600 (↑65% I 35%↓)	5447 (↑70% I 30%↓)
↓H [1]	4030 (↑39% I 61%↓)	4432 (↑44% I 56%↓)	5435 (↑55% I 45%↓)	6282 (↑61% I 39%↓)
↓V [2]	4736 (↑33% I 67%↓)	5137 (↑38% I 62%↓)	6141 (↑48% I 52%↓)	6988 (↑55% I 45%↓)

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	715	815	1066	1278
↓B [1]	799	899	1150	1362
↓H [1]	1008	1108	1359	1571
↓V [2]	1184	1284	1535	1747

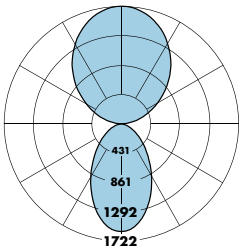
Power, 3500K (Watts Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.2	8.2	10.7	12.8
↓B [1]	8.2	9.2	11.7	13.8
↓H [1]	10.7	11.7	14.2	16.3
↓V [2]	12.8	13.8	16.3	18.5

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	99	99	100	100
↓B [1]	97	98	99	99
↓H [1]	94	95	96	96
↓V [2]	92	93	94	95

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 89132

HP2-P RG-ID-V-V-835-F
Uplight: Flush Diffuser / **Downlight:** Regressed Diffuser

Distribution: 59% Up (**V**) / 41% Down (**V**)
Efficacy: 99 lm/W
Uplight: 4304 lumens (1076 lumens/foot)
Downlight: 2928 lumens (732 lumens/foot)
Total luminaire output: 7232 lumens (1808 lm/ft)
73.2 watts (18.3 W/ft)
Peak Candela Value: 1722 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 90352



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	2960 (↑60% I 40%↓)	3414 (↑65% I 35%↓)	4546 (↑74% I 26%↓)	5503 (↑78% I 22%↓)
↓B [1]	3269 (↑54% I 46%↓)	3722 (↑60% I 40%↓)	4854 (↑69% I 31%↓)	5811 (↑74% I 26%↓)
↓H [1]	4039 (↑44% I 56%↓)	4492 (↑49% I 51%↓)	5625 (↑60% I 40%↓)	6581 (↑65% I 35%↓)
↓V [2]	4690 (↑38% I 62%↓)	5143 (↑43% I 57%↓)	6276 (↑53% I 47%↓)	7232 (↑59% I 41%↓)

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	740	853	1137	1376
↓B [1]	817	930	1214	1453
↓H [1]	1123	1406	1645	1645
↓V [2]	1172	1286	1569	1808

Power, 3500K (Watts Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.2	8.1	10.6	12.7
↓B [1]	8.1	9.1	11.6	13.7
↓H [1]	10.6	11.6	14.0	16.2
↓V [2]	12.7	13.7	16.2	18.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	103	105	107	108
↓B [1]	100	102	105	106
↓H [1]	95	97	100	102
↓V [2]	92	94	97	99

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 90352

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 4265 lm x 0.789 = 3365 lm
Total Light Output per Foot: 1066 lm/ft x 0.789 = 841 lm/ft.
watts/foot: 10.7 W/ft.

$$\textbf{Efficacy} = \frac{841\ \frac{\text{lm}}{\text{ft.}}}{10.57\ \frac{\text{W}}{\text{ft.}}} = 78.6\ \text{lm/W}$$

Submitted by:	Date:
Type:	Project:
Ordering Info:	

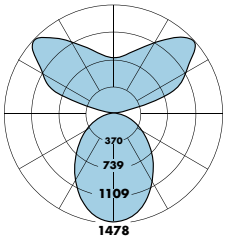
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

Indirect/Direct Photometry - 4' Luminaire 3500K

HP2-P-ID-V-V-835-WSO-F
Uplight: Widespread Optic / **Downlight:** Fluse Diffuser

Distribution: 55% Up (**V**) / 45% Down (**V**)
Efficacy: 101 lm/W
Uplight: 4018 lumens (1005 lumens/foot)
Downlight: 3312 lumens (828 lumens/foot)
Total luminaire output: 7330 lumens (1833 lm/ft)
74.5 watts (18.6 W/ft)
Peak Candela Value: 1461 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 89456



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	3001 (↑55% I 45%↓)	3424 (↑60% I 40%↓)	4481 (↑70% I 30%↓)	5374 (↑75% I 25%↓)
↓B [1]	3349 (↑49% I 51%↓)	3772 (↑55% I 45%↓)	4830 (↑65% I 35%↓)	5722 (↑70% I 30%↓)
↓H [1]	4221 (↑39% I 61%↓)	4644 (↑44% I 56%↓)	5701 (↑55% I 45%↓)	6594 (↑61% I 39%↓)
↓V [2]	4957 (↑33% I 67%↓)	5380 (↑38% I 62%↓)	6437 (↑48% I 52%↓)	7330 (↑55% I 45%↓)

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	750	856	1120	1343
↓B [1]	837	943	1207	1431
↓H [1]	1055	1161	1425	1649
↓V [2]	1239	1345	1609	1833

Power, 3500K (Watts Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.1	8.1	10.5	12.6
↓B [1]	8.1	9.0	11.5	13.6
↓H [1]	10.5	11.5	13.9	16.0
↓V [2]	12.6	13.6	16.0	18.1

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	106	106	107	107
↓B [1]	104	105	105	105
↓H [1]	100	101	102	103
↓V [2]	98	99	100	101

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 89456

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 4481 lm x 0.789 = 3536 lm
Total Light Output per Foot: 1120 lm/ft x 0.789 = 884 lm/ft.
watts/foot: 10.5 W/ft.

$$\textbf{Efficacy} = \frac{884\ \frac{\text{lm}}{\text{ft.}}}{10.5\ \frac{\text{W}}{\text{ft.}}} = 84\ \text{lm/W}$$

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

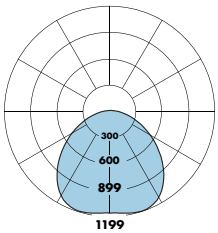
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

Direct Photometry - 4' Luminaire 3500K

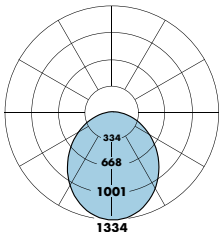
HP2-P-D-4'-V-835-DSO
Downlight: Downlight Spread Optic

Efficacy: 92 lm/W
Total luminaire output: 3273 lumens (818 lm/ft)
35.7 watts (8.9 W/ft)
Peak Candela Value: 1199 @ 17.5°
CRI: 80 / CCT: 3500K
ITL LM79 Report 94139



HP2-P-D-V-835-F
Downlight: Flush Diffuser

Efficacy: 87 lm/W
Total luminaire output: 3215 lumens (804 lm/ft)
36.9 watts (9.2 W/ft)
Peak Candela Value: 1334 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85136



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1340	1684	2546	3273

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
335	421	636	818

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.5	4.4	6.8	8.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
96	95	93	92

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 94139

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1316	1655	2501	3215

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
329	414	625	804

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.6	4.6	7.1	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
91	90	88	87

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85136

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 2546 lm x 0.789 = 2009 lm
Total Light Output per Foot: 636 lm/ft x 0.789 = 502 lm/ft.
watts/foot: 6.8 W/ft.

$$\textbf{Efficacy} = \frac{502\ \frac{\text{lm}}{\text{ft.}}}{6.8\ \frac{\text{W}}{\text{ft.}}} = 74\ \text{lm/W}$$

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

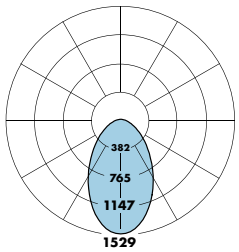
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

Direct Photometry - 4' Luminaire 3500K

HP2-P RG-D-V-835-RG
Downlight: Regressed Diffuser

Efficacy: 79 lm/W
Total luminaire output: 2887 lumens (722 lm/ft)
36.7 watts (9.2 W/ft)
Peak Candela Value: 1529 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 90350



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B** [1]	**H** [1]	**V** [2]
1182	1486	2245	2887

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
295	371	561	722

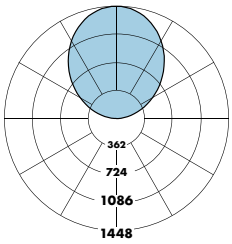
Power, 3500K (Watts Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
3.6	4.6	7.0	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B** [1]	**H** [1]	**V** [2]
82	81	80	79

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 90350

HP2-P-I-V-835-F
Uplight: Flush Diffuser

Efficacy: 102 lm/W
Total luminaire output: 3749 lumens (937 lm/ft)
36.7 watts (9.2 W/ft)
Peak Candela Value: 1448 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85134



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B** [1]	**H** [1]	**V** [2]
1535	1929	2916	3749

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
384	482	729	937

Power, 3500K (Watts Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
3.6	4.6	7.0	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B** [1]	**H** [1]	**V** [2]
107	106	104	102

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85134

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 2245 lm x 0.789 = 1771 lm
Total Light Output per Foot: 561 lm/ft x 0.789 = 443 lm/ft.
watts/foot: 7.0 W/ft.

$$\textbf{Efficacy} = \frac{443\ \frac{\text{lm}}{\text{ft.}}}{7.0\ \frac{\text{W}}{\text{ft.}}} = 63\ \text{lm/W}$$

Submitted by:	Date:
Type:	Project:
Ordering Info:	

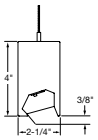
FINELITE® Better Lighting

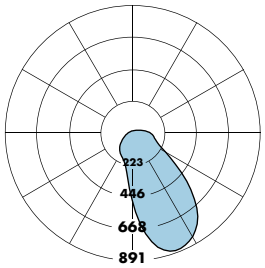
High Performance 2" Aperture (HP-2) Pendant

Wall Wash Direct Photometry - 4' Luminaire 3500K

HP2-P-WW-D-K-V-835
Downlight: With Kicker

Efficacy: 77 lm/W
Total luminaire output: 1500 lumens (375 lm/ft)
19.6 watts (4.9 W/ft)
Peak Candela Value: 882 @ 25°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85137





CANDELA DISTRIBUTION

FLUX	0.0	22.5	45.0	67.5	90.0	
0	485	485	485	485	485	
5	652	606	483	378	342	47
15	863	790	470	251	219	145
25	882	829	442	201	184	231
35	795	764	397	168	152	282
45	581	629	333	133	105	277
55	326	436	251	86	62	217
65	196	250	167	43	24	144
75	158	145	88	7	0	87
85	124	97	24	0	0	50
90	93	68	0	0	0	

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B [1]**	**H [1]**	**V [2]**
614	772	1167	1500

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
154	193	292	375

Power, 3500K (Watts Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
2.0	2.5	3.8	4.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B [1]**	**H [1]**	**V [2]**
76	77	77	77

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 1167 lm x 0.789 = 921 lm

Total Light Output per Foot: 292 lm/ft x 0.789 = 230 lm/ft.

watts/foot: 3.8 W/ft.

$$\textbf{Efficacy} = \frac{230\ \frac{\text{lm}}{\text{ft.}}}{3.8\ \frac{\text{W}}{\text{ft.}}} = 60.5\ \text{lm/W}$$

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85137

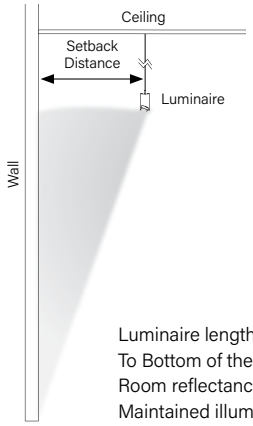
Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2) Pendant

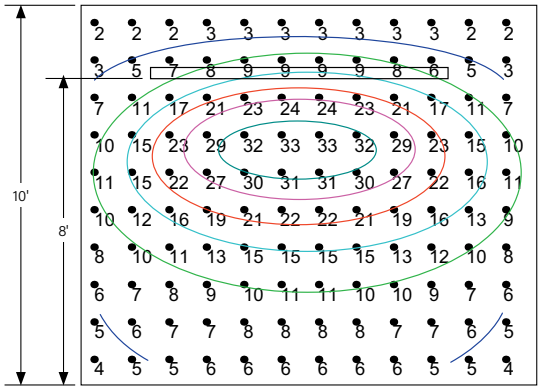
Wall Wash Direct - Setback Info and Application Data

HP2-WW-D-K-4'-V-835
Downlight: With Kicker
Total luminaire output: 1206 lumens (302 lm/ft)
19.6 watts (4.9 W/ft)
CRI: 80 / CCT: 3500K



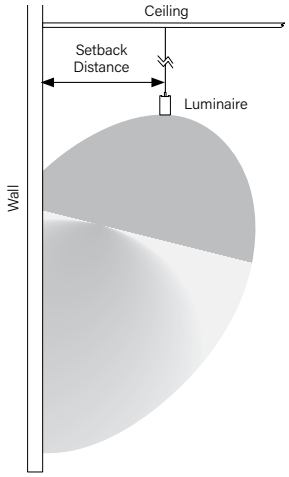
Luminaire length: 8'
To Bottom of the luminaire: 8'-0"
Room reflectances: 80-50-20
Maintained illuminance levels: LLF 0.86"

Setback Distance - 2'

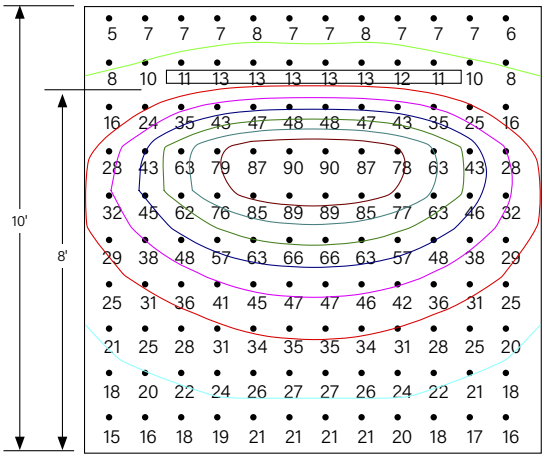


Downlight Asymmetric Optic - Setback Info and Application Data

HP2-P-D-4ft-V-835-DAO
Downlight: DAO
Total luminaire output: 3742 lumens (936 lm/ft)
35.6 watts (8.9 W/ft)
CRI: 80 / CCT: 3500K



Setback Distance - 2'



Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

0-10V Tunable White

Finelite's award-winning, contractor friendly Tunable White luminaires are available at low cost, with powerful and simple 0-10V tuning and intensity controls.

TUNABLE WHITE FEATURES

- CCT range: 2700K - 6500K
- Dimming Range: 100% to 10%
- CRI Options: 80 CRI or 90 CRI

PHOTOMETRY

Apply a power adjustment factor to calculate wattage usage

POWER	CONVERSION FACTOR
	1.1X

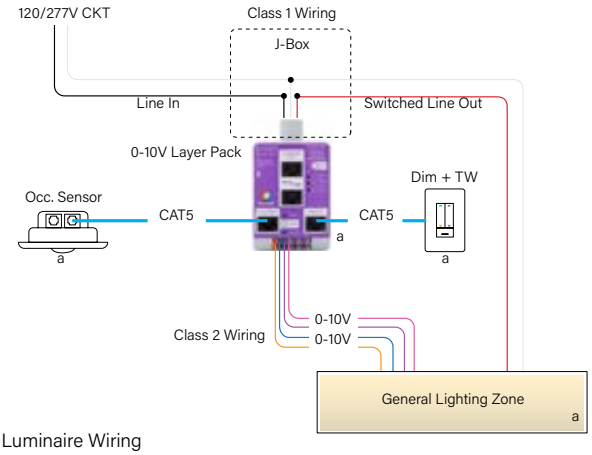
(Example: a 50 watt luminaire in static white would draw 55 watts using 0-10V Tunable White)

LUMINAIRE FAMILY MODIFICATIONS/RESTRICTIONS

	Section Lengths										
Direct	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'
Output S,B,H,V Single Circuit	Rows can be comprised of 2'-12' sections. Tailored lengths available.										
Integral Battery Backup (BSL310LP)							✓		✓		✓
Indirect/Direct											
Output S,B Single Circuit	✓		✓		✓		✓		✓		✓
Integral Battery Backup (BSL310LP)							✓		✓		✓
Output H,V Single Circuit			✓				✓				✓
Integral Battery Not Available	Remote Battery backup solution available. Consult factory for tailored lighting options.										
Output S,B,H,V Dual Circuit			✓				✓				✓
Integral Battery Not Available	Remote Battery backup solution available. Consult factory for tailored lighting options.										

EN/GEN sections available for all body lengths

WIRING DIAGRAM - DIMMABLE TO 10%

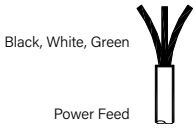


Luminaire Wiring

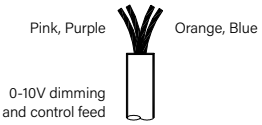
- **Purple** (+) / **Pink** (-) control wires are for intensity control
- **Orange** (+) / **Blue** (-) control wires are for Tunable White control

Note:
Load or Dim to Off options available.

DUAL FEED DETAIL



WIRING LEGEND		
Black	Hot	Line Voltage
White	Neutral	Line Voltage
Green	Ground	



WIRING LEGEND		
Pink	Dimming	0-10V DC
Purple	Dimming	0-10V DC
Orange	TW	0-10V DC
Blue	TW	0-10V DC

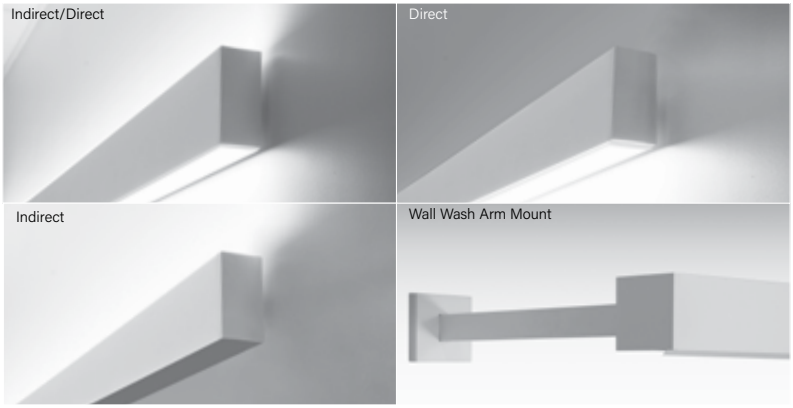
Tunable White LUMINAIRES

TYPE L16

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount



Signal White is standard finish

High Performance 2" Aperture is a patented, linear LED luminaire family. HP-2 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

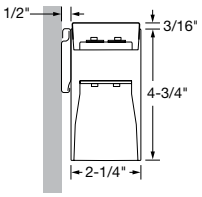
This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Red List Declared** status.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

Note: see page 6 for all aesthetic options

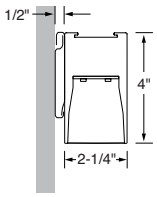
CROSS SECTIONS

Indirect/Direct
Top Glow Diffuser (standard)



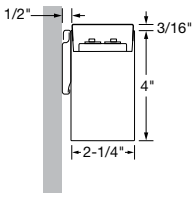
Flush Downlight Diffuser (standard)

Direct

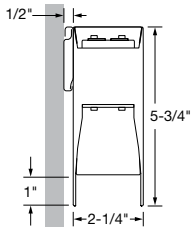


Flush Downlight Diffuser (standard)

Indirect
Top Glow Diffuser (standard)

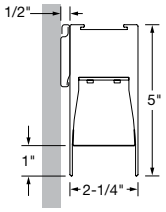


Indirect/Direct Regressed
Top Glow Diffuser (standard)



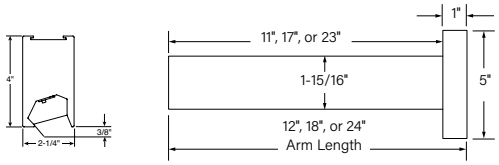
Flat Diffuser with 1" Regress (standard)

Direct Regressed



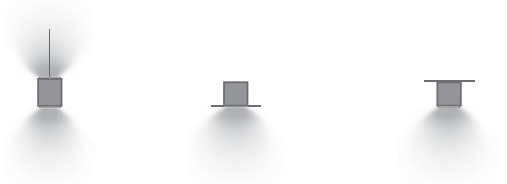
Flush Downlight Diffuser (standard)

Wall Wash Arm Mount



Kicker (standard)

ALSO AVAILABLE IN



Pendant (**D, ID, I**)

Recessed (**R**)

Surface Mount (**SM**)

Also available in Indigo-Clean. See Indigo-Clean Tech Sheet

Submitted by:	Date:
Type:	Project:
Ordering Info:	

FINELITE® Better Lighting

Clear Form

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	◉ 2	◯ WM - Wall Mount [1] ◯ WM RG - Wall Mount Regressed [1] ◯ AM - Arm Mount ◯ AM RG - Arm Mount Regressed	**Wall Mount** ◯ D - Direct ◯ ID - Indirect/Direct ◯ I - Indirect **Arm Mount** ◯ D - Direct ◯ ID - Indirect/Direct ◯ I - Indirect (Not available for **AM RG**) ◯ WW-D - Wall Wash Direct (Not available for **AM RG**)	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT AND LED TYPE

~~Uplight Output~~ ID & I Only (Flush)	Downlight Output ID & D Only (Flush)
◯ S - Standard (393 lm/ft)	◯ S - Standard (322 lm/ft)
◯ B - Boosted (494 lm/ft)	◯ B - Boosted (405 lm/ft)
◯ H - High (747 lm/ft)	◯ H - High (612 lm/ft)
◯ V - Very High (961 lm/ft)	◯ V - Very High (786 lm/ft)
◯ TL - Tailored: lm/ft*	◯ TL - Tailored: lm/ft*

Lumen provided above are for Flush lens only, see pg. 13 for WW lumens. 2ft. luminaires can only have one output only, **S** or **B**. No dual circuit or separate uplight/downlight. Uplight and downlight can be specified with different outputs and dual circuit on luminaires 3ft and longer.
* Specify Tailored lm/ft of outputs between Standard (**S**) and Very High (**V**). Consult factory for tailored lumen output outside of this range.

OUTPUT AND LED TYPE

LED CRI/CCT
◯ 830 - 80 CRI, 3000K
◯ 835 - 80 CRI, 3500K
◯ 840 - 80 CRI, 4000K
◯ 930 - 90 CRI, 3000K
◯ 935 - 90 CRI, 3500K
◯ 940 - 90 CRI, 4000K
◯ 8TW - 80 CRI, Tunable White
◯ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

~~Uplight~~	Downlight	Reflector System
◯ TG - Top Glow (standard)	◯ F - Flush (standard) [1]	◯ 96LG - 96 Low Gloss White
◯ F - Flush	◯ BG - Bottom Glow [1]	◯ SW - Signal White for Wall Wash only
◯ ASY-L - Asymmetric Left Optic	◯ DL - 1" Drop Down Lens [1]	
◉ ASY-R - Asymmetric Right Optic	◯ RG-D - Flat Diffuser with 1" Regress [1,2]	
◯ ASYTG-L - Asymmetric Left Optic with Top Glow	◯ RG-WCB - White Cross Blade Baffle [1,2]	
◯ ASYTG-R - Asymmetric Right Optic with Top Glow	◯ RG-LHE - Hollowed Ellipse Louver [1,2]	
◯ WSO - Widespread Optic	◯ RG-LHC - Hex Louver [1,2]	
◯ WSOTG - Widespread Optic with Top Glow	◯ DAO-L - Downlight Asymmetric Optic Left [3]	
	◯ DAO-R - Downlight Asymmetric Optic Right [3]	
	◯ K - Kicker for Wall Wash only (standard) [4]	
	◯ FO - Fully Open for Wall Wash only	

ELECTRICAL OPTIONS

Voltage	Circuiting [5]
◯ 120 - 120 Voltage	◯ SC - Single Circuit* One single circuit in a run
◯ 277 - 277 Voltage	◯ DC - Dual Circuit* [6] Independent control of up and down separately in an I/D style fixture
◯ 347 - 347 Voltage	◯ MC - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required
	* Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

Driver Selection	
0-10V Driver Options	**DMX Driver Options**
◯ FC-10% - 0-10V 10% (standard)	◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [8]
◯ FC-1% - 0-10V 1%	◯ ELD-DMX - EldoLED POWERdrive, 0.1%
◯ OTi-10% - EldoLED OTi, 0-10V 10% [7]	◯ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*
◯ OTi-1% - EldoLED OTi, 0-10V 1% [7]	**Lutron Driver Options**
◯ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%	◯ LUT-ES1 - Lutron, Ecosystem 1%
◯ 10V-TW-10% - EldoLED OTi, 0-10V 10% *(Tunable White)* [7]	◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*
DALI Driver Options	
◯ FC-DALI-1% - DALI 1%	See Page 3 for additional driver options and details
◯ DXL-DALI-1% - EldoLED Dexal, 1%	
◯ ELD-DALI-0% - EldoLED SOLOdrive, 0.1%	
◯ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*	

MOUNTING OPTIONS

Mounting Method
◯ MB - Mounting Bracket [9]
◯ AM12 - 12" [10]
◯ AM18 - 18" [10]
◯ AM24 - 24" [10]

FINISH TO BE SELECTED BY ARCHITECT

OTHER OPTIONS

Endcap Style	Finish
◯ FE - Flat Endcap (standard)	◯ SW - Signal White (standard)
◯ DE - 1" Drop Endcap [11]	◯ FB - Finelite Black
◯ OE - Open Endcap [12]	◯ SA - Satin Aluminum
	◯ #### - RAL Color Code [13] _____

Emergency Style (Optional) See page 5 Backup Battery table — Clear Selection
◯ LGD18W - Legrand 18W Brand Battery Back-up
◯ LGD10W - Legrand 10W Brand Battery Back-up
◯ EM/GEN - Emergency to Generator
◯ NL - Night Light
◯ BSL310LP - Bodine Battery Back up Low Profile
◯ GTD - Generator Transfer Device
◯ ALCR - Automatic Load Control Relay

Integrated Sensor (Optional) [14] — Clear Selection
◯ OBO - Occupancy [1] (Not available with Indirect)
◯ OBD - Daylight [1]
◯ W601 - Wattstopper Wireless Sensor [15]
◯ OBE - Enlighted [1,16]
◯ REE - Remote Enlighted [17]
◯ VOCC - Lutron Vive Wireless Sensor (VDO) [18]
◯ VRF - Lutron Vive Radio Only [18]

Special Options (Optional) — Clear Selection
◯ RLA - Red List Approved
◯ RLD - Red List Declared

[1] Not available for Wall Wash
[2] D & ID Regressed only
[3] Not available with regressed
[4] Kicker standard in Signal White. Customer Custom color kickers have a surcharge
[5] Contact factory for switching options
[6] Indirect/Direct only
[7] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO, FC-1% - DTO)
[8] B & V outputs only
[9] Wall Mount only
[10] Arm Mount only
[11] 1" Drop Down Lens downlight only
[12] Available with Hollowed Ellipse Louver (LHE) only
[13] 20 business days lead time for color
[14] Minimum fixture length: Direct and Indiret with a sensor is 3ft. Indirect/Direct with a sensor is 4ft.
[15] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.
[16] Enlighted components installed by Finelite, provided by others.
[17] Enlighted for Wall Wash fixtures. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor.
[18] Lutron Vive Ingrated Sensors require a DALI driver. **Not available with Indirect**.

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
10V-TW-10%	EldoLED OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
10V-TW-10%-DTO	EldoLED OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OTi-10%	EldoLED OTi, 0-10V 10% Dimming (Linear)
OTi-10%-DTO	EldoLED OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OTi-1%	EldoLED OTi, 0-10V 1% Dimming (Linear)
OTi-1%-DTO	EldoLED OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
DXL-DALI-1%	EldoLED Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE®
Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS[1]: Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, Regressed Diffuser, or White Cross Blade Baffle[3]. Corners not available with Wall Wash (**WW-D**), Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**), 1" Drop Down Lens. Contact factory for Double miters using the White Cross Blade Baffle. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

UPLIGHT OPTION[4]: Patented Top Glow frost white diffuser standard. 12' maximum diffuser length. 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination Optional: Flush frost white snap-in diffuser, 73% transmissive, 99% diffusion; Widespread Optic (**WSO**) and Widespread Optic with Top Glow (WSOTG); WSO enables increased luminaire spacing with improved ceiling uniformity. Asymmetric optic directs light in a specific direction. **ASY-L** distributes light to the left, **ASY-R** distributed light to the right of the luminaire. Consult factory for more tailored lumen outputs.

DOWNLIGHT OPTION[5]: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), Bottom Glow (**BG**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**)[6], Hollowed Ellipse Louver (**LHE**)[6], Hex Louver (**LHC**)[6], Downlight Asymmetric Optic (**DAO**)[7], and Regressed downlight diffusers (**RG**). 1" Drop Down Lens made of highly efficient acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Asymmetric Optic is an extruded lens with a subtle ribbed appearance providing an asymmetric distribution for improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Wall Mount: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white power coat paint. **Arm Mount**: The standard Signal White (**SW**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL FEATURES

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed controlling uplight and downlight together (power and dimming). Specify dual feeds for independent control of uplight and downlight. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.

- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:

- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.

- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime.:** 100,000 hours
- **FineTune DMX:** 1%

LUTRON TUNABLE WHITE DRIVER OPTION: LUT-TW (1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE: Wall Mount: Luminaire hangs securely from mounting brackets fastened directly to the wall for easy installation. Luminaire stands 1/2" off the wall. The mounting bracket is concealed behind the luminaire. **Arm Mount**: bracket mounts directly to wall j-box, extends luminaire 12", 18", or 24" from wall. Other lengths available. Consult factory.

[1] Not available with Wall Wash
[2] Indirect/Direct and Direct only
[3] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[4] Wall Mount Indirect/Direct, Wall Mount Regressed Indirect/Direct, and Wall Mount Indirect only
[5] Wall Mount Indirect/Direct, Wall Mount Regressed Indirect/Direct, Wall Mount Direct, and Wall Mount Regressed Direct only
[6] Wall Mount Regressed Indirect/Direct & Wall Mount Regressed Direct only
[7] Not available with Regressed

Continued

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE®
Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

SPECIFICATIONS

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of luminaire runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER OPTIONS

ENDCAPS: Flat diecast aluminum endcaps (**FE**) add 1/4" to each end of luminaire. 1" Drop Down Lens Endcap (**DE**)[8] includes diffuse element to continue luminance of drop lens. Open Endcap (**OE**) is for use with the Hollowed Ellipse Louver (**LHE**); following the curve of the louver.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery. Factory choice low-profile backup battery available. 8' minimum luminaire length for low profile battery pack.

Backup Battery

	Legrand 18W	Legrand 10W/ Bodine BSL310LP
HP2-P-WM-D		
Min. Housing Length	8'*	4'**
EM Lumen Output	1608	956
EM Section Illuminated	2'	2' or 4'
HP2-P-WW-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	1500	891
EM Section Illuminated	4'	4'

* Minimum fixture housing length for battery pack approved without sensor
** Exception: 5' not available, 6'+ okay

Backup Battery

	Legrand 18W	Legrand 10W/ Bodine BSL310LP
HP2-P-WM-ID		
Min. Housing Length	12'	8'
EM Lumen Output	1608	956
EM Section Illuminated	2'	2' or 4'
HP2-P-WM-I		
Min. Housing Length	8'*	4'*
EM Lumen Output	1874	956
EM Section Illuminated	2'	2' or 4'

* Minimum fixture housing length for battery pack approved without sensor

Bodine GTD and Legrand ALCR Min. Length

Configuration	Min Length
Generator	D-4'; I-4'; ID-6'
Generator + OCC	D-6'; I-6'; ID-8'
Daylight	D-4'; I-4'; ID-6'
Generator + Daylight	D-6'; I-6'; ID-8'

Indirect/Direct: backup batteries deliver 1608 lumens. 12' minimum luminaire length. 2' illuminated (downlight standard).

- **Direct:** backup batteries deliver 1608 lumens. 8' minimum luminaire length. 2' illuminated.
- **Indirect:** backup batteries deliver 1874 lumens. 8' minimum luminaire length. 2' illuminated.
- **Wall Wash:** backup batteries deliver 1500 lumens. 8' minimum luminaire length. 2' illuminated.

Tunable White ELECTRICAL OPTIONS[9]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options. Minimum fixture length: Direct and Indiret with a sensor is 3ft. Indirect/ Direct with a sensor is 4ft..

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**), and Satin Aluminum (**SA**) are standard. Optional Adder: 179 RAL colors[10] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These fixtures are rated for Damp Location. HP-2 can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Red List Declared) to your part number.

WEIGHT[11]: ID - 2.9 lb/ft; D - 2.3 lb/ft; I - 2.3 lb/ft; AM - 2.9 lb/ft (luminaire only)

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

[8] Available in Indirect/Direct Regressed & Direct Regressed only
[9] Consult Finelite for Generator Transfer Device and Battery Back up fit
[10] 20 business days lead time for color
[11] Excludes Battery Back up and Generator Transfer Device weight

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

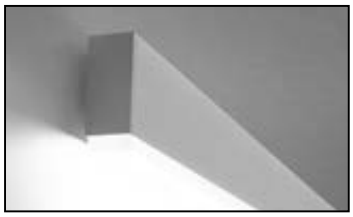
FINELITE®
Better Lighting

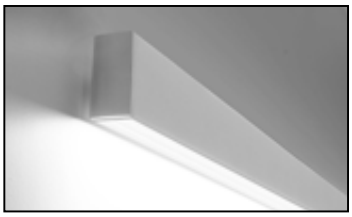
High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

AESTHETIC OPTIONS

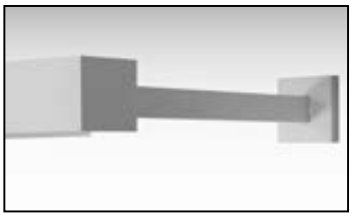

Flush Diffuser (**F**)

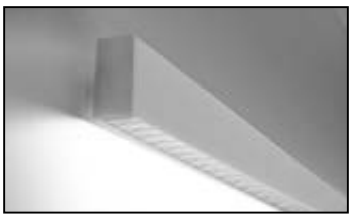

Bottom Glow Diffuser (**BG**)

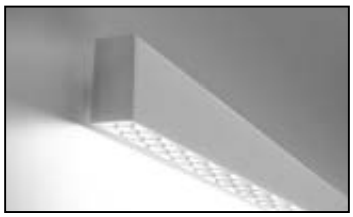

1" Drop Down Lens (**DL**)

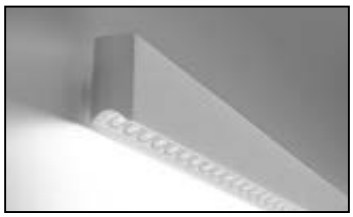

Downlight Asymmetric Optic (**DAO**)[1]
Externally flush


Flat Diffuser with 1" Regressed (**RG-D**)


Kicker (**K**) - Wall Wash Arm Mount only


White Cross Blade Baffle[2] (**RG-WCB**)


Hex Louver[2] (**RG-LHC**)


Hollowed Ellipse Louver[2] (**RG-LHE**)

[1] With a subtle ribbed appearance providing an asymmetric distribution
[2] Regressed only

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

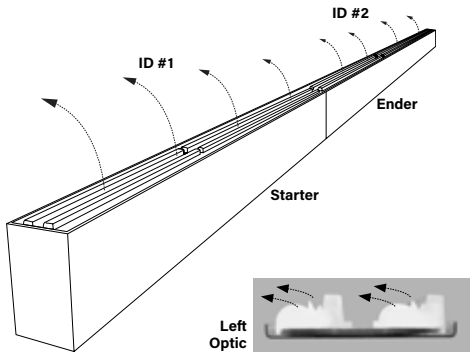
FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

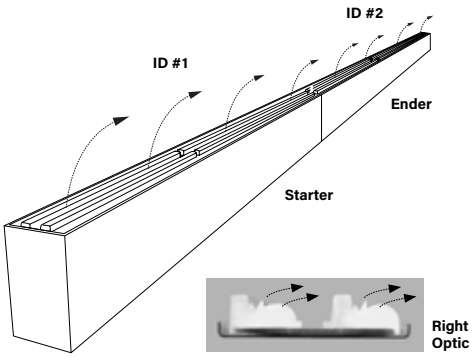
ASYMMETRIC OPTIONS

Use this tool to understand how to specify Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify ASY-L distributes light to the left or ASY-R distributes light to the right.

Asymmetric Left Optic (ASY-L)



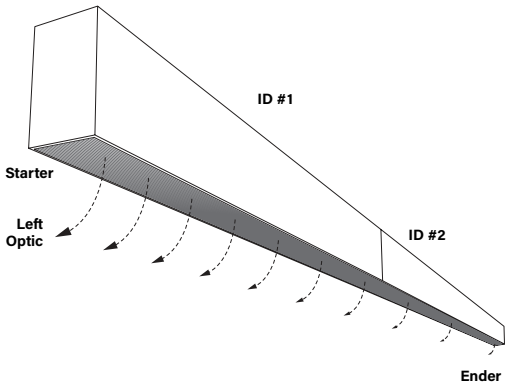
Asymmetric Right Optic (ASY-R)



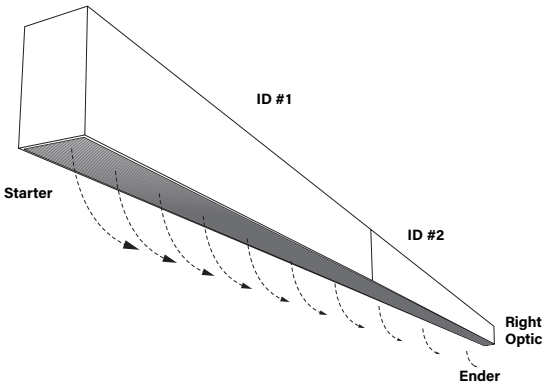
DOWNLIGHT ASYMMETRIC OPTIONS

Use this tool to understand how to specify Downlight Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify DAO-L distributes light to the left or DAO-R distributes light to the right.

Downlight Asymmetric Optic Left (DAO-L)



Downlight Asymmetric Optic Right (DAO-R)



PREINSTALLED LABEL

For DAO, Preinstalled label on diffuser shows direction of light. Remove after installation.

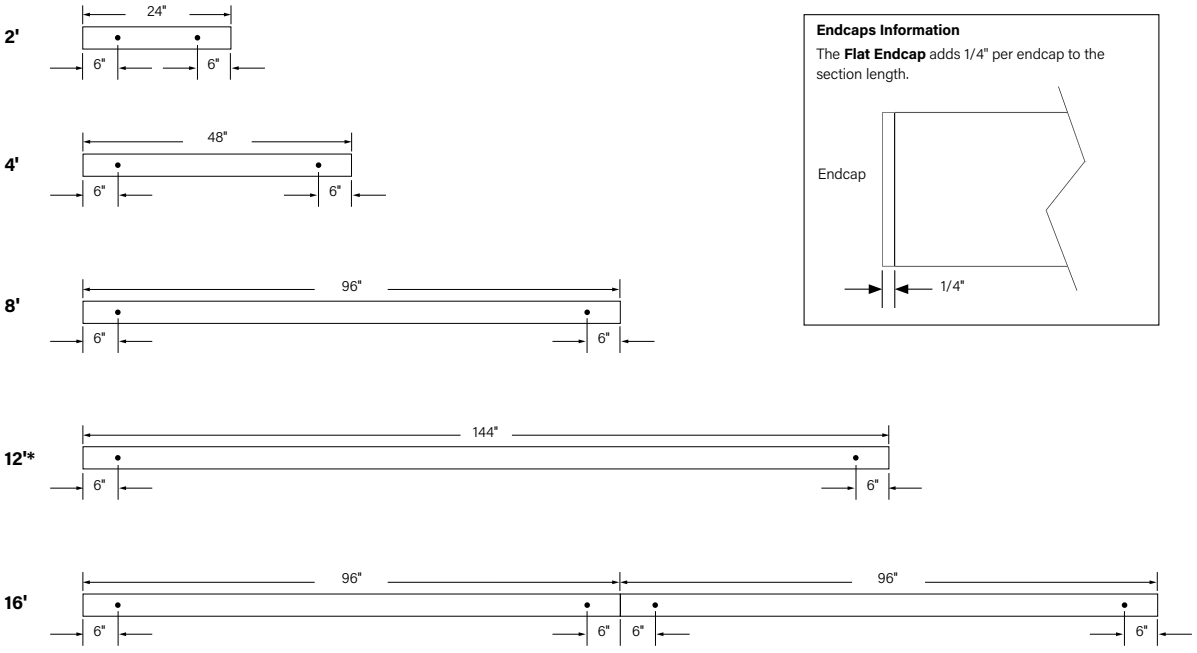
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

WALL WASH ARM MOUNT - Run Lengths & Mounting Location Examples

Tailored Lengths Available Down To 1/16" (±1/32")



Endcaps Information

The **Flat Endcap** adds 1/4" per endcap to the section length.

▪ = Bracket Location
* = 12' Maximum spacing for two Arm Mount supports

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

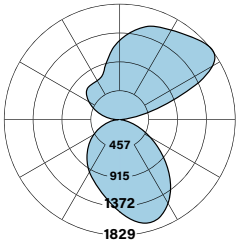
FINELITE®
Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

Indirect/Direct Photometry - 4' Luminaire 3500K

HP2-P-ID-4'-V-V-835-ASY-R-DAO-R
Uplight: Asymmetric Right Optic
Downlight: Downlight Asymmetric Optic - Right

Distribution: 53% Up (**V**) / 47% Down (**V**)
Efficacy: 112 lm/W
Uplight: 4301 lumens (1075 lumens/foot)
Downlight: 3742 lumens (936 lumens/foot)
Total luminaire output: 8043 lumens (2011 lm/ft)
72 watts (18 W/ft)
Peak Candela Value: 1829 @ 127.5°
CRI: 80 / CCT: 3500K
ITL LM79 Report REP-051921-01



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	3292 [↑53% I 47%↓]	3745 [↑59% I 41%↓]	4877 [↑69% I 31%↓]	5833 [↑74% I 26%↓]
↓B [1]	3686 [↑48% I 52%↓]	4139 [↑53% I 47%↓]	5271 [↑63% I 36%↓]	6227 [↑69% I 31%↓]
↓H [1]	4671 [↑38% I 62%↓]	5124 [↑43% I 57%↓]	6256 [↑54% I 46%↓]	7211 [↑60% I 40%↓]
↓V [2]	5503 [↑32% I 68%↓]	5955 [↑37% I 63%↓]	7087 [↑47% I 53%↓]	8043 [↑53% I 47%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	823	936	1219	1458
↓B [1]	922	1035	1318	1557
↓H [1]	1168	1281	1564	1803
↓V [2]	1376	1489	1772	2011

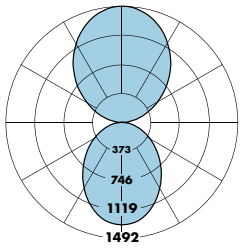
Power, 3500K (Watts Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.0	8.0	10.4	12.5
↓B [1]	8.0	9.0	11.4	13.5
↓H [1]	10.4	11.4	13.8	15.9
↓V [2]	12.5	13.5	15.9	18.0

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	117	117	117	116
↓B [1]	115	116	116	116
↓H [1]	112	113	113	113
↓V [2]	110	111	111	112

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 89456, 94139

HP2-P-ID-V-V-835-F-F
Uplight: Flush Diffuser
Downlight: Flush Diffuser

Distribution: 55% Up (**V**) / 45% Down (**V**)
Efficacy: 95 lm/W
Uplight: 3813 lumens (953 lumens/foot)
Downlight: 3175 lumens (794 lumens/foot)
Total luminaire output: 6988 lumens (1747 lm/ft)
73.8 watts (18.5 W/ft)
Peak Candela Value: 1492 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85132



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	2861 (↑55% I 45%↓)	3262 (↑60% I 40%↓)	4265 (↑70% I 30%↓)	5113 (↑75% I 25%↓)
↓B [1]	3195 (↑49% I 51%↓)	3596 (↑55% I 45%↓)	4600 (↑65% I 35%↓)	5447 (↑70% I 30%↓)
↓H [1]	4030 (↑39% I 61%↓)	4432 (↑44% I 56%↓)	5435 (↑55% I 45%↓)	6282 (↑61% I 39%↓)
↓V [2]	4736 (↑33% I 67%↓)	5137 (↑38% I 62%↓)	6141 (↑48% I 52%↓)	6988 (↑55% I 45%↓)

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	715	815	1066	1278
↓B [1]	799	899	1150	1362
↓H [1]	1008	1108	1359	1571
↓V [2]	1184	1284	1535	1747

Power, 3500K (Watts Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.2	8.2	10.7	12.8
↓B [1]	8.2	9.2	11.7	13.8
↓H [1]	10.7	11.7	14.2	16.3
↓V [2]	12.8	13.8	16.3	18.5

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	99	99	100	100
↓B [1]	97	98	99	99
↓H [1]	94	95	96	96
↓V [2]	92	93	94	95

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 89132

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 4265 lm x 0.789 = 3365 lm
Total Light Output per Foot: 1066 lm/ft x 0.789 = 841 lm/ft.
watts/foot: 10.5 W/ft.

$$\textbf{Efficacy} = \frac{841\ \frac{\text{lm}}{\text{ft.}}}{10.7\ \frac{\text{W}}{\text{ft.}}} = 79\ \text{lm/W}$$

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

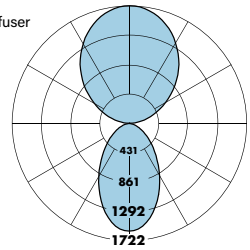
High Performance 2" Aperture (HP-2)

Wall Mount and Arm Mount

Indirect/Direct Photometry - 4' Luminaire 3500K

HP2-P RG-ID-V-V-835-F
Uplight: Flush Diffuser / **Downlight:** Regressed Diffuser

Distribution: 59% Up (**V**) / 41% Down (**V**)
Efficacy: 99 lm/W
Uplight: 4304 lumens (1076 lumens/foot)
Downlight: 2928 lumens (732 lumens/foot)
Total luminaire output: 7232 lumens (1808 lm/ft)
73.2 watts (18.3 W/ft)
Peak Candela Value: 1722 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 90352



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	2960 (↑60% I 40%↓)	3414 (↑65% I 35%↓)	4546 (↑74% I 26%↓)	5503 (↑78% I 22%↓)
↓B [1]	3269 (↑54% I 46%↓)	3722 (↑60% I 40%↓)	4854 (↑69% I 31%↓)	5811 (↑74% I 26%↓)
↓H [1]	4039 (↑44% I 56%↓)	4492 (↑49% I 51%↓)	5625 (↑60% I 40%↓)	6581 (↑65% I 35%↓)
↓V [2]	4690 (↑38% I 62%↓)	5143 (↑43% I 57%↓)	6276 (↑53% I 47%↓)	7232 (↑59% I 41%↓)

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	740	853	1137	1376
↓B [1]	817	930	1214	1453
↓H [1]	1123	1406	1645	1645
↓V [2]	1172	1286	1569	1808

Power, 3500K (Watts Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.2	8.1	10.6	12.7
↓B [1]	8.1	9.1	11.6	13.7
↓H [1]	10.6	11.6	14.0	16.2
↓V [2]	12.7	13.7	16.2	18.3

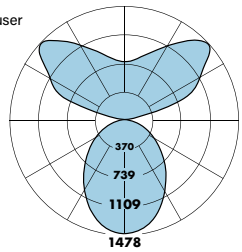
Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	103	105	107	108
↓B [1]	100	102	105	106
↓H [1]	95	97	100	102
↓V [2]	92	94	97	99

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 90352

HP2-P-ID-V-V-835-WSO-F
Uplight: Widespread Optic / **Downlight:** Fluse Diffuser

Distribution: 55% Up (**V**) / 45% Down (**V**)
Efficacy: 101 lm/W
Uplight: 4018 lumens (1005 lumens/foot)
Downlight: 3312 lumens (828 lumens/foot)
Total luminaire output: 7330 lumens (1833 lm/ft)
74.5 watts (18.6 W/ft)
Peak Candela Value: 1461 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 89456



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	3001 (↑55% I 45%↓)	3424 (↑60% I 40%↓)	4481 (↑70% I 30%↓)	5374 (↑75% I 25%↓)
↓B [1]	3349 (↑49% I 51%↓)	3772 (↑55% I 45%↓)	4830 (↑65% I 35%↓)	5722 (↑70% I 30%↓)
↓H [1]	4221 (↑39% I 61%↓)	4644 (↑44% I 56%↓)	5701 (↑55% I 45%↓)	6594 (↑61% I 39%↓)
↓V [2]	4957 (↑33% I 67%↓)	5380 (↑38% I 62%↓)	6437 (↑48% I 52%↓)	7330 (↑55% I 45%↓)

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	750	856	1120	1343
↓B [1]	837	943	1207	1431
↓H [1]	1055	1161	1425	1649
↓V [2]	1239	1345	1609	1833

Power, 3500K (Watts Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.1	8.1	10.5	12.6
↓B [1]	8.1	9.0	11.5	13.6
↓H [1]	10.5	11.5	13.9	16.0
↓V [2]	12.6	13.6	16.0	18.1

Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	106	106	107	107
↓B [1]	104	105	105	105
↓H [1]	100	101	102	103
↓V [2]	98	99	100	101

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 89456

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 4265 lm x 0.789 = 3365 lm
Total Light Output per Foot: 1066 lm/ft x 0.789 = 841 lm/ft.
watts/foot: 10.7 W/ft.

$$\textbf{Efficacy} = \frac{841\ \frac{\text{lm}}{\text{ft.}}}{10.57\ \frac{\text{W}}{\text{ft.}}} = 78.6\ \text{lm/W}$$

Submitted by:		Date:
Type:	Project:	
Ordering Info:		

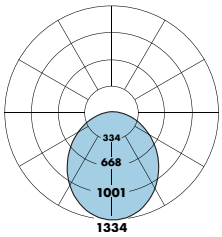
FINELITE®
Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

Direct Photometry - 4' Luminaire 3500K

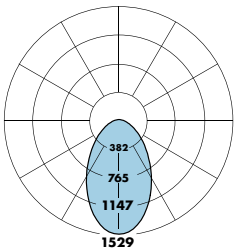
HP2-P-D-V-835-F
Downlight: Flush Diffuser

Efficacy: 87 lm/W
Total luminaire output: 3215 lumens (804 lm/ft)
36.9 watts (9.2 W/ft)
Peak Candela Value: 1334 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85136



HP2-P RG-D-V-835-RG
Downlight: Regressed Diffuser

Efficacy: 79 lm/W
Total luminaire output: 2887 lumens (722 lm/ft)
36.7 watts (9.2 W/ft)
Peak Candela Value: 1529 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 90350



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1316	1655	2501	3215

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
329	414	625	804

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.6	4.6	7.1	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
91	90	88	87

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85136

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1182	1486	2245	2887

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
295	371	561	722

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.6	4.6	7.0	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
82	81	80	79

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 90350

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 2546 lm x 0.789 = 2009 lm
Total Light Output per Foot: 636 lm/ft x 0.789 = 502 lm/ft.
watts/foot: 6.8 W/ft.

$$\textbf{Efficacy} = \frac{502\ \frac{\text{lm}}{\text{ft.}}}{6.8\ \frac{\text{W}}{\text{ft.}}} = 74\ \text{lm/W}$$

Submitted by:	Date:
Type:	Project:
Ordering Info:	

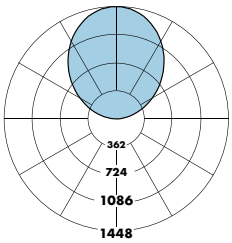
FINELITE®
Better Lighting

High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

Indirect Photometry - 4' Luminaire 3500K

HP2-P-I-V-835-F
Uplight: Flush Diffuser

Efficacy: 102 lm/W
Total luminaire output: 3749 lumens (937 lm/ft)
36.7 watts (9.2 W/ft)
Peak Candela Value: 1448 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85134



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B** [1]	**H** [1]	**V** [2]
1535	1929	2916	3749

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
384	482	729	937

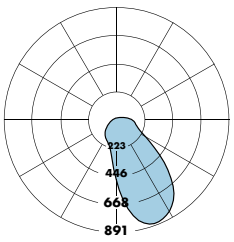
Power, 3500K (Watts Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
3.6	4.6	7.0	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B** [1]	**H** [1]	**V** [2]
107	106	104	102

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85134

HP2-AM-WW-D-K-V-835
Uplight: Flush Diffuser

Efficacy: 77 lm/W
Total luminaire output: 1500 lumens (375 lm/ft)
19.6 watts (4.9 W/ft)
Peak Candela Value: 882 @ 25°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85137



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B** [1]	**H** [1]	**V** [2]
614	772	1167	1500

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
154	193	292	375

Power, 3500K (Watts Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
2.0	2.5	3.8	4.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B** [1]	**H** [1]	**V** [2]
76	77	77	77

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85137

Wattage is Real Power. If you would like additional details to calculate Apparent Power, please contact your local Finelite representative.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 2245 lm x 0.789 = 1771 lm
Total Light Output per Foot: 561 lm/ft x 0.789 = 443 lm/ft.
watts/foot: 7.0 W/ft.

$$\textbf{Efficacy} = \frac{443\ \frac{\text{lm}}{\text{ft.}}}{7.0\ \frac{\text{W}}{\text{ft.}}} = 63\ \text{lm/W}$$

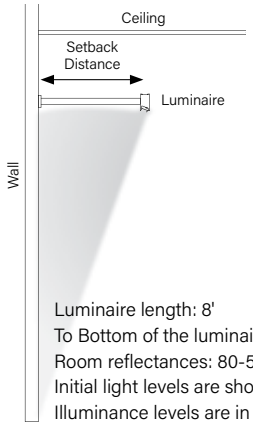
Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

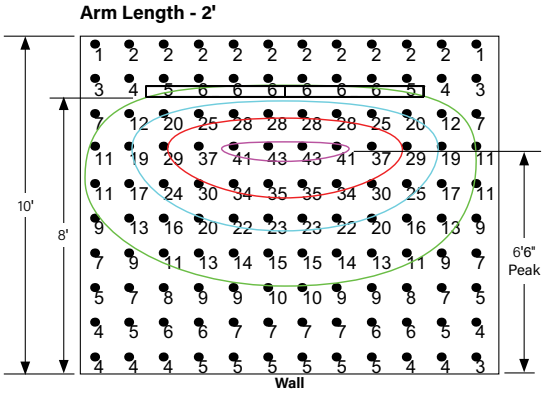
High Performance 2" Aperture (HP-2)
Wall Mount and Arm Mount

Wall Wash Direct - Setback Info and Application Data

HP2-AM-WW-D-K-4'-V-835
Downlight: With Kicker
Total luminaire output: 935 lumens (234 lm/ft)
10.2 watts (2.6 W/ft)
CRI: 80 / CCT: 3500K

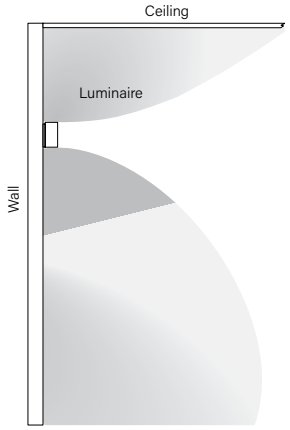


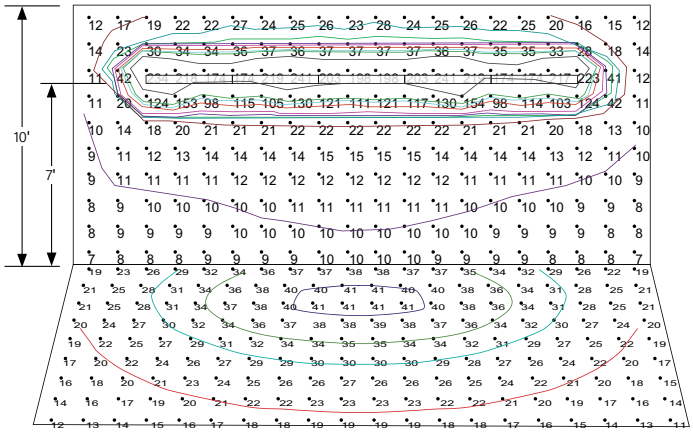
Luminaire length: 8'
To Bottom of the luminaire: 8'-0"
Room reflectances: 80-50-20
Initial light levels are shown
Illuminance levels are in footcandles



Downlight Asymmetric Optic - Setback Info and Application Data

HP2-AM-D-4ft-V-835-DAO
Downlight: DAO
Total luminaire output: 3742 lumens (936 lm/ft)
35.6 watts (8.9 W/ft)
CRI: 80 / CCT: 3500K





Submitted by:		Date:
Type:	Project:	
Ordering Info:		

FINELITE® Better Lighting

0-10V Tunable White

Finelite's award-winning, contractor friendly Tunable White luminaires are available at low cost, with powerful and simple 0-10V tuning and intensity controls.

TUNABLE WHITE FEATURES

- CCT range: 2700K - 6500K
- Dimming Range: 100% to 10%
- CRI Options: 80 CRI or 90 CRI

PHOTOMETRY

Apply a power adjustment factor to calculate wattage usage

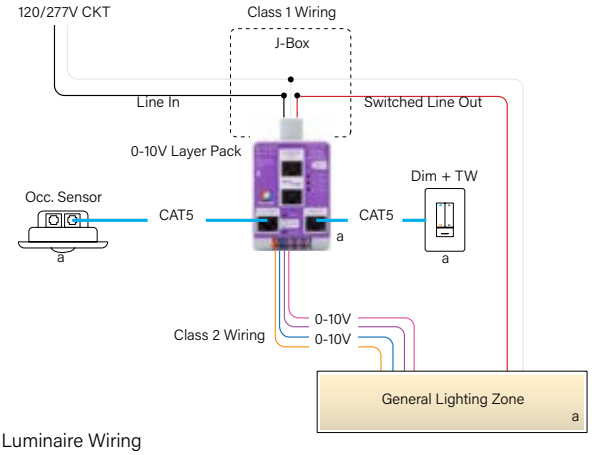
POWER	CONVERSION FACTOR
	1.1X

(Example: a 50 watt luminaire in static white would draw 55 watts using 0-10V Tunable White)

LUMINAIRE FAMILY MODIFICATIONS/RESTRICTIONS

	Section Lengths										
Wall Mount Direct	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'
Output S,B,H,V Single Circuit	Rows can be comprised of 2'-12' sections. Tailored lengths available.										
Integral Battery Backup (BSL310LP)							✓		✓		✓
Wall Mount Indirect/Direct											
Output S,B Single Circuit	✓		✓		✓		✓		✓		✓
Integral Battery Backup (BSL310LP)							✓		✓		✓
Output H,V Single Circuit			✓				✓				✓
Integral Battery Not Available	Remote Battery backup solution available. Consult factory for tailored lighting options.										
Output S,B,H,V Dual Circuit			✓				✓				✓
Integral Battery Not Available	Remote Battery backup solution available. Consult factory for tailored lighting options.										

WIRING DIAGRAM - DIMMABLE TO 10%

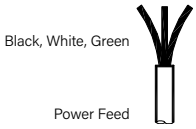


Luminaire Wiring

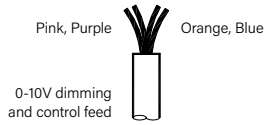
- **Purple** (+) / **Pink** (-) control wires are for intensity control
- **Orange** (+) / **Blue** (-) control wires are for Tunable White control

Note:
Load or Dim to Off options available.

DUAL FEED DETAIL



WIRING LEGEND		
Black	Hot	Line Voltage
White	Neutral	Line Voltage
Green	Ground	



WIRING LEGEND		
Pink	Dimming	0-10V DC
Purple	Dimming	0-10V DC
Orange	TW	0-10V DC
Blue	TW	0-10V DC

Tunable White LUMINAIRES

Horizontal Louver LED Step Light

By Bruck Lighting

L17

LUMENS

Call Us (877) 445-4486

Horizontal Louver LED Step Light
By Bruck Lighting

Product Options

Finish: Brushed Nickel

Details

IP65 wet rated, suitable for outdoors
Built-in enclosed LED driver
Suitable for vertical and horizontal orientation
Additional mounting screws for hanger bars are supplied for new construction
3 x 1/2" knock out for feed-through
Die cast zinc magnesium housing

Dimensions

Fixture: Width 8.7", Height 3.31", Depth 3.06", Weight 0.48Lbs

Lighting

Lamp Type	LED Built-in
Total Lumens	190
Volts	120
Color Temp	3200 (Soft White)
Equivalent Halogen, CFL or LED Bulb Can Be Used	No

Notes:

PBA: Coordinate final finish with architect

Prepared by:

Prepared for:
Project:
Room:
Placement:
Approval:

Additional Details

Product URL: https://www.lumens.com/horizontal-louver-step-light-by-bruck-lighting-BLS497328.html
Rating: ETL Listed Wet

ITEM#: BLS497328

Created September 30th, 2024

GARDCO by signify

Wall Mount

LED Mini sconce

111L

OL2

Gardco 111 LED mini sconce luminaires are compact in size, perfect for low mounting height wall mount applications. 111 LED luminaires are designed to integrate naturally to wall surfaces. 111 LED luminaires are available in Type 2, 3, and 4 distributions, and provide output from 1,300 to 4,600 lumens.

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

Project:
Location:
Cat.No:
Type:
Lamps: Qty:
Notes:

FINISH TO BE SELECTED BY ARCHITECT

example: 111L-16L-550-CW-G3-2-UNV-PCB-F1-BK

Ordering guide

Prefix	No. of LEDs	Drive Current	Color/Generation	Distribution	Voltage	Controls	Electrical	Finish
111L Trapezoidal Wedge Mini Sconce LED	**16L** 16 LED module	**200** 200mA **350** 350mA **550** 550mA **750** 750mA	**WW-G3** Warm White 3000K, 70 CRI generation 3 **NW-G3** Neutral White 4000K, 70 CRI generation 3 **CW-G3** Cool White 5000K, 70 CRI generation 3 **WY-G3** Warm Yellow 2700K, 80 CRI Generation 3[2] **BW-G3** Balanced White 3500K 80CRI Generation 3[2] **AM-G3** Direct Amber (590nm) Generation 3[2]	**2** Type II Wide Throw Optic, with maximized lateral throw **3** Type III Preferred Wide Throw Optic, with improved forward throw **4** Type IV Maximized forward throw optic	**UNV** 120-277V 50hz/60hz **120** 120V **208** 208V **240** 240V **277** 277V	**PCB** Photocontrol Button[1]	**F1** Single fusing (120, 277VAC)[1] **F2** Double fusing (208, 240VAC)[1] **F3** Canadian double pull fusing (208, 240VAC)[1]	**Textured** **BK** Black **WH** White **BZ** Bronze **DGY** Dark Grey **MGY** Medium Grey **Customer specified** **RAL** Specify optional color or RAL (ex: OC-LGP or OC-RAL7024) **CC** Custom color (must supply color chip for required factory quote)

1. Provide specific input voltage.
2. Extended lead times apply. Contact factory for details.

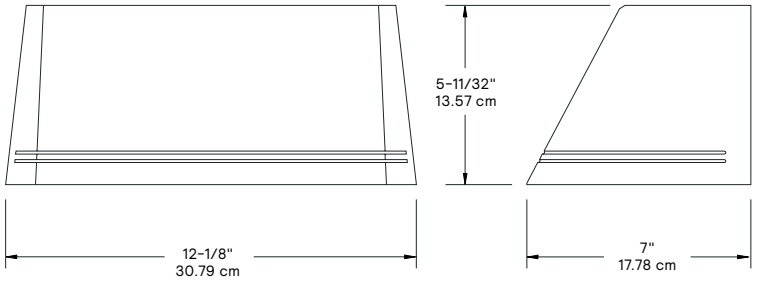
FINISH TO BE SELECTED BY ARCHITECT

Accessories (ordered separately)

Mounting Accessories	
Wall Mount	
WS	Wall Mounted Box for Surface Conduit

111 LED Mini Wall Sconce

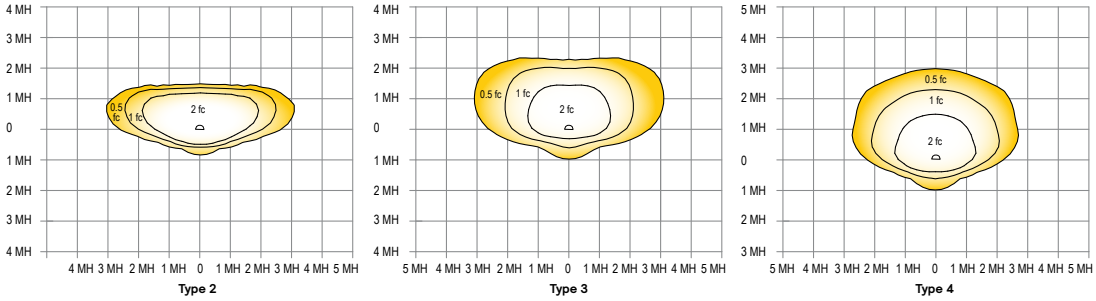
Dimensions



Note: Mounting plate center is located in the center of the luminaire width and 2.38" (6.03cm) above the luminaire bottom (lens down position). Splices must be made in the J-box (by others). Mounting plate must be secured by max. 1/4" (.64cm) diameter bolts (by others) structurally to the wall.

Weight: 6.6 lbs

Optical Distributions



111 LED Mini Wall Sconce

3000K LED Wattage and Lumen Values

CAT LOGIC	LED QTY	System Current (mA)	Color Temp	Avg System Wattage (W)	2			3			4		
					Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating
111L-16L-200-WW-G3-x	16	200	3000	12	1370	114	B1-U0-G0	1343	112	B0-U0-G0	1315	110	B0-U0-G0
111L-16L-350-WW-G3-x	16	350	3000	18	2304	128	B1-U0-G0	2260	126	B1-U0-G1	2213	123	B1-U0-G1
111L-16L-550-WW-G3-x	16	550	3000	29	3503	121	B1-U0-G0	3435	118	B1-U0-G1	3363	116	B1-U0-G1
111L-16L-750-WW-G3-x	16	750	3000	39	4598	117	B1-U0-G1	4509	114	B1-U0-G1	4415	112	B1-U0-G1

4000K LED Wattage and Lumen Values

CAT LOGIC	LED QTY	System Current (mA)	Color Temp	Avg System Wattage (W)	2			3			4		
					Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating
111L-16L-200-NW-G3-x	16	200	4000	12	1439	120	B1-U0-G0	1411	118	B0-U0-G0	1381	115	B0-U0-G0
111L-16L-350-NW-G3-x	16	350	4000	18	2420	134	B1-U0-G0	2373	132	B1-U0-G1	2323	129	B1-U0-G1
111L-16L-550-NW-G3-x	16	550	4000	29	3678	127	B1-U0-G0	3606	124	B1-U0-G1	3531	122	B1-U0-G1
111L-16L-750-NW-G3-x	16	750	4000	39	4828	123	B1-U0-G1	4734	120	B1-U0-G1	4636	118	B1-U0-G1

5000K LED Wattage and Lumen Values

CAT LOGIC	LED QTY	System Current (mA)	Color Temp	Avg System Wattage (W)	2			3			4		
					Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating
111L-16L-200-CW-G3-x	16	200	5000	12	1439	120	B1-U0-G0	1411	118	B0-U0-G0	1381	115	B0-U0-G0
111L-16L-350-CW-G3-x	16	350	5000	18	2420	134	B1-U0-G0	2373	132	B1-U0-G1	2323	129	B1-U0-G1
111L-16L-550-CW-G3-x	16	550	5000	29	3678	127	B1-U0-G0	3606	124	B1-U0-G1	3531	122	B1-U0-G1
111L-16L-750-CW-G3-x	16	750	5000	39	4828	123	B1-U0-G1	4734	120	B1-U0-G1	4636	118	B1-U0-G1

Values from photometric tests performed in accordance with IESNA LM-79 and are representative of the configurations shown.
Actual performance may vary due to installation and environmental variables, LED and driver tolerances, and field measurement considerations. It is highly recommended to confirm performance with a photometric layout.
NOTE: Some data may be scaled based on tests of similar (but not identical) luminaires. Contact factory for configurations not shown.

111 LED Mini Wall Sconce

Specifications

Housing

Housings are die cast aluminum. A memory retentive gasket seals the housing to the door frame to exclude moisture, dust, insects and pollutants from the optical system. A black, die cast ribbed backplate dissipates heat for longer system life. Main body cast housing and back plate made of a low copper die cast. Hinged door allows access to driver and LED compartment.

Mounting

Mounting is completed through integral back plate that features a separate recessed feature for hook and lock quick mount plate that secures with two set screws from bottom of luminaire. Luminaire ships fully assembled, ready to install.

Light Engine

Light engine comprises of a module of 16-LED aluminum metal clad board fully sealed with optics offered in 1 module of 16 LEDs. Module is RoHS compliant. Standard color temperatures: 3000K +/-125K, 4000K, 5000K +/- 200K. Minimum CRI of 70. Also available in 2700K, 3500K, and Amber (590nm) with extended lead times. Contact factory for details. LED light engine is rated IP66 in accordance to Section 9 of IEC 60598-1.

IP Rating

Luminaires are rated IP66.

Optical system

Type 2, 3, and 4 distributions available. Performance tested per LM-79 and TM-15 (IESNA) certifying its photometric performance. Luminaire designed with 0% uplight (U0 per IESNA TM-15).

Electrical

Driver: Driver efficiency (>90% standard). 120-480V available (restrictions apply). Open/short circuit protection. Standard 0-10V dimming drivers. RoHS compliant.

Button Photocontrol (PCB): Button style design for internal luminaires mounting applications. The photocontrol is constructed of a high impact UV stabilized polycarbonate housing. Rated voltage of 120V or 208-277V with a load rating of 1000 VA. The photocell will turn on with 1-4Fc of ambient light.

Surge protection (SP1): Each luminaire is provided as standard with surge protector tested in accordance with ANSI/IEEE C62.45 per ANSI/IEEE C62.41.2 Scenario I Category C High Exposure 10kV/5kA waveforms for Line Ground, Line Neutral and Neutral Ground, and in accordance with U.S. DOE (Department of Energy) MSSLC (Municipal Solid-State Street Lighting Consortium) Model Specification for LED Roadway Luminaires Appendix D Electrical Immunity High Test Level 10kV / 5kA.

Finish

Five standard colors offered in textured black, white, bronze, dark gray and medium gray. Color in accordance with the AAMA 2604 standard. Application of polyester powder coat paint 2.5 mils minimum. The thermosetting resins provides a discoloration resistant finish in accordance with the ASTM D2244 standard, as well as luster retention in keeping with the ASTM D523 standard and humidity proof in accordance with the ASTM D2247 standard. RAL and custom color matching available.

Listings

cULus Listed for Canada and USA suitable for wet locations when mounted downward facing. cULus Listed for Canada and USA suitable for damp locations when inverted upward facing when mounted in covered ceiling application. DesignLights Consortium qualified on models as listed on DLC QPL. CCTs 3000K and warmer are Dark Sky Approved. Luminaire is rated for operation in ambient temperature of -40°C (-40°F) up to +40°C (+104°F).

Limited Warranty

111 LED mini sconce luminaires feature a 5-year limited warranty.

See signify.com/warranties for complete details and exclusions

Predicted Lumen Depreciation Data

Ambient Temperature °C	System Current	LED Current	Calculated L_{70}hrs[1,2]	L_{70} per TM21[2,3]	Lumen Maintenance @ 60,000hrs
25 °C	750 mA	750 mA	>100,000	>60,000	97%

1. Predicted performance derived from LED manufacturer's data and engineering design estimates, based on IESNA LM-80 methodology. Actual experience may vary due to field application conditions.
2. L70 is the predicted time when LED performance depreciates to 70% of initial lumen output.
3. Calculated per IESNA TM 21-11. Published L70 hours limited to 6 times actual LED test hours.

Buy American Act of 1933 (BAA):

This product is manufactured in one of our US factories and, as of the date of this document, this product was considered a commercially available off-the-shelf (COTS) item meeting the requirements of the BAA. This BAA designation hereunder does not address (i) the applicability of, or availability of a waiver under, the Trade Agreements Act, or (ii) the "Buy America" domestic content requirements imposed on states, localities, and other non-federal entities as a condition of receiving funds administered by the Department of Transportation or other federal agencies. Prior to ordering, please visit www.signify.com/baa to view a current list of BAA-compliant products to confirm this product's current compliance.

Signify North America Corporation
400 Crossing Blvd, Suite 600
Bridgewater, NJ 08807
Telephone 855-486-2216

Signify Canada Ltd.
281 Hillmount Road,
Markham, ON, Canada L6C 2S3
Telephone 800-668-9008

OL2

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

SHOP NOW

Alcon Lighting **9066 Spruce** LED Architectural Landscape Contemporary Path Light

FEATURES & SPECIFICATIONS

INTENDED USE

The **Spruce LED Architectural Landscape Path Light** is a unique lighting fixture offering quality and durability with a naturally etched finish designed to last. The Spruce LED Architectural Landscape Path Light is used to accent and create dramatic effect while providing a great source of lighting.

DETAILS

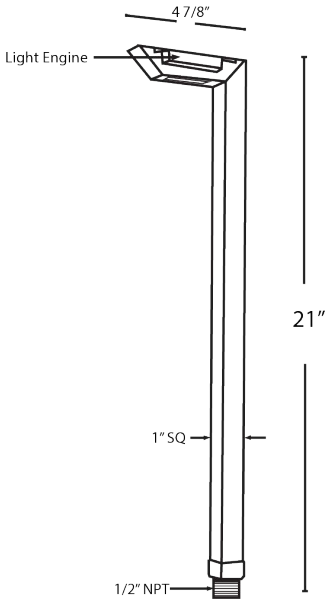
Model Number: 9066
W 4.875" x **H** 21"
Finish: PVD Satin
Construction: Solid Brass

ADDITIONAL FEATURES

Type: Path Light
Voltage: 9-15V
Wattage: 2W
Beam Spread: 120°
Lumens: 125lms
Dimmable
Mounting: 1/2" NPT Dual Fin Spike Included
Warranty:
LED Component: 20 Years Residential, 10 years Commercial
Housing: Lifetime
Wet Listed

PROVIDE OUTDOOR RATED 120V POWER SUPPLY

LISTINGS



Ordering Information:

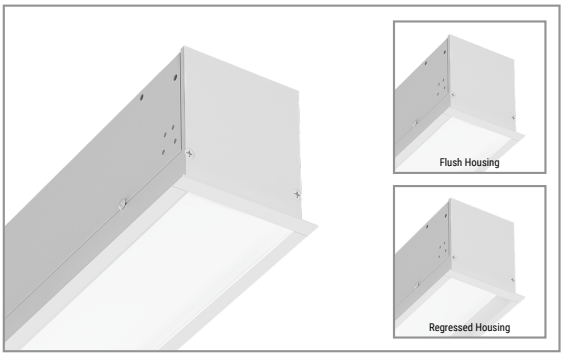
Example: (9066-40K-MBR)

Model		Light Color Temp		Finishes	
9066	Spruce	(Blank)	2700K	**MBR**	Matte Bronze
		40K	4000K	**B**	Black
		65K	6500K	**PVDS**	PVD Satin
		TF	Turtle Friendly *(4 wk lead time)*	**SILV**	Silver

FINISH TO BE SELECTED BY ARCHITECT

OL3

Project		Catalog #		Type	
Prepared by		Notes		Date	



Neo-Ray

Define 4

LED
Recessed
Direct

Typical Applications

Office • Education • Healthcare • Hospitality • Retail

Interactive Menu

Product Certification

Product Features

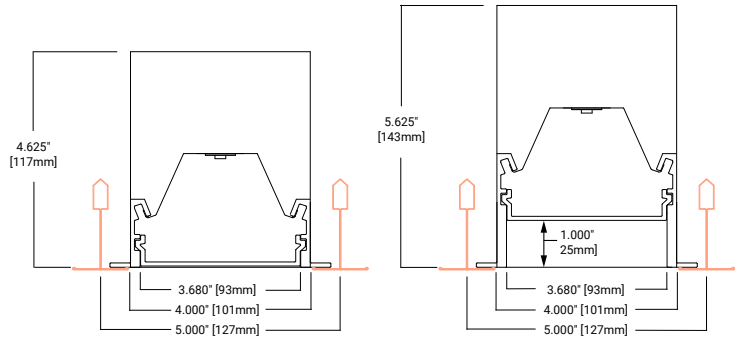
VividTune

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

Top Product Features

- Specifiable to the nearest 1" in length
- Satin Lens, Asymmetric Lens and Drop Lens available
- Flush and Regressed Housing
- Customizable lumen packages
- Precision extended trims fit a variety of different architectural ceiling types
- Industry leading performance and efficacy
- Standard and custom corners / transitions available
- Options to meet Buy American Act requirements

Dimensions



additional product diagrams

Order Information

SAMPLE ORDER NUMBER: **S124DR-S795D840-ETG4F0-1B1-UDD-F-W-SWPD1**

Icon Key: Grey bar denotes available with 10-Day Quick Ship
Ø Consult factory for availability

Domestic Preference	Light Distribution	Light Engine	Lumen Package Down	CRI	LED CCT	Ceiling Type	Length	Circuiting
[Blank]=Standard **BAA**=Buy American Act	**S124DR**=Define 4 Direct Recessed **S124RDR**=Define 4 Regressed Direct Recessed **QS-S124DR**=Define 4 Direct Recessed Quick Ship	**-S**=Standard **-H**=High Performance **-V**=VividTune	**350D**=350 Lms/ft **575D**=575 Lms/ft **795D**=795 Lms/ft **1020D**=1020 Lms/ft **1195D**=1195 Lms/ft **____D**=Custom Lms/ft	**8**=80 **9**=90	**27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K **2765**=2700K-6500K **3050**=3000K-5000K	**-ETG**=15/16" T-Grid **-FTG**=9/16" T-Grid **-STG**=9/16" Slot T-Grid **-FTT**=9/16" Tegular T-Grid **-ITG**=9/16" Interlude T-Grid **-ETT**=15/16" Tegular T-Grid **-GYP**=Gypsum board **-FSR**=Mud-in Gypsum Board **-FES**="Finished" Extruded Side	**2F0**=2' Individual **4F0**=4' Individual **8F0**=8' Individual **12F0**=12' Individual **__F0**=4' Incremental Run (e.g. 40F0 = 40' 0") **__F_**=1" Incremental Run (e.g. 21F3 = 21' 3")	**-1**=Single Circuit **-S**=Secondary Circuit
Notes Only product configurations with this designated prefix are built to be compliant with the Buy American Act of 1933 (BAA). Please refer to Domestic Preferences website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.	**Notes** RDR regress of 1" will add an additional 1" to fixture depth.	**Notes** See performance table for add'l details. Light engine must be consistent across run length.	**Notes** 3500K/80CRI/DR housing/F Lens. Please refer to scaling data for other variables. For custom lumen output, please refer to additional information on page 4. VividTune available with 795D, 1020D, and 1195D.	**Notes** Additional lead-time and cost may apply for 927, 930, 935 and 940 configurations. 2700K not available in 80CRI. 2765 & 3050 VividTune configurations require V light engine, 90 CRI, and W2A driver.	**Notes** Please refer to ceiling interface diagrams for additional detail and dimensions.	**Notes** 42'-0" LENGTH - SOUTH FIXTURE 45'-0" LENGTH - NORTH FIXTURE	**Notes** Secondary circuit similar to A/B switching. Price adder applies for "S" configuration. VividTune Secondary Circuit has shared CCT wiring.

Emergency	Voltage	Integral LED Driver	Shielding Down	Options	Color	Integrated Sensor
E=Emergency circuit **B1**=Surelite 7W UNV integral battery **B2**=Surelite 14W UNV integral battery **B3**=Bodine 6W UNV Integral **T**=UL924 EPC Emergency Bypass Relay	**-U**=UNV 120-277V **-1**=120V **-2**=277V **-3**=347V **-4**=48VDC Ø	**DD**=0-10 Volt Dimming, 1% **5L**=DALI Dimming, 5%-100% **LH**=Lutron LDE1 w/ecosys **LV1**=DLVP Ø **W2A**=White Tuning, 0-10V Dimming (VividTune only)	**-F**=Satin Flush Diffuser **-A**=Asym Flush Optic **-D**=Satin Drop Diffuser **-L**=Straight blade louver with diffuser Ø	**-CP**=Chicago Plenum **-R**=GLR Fuse (Fast) **-F**=GMF Fuse (Slow)	**-W**=Matte White **-S**=Silver **-B**=Black **-C**=Custom Color Ø FINISH TO BE SELECTED BY ARCHITECT	**-WAA**=WaveLinx Pro Integral **-WTA**=WaveLinx Pro Tilemount **-WAB**=WaveLinx Lite Integral Ø **-WTB**=WaveLinx Lite Tilemount Ø **-LWIPD1**=Enlighted Integral **-LWTPD1**=Enlighted Tilemount **-SVPD1**=Standalone Sensor **-SVTPD1**=Standalone Sensor Tilemount
Notes Internal battery standard for fixtures ≥ 4ft and lumen output ≤1195 Lms/ft. Fixture Non-IC-Rated for internal battery and lumen output ≥1020 Lms/ft. External battery standard with fixtures <4ft and all Chicago plenum fixtures.	**Notes** 48V for use with LV1 driver. 347V only available with DD driver.	**Notes** DD driver is standard. For non-dimming applications, the driver will default to full brightness if no connection is made to the capped dimming wires in the field.	**Notes** All lensing options are snap-in lenses. "L" option required RDR housing and may require additional lead-time, please consult factory for details. A option not available with VividTune.	**Notes**		**Notes** Please refer to page 6 for additional detail required to specify integrated or tile-mount sensors. Integral option not available with regressed, drop or asymmetric configurations. Tilemount configuration recommended for these applications.

Product Specifications

Construction
- Available in Flush and Regressed Housing
- Precision cut housing trim extruded from 6063 aluminum with aluminum frame
- Extruded end-caps ensure a precise and uniform ceiling interface
- Nominal 2' -12' illuminated sections used in run configuration and/or individual fixtures

Finish
- Electrostatically applied polyester powder coat paint

LED Module
- Modular LED tray assembly comprising reflector, light engine, led driver and quick disconnect wire-harness for ease of installation and maintenance over the life of the luminaire

Light Engine
- Offered with three next generation Neo-Ray light engines delivering industry leading efficacy and long-life
- LED's are available in 2700K, 3000K, 3500K, 4000K or VividTune ranges of 2700K-6500K and 3000K-5000K
- CRI options of either ≥80CRI or ≥90CRI (Lumen output will be affected - please refer to the lumen adjustment factor table)

LED Drivers
- LED system coupled with electrical driver
- Traditional electronic drivers are available for 120-277V and 347V applications
- Cooper Lighting Solutions's DLVP Low voltage drivers are available for 48VDC applications

Controls and Integrated Sensors
- Equipped standard with a 0-10V continuous dimming driver. Compatible with most standard dimming devices
- Additional control types are available (DALI, Lutron, DLVP) at an additional cost
- WaveLinx and Enlighted wireless sensors as well as stand-alone sensors available

Mounting
- Recessed

Lengths
- Available in any length (23" min) with a resolution of 1 inch. Max section length of 12ft (8ft max option available)
- Additional fixture lengths are available please consult factory. All lengths are nominal
- VividTune available as standard product in 1ft resolution
- Actual sizes are one inch shorter than nominal to allow easy in-grid installation
- For Gypsum or Flangeless installations add 1 inch to overall fixture length (e.g. 4F1 for 48" length)
- Refer to ceiling type section of specification sheet and submittal drawings for actual sizes

Corners and Transition Pieces
- Corners and other transition pieces are fully luminous
- Constructed using precision mitered frame and lens components
- The frame is welded to ensure a precise and robust assembly
- Standard 90° horizontal and vertical corners as well as custom corners are available
- Consult corner and pattern addendum for additional information
- Alternative transition pieces such as T's, Y's, X's, etc. are also available

Snap-In lensing Options
- Satin Flush - Flush, high diffusion glare-free lens
- Satin Drop - 1" Drop, high diffusion glare-free lens
- Asymmetric - Flush, low-glare Asymmetric lens
- Flush options ship with our patent-pending underlens solution, the proud lens ships with an injection molded end cap to eliminate light leak

Reflectors
- Precision formed cold-rolled steel reflectors with high reflectivity
- Ultra high reflectivity used with High Performance light engine

Lumen Maintenance
- 90% (L90) of initial light output at 100,000+ hrs
- 70% (L70) of initial light output at 400,000+ hrs
- Derived from TM-21 standard @25°C ambient and typical operating conditions

Custom Lumen Output
- Custom lumen output expressed option in Lumens per foot (e.g. -725D for 725 Lms/ft down). Refer to additional detail on page 4.

Electrical
- Dimming provided as standard
- Dimming wires capped with wire-nuts for non-dimming applications
- Optional battery backup options provided
- Default battery location is internal to fixture
- Default emergency section is 4ft in length and located at the beginning of the fixture unless designated elsewhere
- Estimated lumen output = battery wattage * min efficacy (see performance table)
- Estimate lumen output from the emergency section, multiply battery wattage x minimum fixture efficacy
- The EPC option will bypass local controls and dimming upon loss of normal power. This option is required when the fixture has both integrated sensors and emergency circuiting

Integrated Sensors
- Please reference page 6 for details

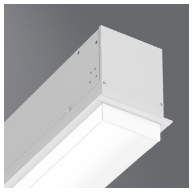
Weight
- 2.65 lbs per foot

Approvals
- cULus - listed for damp locations
- RoHS compliant
- Meets NYC requirements
- Meets CCEC requirements
- IC Rated for insulation contact (except where noted)
- Tested to IESNA LM-79 and LM-80
- Can be used for State of California Title 24 high efficacy luminaire
- DesignLights Consortium® Qualified and classified for both DLC Standard and DLC Premium, refer to www.designlights.org for details

Warranty
- Five year warranty standard.

Shielding Options

S124DR with Flush Satin Lens (F)

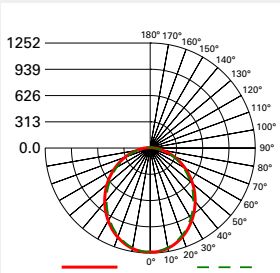


S124DR with Drop Satin Lens (D)

S124DR with Flush Asymmetric Lens (A)

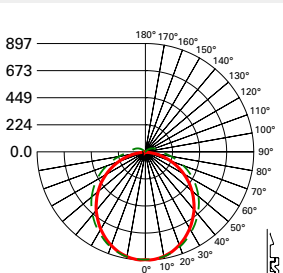
Photometric Data

View IES files



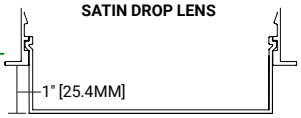
FILE NAME: S124DR-S795D835-GYP4F0-1-UDD-F-W
LUMENS: 3203 Lms
LPW: 121.3 LPW
CCT: 3500K
WATTS: 26.2 W
TEST NUMBER: G3-1802-639-5

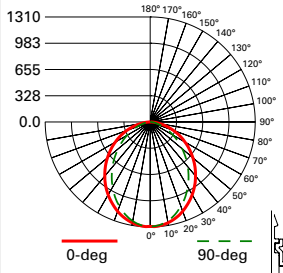
SATIN FLUSH LENS



FILE NAME: S124DR-S795D835-GYP4F0-1-UDD-D-W
LUMENS: 3045 Lms
LPW: 115.3 LPW
CCT: 3500K
WATTS: 26.4 W
TEST NUMBER: G3-1802-639-16

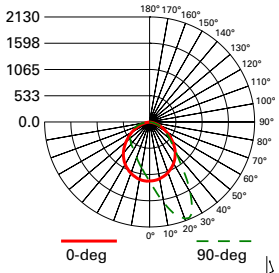
SATIN DROP LENS





FILE NAME: S124RDR-S795D835-GYP4F0-1-UDD-F-W
LUMENS: 3018 Lms
LPW: 114.3 LPW
CCT: 3500K
WATTS: 26.4 W
TEST NUMBER: G3-1802-639-26

SATIN REGRESSED DIFFUSER



FILE NAME: S124DR-S795D835-GYP4F0-1-UDD-A-W
LUMENS: 3331 Lms
LPW: 126.2 LPW
CCT: 3500K
WATTS: 26.4 W
TEST NUMBER: G3-1802-639-21

ASYMMETRIC FLUSH LENS

Photometric Overview and Performance Data

Performance Per Linear Foot at 3500K/80CRI

Nominal Output	Standard and VividTune Light Engine		High Performance Light Engine	
lms/ft	W/ft	lm/W	W/ft	lm/W
350	3.0	121	2.9	126
575	4.8	123	4.4	133
795	6.8	121	6.1	133
1020	8.9	118	8.1	130
1195	10.6	115	9.7	126

Lumen Adjustment Factors

CCT	80CRI	90CRI
2700K	N/A	0.801
3000K	0.943	0.815
3500K	1.000	0.861
4000K	1.010	0.892

LUMEN ADJUSTMENT CALCULATIONS

Example 1 - Adjusted Lumen Output
Nominal Lumen Output selected = 1025 lms/ft (based on standard of 3500K/80CRI)
Lumen Adjustment Factor = 0.801 (2700K/90CRI desired)

Adjusted Lumen Output = Nominal Lumen Output x Lumen Adjustment Factor
Adjusted Lumen Output = 1025 lms/ft x 0.801 = 821 lms/ft

Example 2 - Custom Lumen Output based on Required Lumens Per Foot
Total light output (4ft) requirement of 2800 lms, desired CCT and CRI of 4000K/80CRI

Total required lumens per foot @ 4000K= 2800 lms / 4 ft = 700 lms/ft
Lumen Adjustment Factor = 1.018 (Requirement based on 4000K / 80CRI)

Total required lumens per foot @ 3500K / 80CRI = 700 lms/ft ÷ 1.018 = 688 lms/ft

Estimated efficacy = 121 lm/W (find nearest value using table above)
Estimated power consumption = 688 lms/ft ÷ 121 lm/W = 5.69 W/ft

Custom Lumen Output

Total Light Output Range (lms/ft)

CCT	80CRI	90CRI
2700K	N/A	189-1058
3000K	222-1246	192-1077
3500K	236-1321	203-1138
4000K	238-1335	210-1179

If your requirement is expressed in power consumption (W/ft) rather than light output, you can use the power to lumen output curves to convert power consumption to light output for specification.

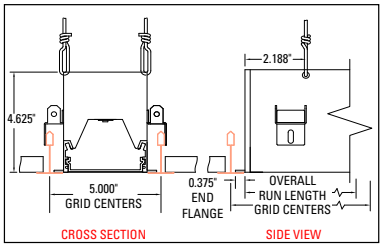
Efficacy for custom lumen outputs can be estimated using lumen output curves or with the use of our online custom lumen output tool.

Ceiling Type

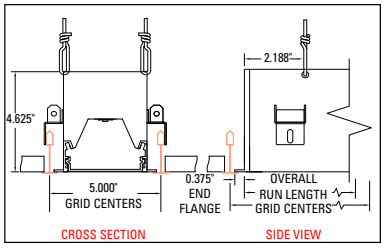
Extruded Trim Flange Details - Refer to submittal drawings for detailed flange information - for additional options consult factory.

Grid Ceiling Systems

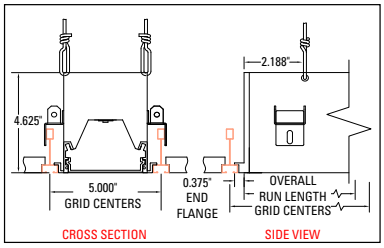
15/16 Tee (ETG)



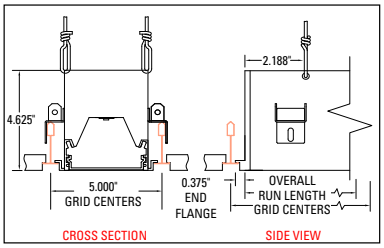
9/16 Tee (FTG)



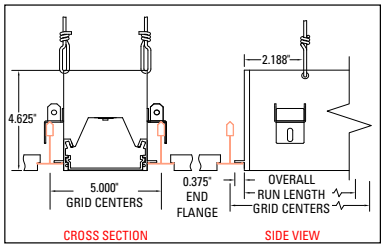
9/16 Slotted Tee (STG)



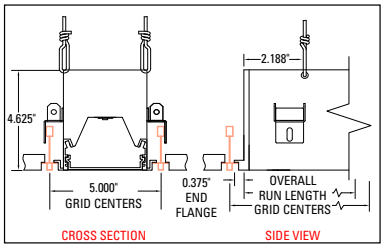
9/16 Tegular (FTT)



15/16 Tegular (ETT)

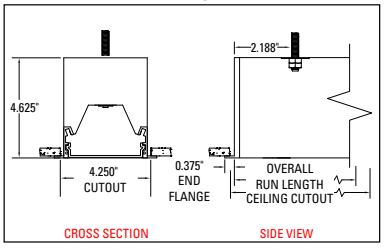


9/16 Interlude Tee (ITG)

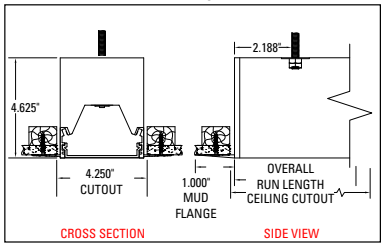


Drywall Ceiling

Visible Flange (GYP)



Mud-In Flange (FSR)



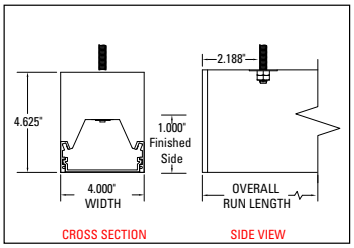
NOTE: ACTUAL LENGTH OF GYP/FSR FIXURES WILL BE 1" SHORTER IN LENGTH THAN TOTAL REQUESTED RUN LENGTH FOR ALL RECESSED / PERIMETER FIXTURES

OVERALL RUN LENGTH = 'FIXTURE ORDER LENGTH' - 1" E.G. - OVERALL RUN LENGTH OF 3' 11" WILL SHIP WHEN ORDERING A '4F0' FIXTURE

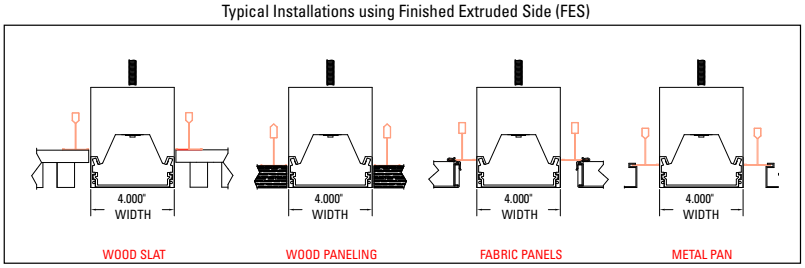
CEILING CUTOUT = 'OVERALL RUN LENGTH' + 0.250" OR CEILING CUTOUT = 'FIXTURE ORDER LENGTH' - 0.750" E.G. - CEILING CUTOUT WHEN ORDERING A '4F0' LENGTH FIXTURE WILL BE 3' 11.250"

Other Ceiling Systems (Wood, Fabric, Metal Pan, HD Box Style)

Finished Extruded Side (FES)



Typical Installations using Finished Extruded Side (FES)



Integrated Sensor Details and Placement

Sensor Type	Wireless	Sensor Integration	Sensor Mounting	Ordering Code
WaveLinx Pro	Yes	Integral to Fixture	Mounted in solid cover	WAA
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	WTA
WaveLinx Lite	Yes	Integral to Fixture	Mounted in solid cover	WAB
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	WTB
Enlighted	Yes	Integral to Fixture	Mounted in illuminated lens	LWIPD1
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	LWTPD1
Stand-Alone SVPD1	No	Integral to Fixture	Mounted in solid cover	SVPD1
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	SVTPD1

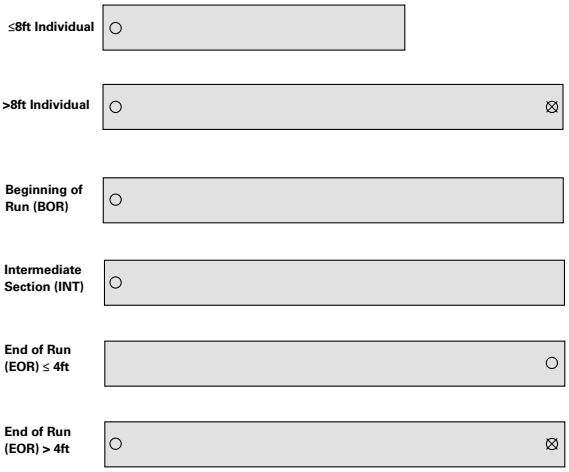
○ Standard Sensor with Luminaire Control
⊗ Auxiliary Sensor used for Sensor Coverage (wireless systems only)

Optional standalone and wireless connected integrated sensors require use of the DD (0-10V) driver. WaveLinx Pro and Enlighted sensors require additional system hardware (not provided) for full functionality. Tilemount sensor recommended for optimal sensor coverage on perimeter applications. Tilemount sensor not available with Chicago plenum option.

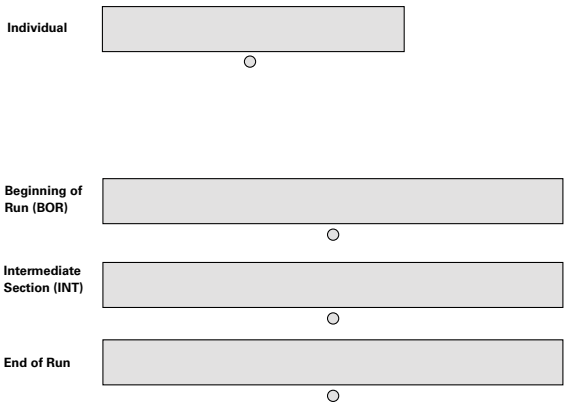
Standard sensor layout is shown below. Please refer to sensor coverage pattern diagrams to ensure proper coverage for the application. Standard configurations are available in both individual fixtures and in continuous runs. For optimal coverage, continuous runs will default to 8ft max section length.

For additional information integrated sensors and connected lighting, please visit Cooper Lighting Solutions's Connected Lighting Website.

INTEGRAL SENSOR



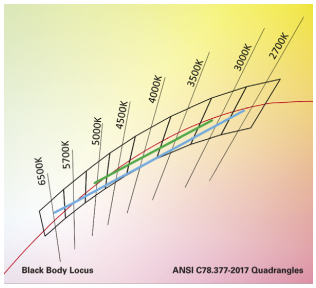
TILEMOUNT SENSOR (OPTIMAL LOCATION)



VividTune color tuning solutions

Define 4 LED Recessed with VividTune Tunable White

VividTune tunable white luminaires deliver high-quality light in a broad range of continuously variable color temperatures and intensities. Create a dynamic environment by adjusting the ambient light warmer or cooler to influence mood, support the task at hand, or create a dramatic ambience. The ability to control correlated color temperature and intensity separately using simple controls is the next evolution of LED lighting for the commercial, educational, healthcare and hospitality space. The unparalleled flexibility and number of available lighting environments enable users to find the right light with tunable white.



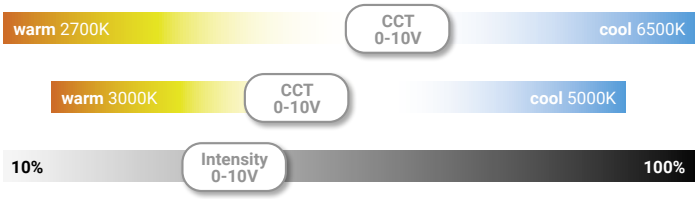
Performance Data*

Tunable White - Lumen Adjustment Factors				
CCT	3000K-5000K		2700K-6500K	
	80 CRI	90 CRI	80 CRI	90 CRI
2700K	-	-	0.868	0.741
3000K	0.894	0.736	0.893	0.771
3500K	0.946	0.804	0.924	0.809
4000K	0.993	0.868	0.944	0.835
4500K	1.002	0.883	0.961	0.857
5000K	1.002	0.883	0.974	0.874
6500K	-	-	0.988	0.897

Example of Approximate Lumen Calculation			
	Standard Catalog #	VividTune 80 CRI Catalog #	VividTune 90 CRI Catalog #
CCT Setting	S124DR-C1020D835-X-UDD-F-W	S124DR-V1020D83050-X-UW2A-F-W	S124DR-V1020D93050-X-UW2A-F-W
3000K	-	3648	3003
3500K	4080	3860	3280
4000K	-	4051	3541
4500K	-	4088	3603
5000K	-	4088	3603

Controlling VividTune Tunable White

VividTune luminaires make tunable white more accessible by using simple and familiar controls. From wall dimmers to wireless controls, VividTune tunable white luminaires are compatible with industry standard 0-10V dimming controls. A single 0-10V dimming input is used to control intensity (brightness) while a second 0-10V dimming input is used to adjust CCT. For suggested control configurations, go to www.cooperlightingsolutions.com for tunable white application guides.



Example of Lumen Adjustment Calculation

S124DR-V1020D83050-X-UW2A-F-W
at 80 CRI tuned to 3500K

Adjusted Lumen =
published lm x adjusted lm factor

Adjusted Lumen = 4080 x 0.946

Adjusted Lumen = 3860 lm

* Lumen adjustment factors are for reference and may be different for each product selected. Refer to IES files for actual performance data on each.

COOPER Lighting Solutions

Cooper Lighting Solutions
18001 East Colfax Avenue
Aurora, CO 80011
P: 303-393-1522
www.cooperlighting.com

d"series

D-Series DSXF2
LED Floodlight

Catalog Number

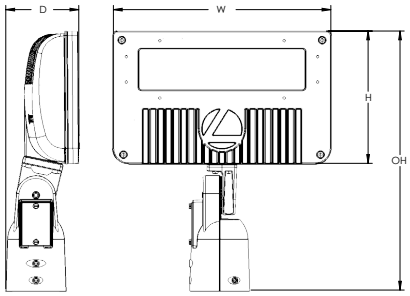
Notes

Type TYPE OL4

Hit the Tab key or mouse over the page to see all interactive elements.

Specifications

EPA @ 90°:	0.8 ft² *(0.07 m²)*
Depth:	4.32" *(11.0 cm)*
Width:	12.87" *(32.7 cm)*
Height:	7.83" *(19.9 cm)*
Overall Height	15.33" *(39.0 cm)*
Weight:	12.0 lbs *(5.4 kg)*



Introduction

The D-Series floodlights feature a site-wide offering to meet specifier's every floodlighting need in application. The D-Series flood offers three sizes delivering 3,000 to 27,000 lumens. Available with seven precision optics, three mountings and three color temperatures, D-Series floodlights offer vast design capabilities while delivering significant energy savings and long life.

The DSXF2 delivers 7,000 to 17,000 lumens, meeting a large breadth of illumination requirements for design and renovation when replacing 175W, 250W and 400W HID floodlights. All configurations are assembled in the USA allowing for quick delivery.

Ordering Information

EXAMPLE: DSXF2 LED P1 40K 70CRI MSP MVOLT THK DDBXD

DSXF2 LED

Series	Performance Package	Color Temperature	CRI	Distribution	Voltage	Mounting
DSXF2 LED	P1	30K 3000K	70CRI	WFL Wide flood (6X6)	MVOLT[2]	**Shipped included**
	P2	40K 4000K		FL Flood (5X5)	347	THK Knuckle with 1/2" NPT threaded pipe
	P3	50K 5000K		MFL Medium flood (4X4)	480	YKC62 Yoke with 2ft 16-3 SO cord
	P4[1]			WFR Wide flood, rectangular (6X5)		IS Integral slipfitter (fits 2-3/8" O.D. tenon)
				HMF Horizontal flood (6X4)		
				MSP Medium spot (4X4)		
				NSP Narrow spot (3X3)		

Options

Shipped installed

PE	Photocontrol, button style (MVOLT or 347V)[3]
DMG	0-10v dimming wires pulled outside fixture (for use with an external control, ordered separately)
SPD10KV	Separate surge protection

Shipped separately[4]

UBV	Upper/bottom visor (universal)
FV	Full visor
VG	Vandal guard

Finish (required)

DDBXD	Dark bronze
DBLXD	Black
DNAXD	Natural aluminum
DWHXD	White

PBA: FINISH TO BE SELECTED BY ARCHITECT

Accessories[4]

Ordered and shipped separately.

DSXF1/2TS DDBXD U	Slipfitter for 1-1/4" to 2-3/8" OD tenons; 1/2" THK required (specify finish)
FTS CG6 DDBXD U	Slipfitter for 2-3/8" to 2-7/8" OD tenons; YKC62 required (specify finish)
FRWB DDBXD U	Radius wall bracket, 2-3/8" OD tenon (specify finish)
FSPB DDBXD U	Steel square pole bracket, 2-3/8" OD tenon (specify finish)
DSXF2UBV DDBXD U	Upper/bottom visor accessory (specify finish)
DSXF2FV DDBXD U	Full visor accessory (specify finish)
DSXF2VG U	Vandal guard accessory

For more mounting options, visit our Floodlighting Accessories pages.

NOTES

1. Performance package P4 is not available with HMF, MFL, MSP and NSP optics.
2. MVOLT driver operates on line voltage from 120-277V.
3. Requires MVOLT or 347V (Not available in 480V).
4. Also available as separate accessories; see Accessories information at left.

Mounting, Options and Accessories

Mountings

IS – Adjustable Slipfitter
(Fits 2-3/8" O.D. tenon)

YKC62 - Yoke with 16-3
SO cord, 2ft

THK - Threaded Knuckle with
1/2" NPT threaded pipe

External Shields

UBV Visor
Top Mounted

UBV Visor
Bottom Mounted

FV - Full Visor

Accessories

VG - Vandal Guard

DSXF1/2TS - THK
Slipfitter Accessory

One Lithonia Way • Conyers, Georgia 30012 • Phone: 1-800-705-SERV (7378) • www.lithonia.com

Performance Data

Lumen Output

Lumen values are from photometric tests performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown within applicable tolerances. Actual performance may differ as a result of end-user environment and application. Actual wattage may differ by +/- 8% when operating between 120-480V +/- 10%. Contact factory for performance data on any configurations not shown here.

Performance Package	System Watts	Dist.Type	NEMA Type	Field Angle		Beam Angle		30K (3000K, 70 CRI)			40K (4000K, 70 CRI)			50K (5000K, 70 CRI)		
				°H	°V	°H	°V	Lumens	LPW	Max Cd	Lumens	LPW	Max Cd	Lumens	LPW	Max Cd
P1	52	WFL	6 X 6	109	106	83	87	7,353	140	3,777	7,489	143	3,847	7,625	145	3,917
		FL	5 X 5	94	93	68	69	7,290	139	5,804	7,426	142	5,912	7,561	144	6,019
		WFR	6 X 5	108	93	84	69	7,375	141	4,722	7,512	143	4,810	7,648	146	4,897
	64	HMF	6 X 4	125	65	96	54	7,576	119	6,204	7,850	123	6,428	7,774	122	6,365
		MFL	4 X 4	61	60	46	46	7,915	124	12,766	8,201	128	13,228	8,121	127	13,099
		MSP	4 X 4	51	52	27	30	8,138	128	29,618	8,433	132	30,690	8,351	131	30,391
		NSP	3 X 3	41	40	20	17	8,248	129	47,865	8,546	134	49,597	8,463	133	49,114
P2	75	WFL	6 X 6	109	106	83	87	10,161	135	5,219	10,349	138	5,316	10,538	140	5,142
		FL	5 X 5	94	93	68	69	10,192	136	6,526	10,262	137	8,169	10,448	139	8,318
		WFR	6 X 5	108	93	84	69	10,075	134	8,021	10,381	138	6,646	10,570	141	6,767
	80	HMF	6 X 4	125	65	96	54	8,963	113	7,340	9,288	117	7,605	9,197	115	7,531
		MFL	4 X 4	61	60	46	46	9,364	118	15,104	9,703	122	15,651	9,609	121	15,498
		MSP	4 X 4	51	52	27	30	9,629	121	35,043	9,977	125	36,310	9,880	124	35,957
		NSP	3 X 3	41	40	20	17	9,758	122	56,632	10,111	127	58,681	10,013	126	58,109
P3	93	WFL	6 X 6	109	106	83	87	12,054	130	6,191	12,278	132	6,306	12,501	135	6,421
		FL	5 X 5	94	93	68	69	11,952	129	9,515	12,173	131	9,691	12,395	133	9,868
		WFR	6 X 5	108	93	84	69	12,091	130	7,741	12,315	133	7,885	12,539	135	8,028
	100	HMF	6 X 4	125	65	96	54	10,487	105	8,588	10,867	109	8,898	10,761	108	8,812
		MFL	4 X 4	61	60	46	46	10,956	110	17,672	11,353	114	18,311	11,242	113	18,133
		MSP	4 X 4	51	52	27	30	11,266	113	41,000	11,674	117	42,483	11,560	116	42,070
		NSP	3 X 3	41	40	20	17	11,417	114	66,260	11,830	119	68,657	11,715	117	67,988
P4	145	WFL	6 X 6	109	106	83	87	17,104	118	8,785	17,421	120	8,948	17,738	123	9,110
		FL	5 X 5	94	93	68	69	16,959	117	13,501	17,273	119	13,751	17,587	122	14,001
		WFR	6 X 5	108	93	84	69	17,156	119	10,984	17,473	121	11,188	17,791	123	11,391

Lumen Ambient Temperature (LAT) Multipliers

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

Ambient Temperature		Lumen Multiplier (Optics WFL, FL, WFR)	Lumen Multiplier (Optics HMF, MFL MSP, NSP)
0°C	32°F	1.04	1.06
5°C	41°F	1.04	1.05
10°C	50°F	1.03	1.04
15°C	59°F	1.02	1.03
20°C	68°F	1.01	1.01
25°C	**77°F**	**1.00**	**1.00**
30°C	86°F	0.99	0.99
35°C	95°F	0.98	0.97
40°C	104°F	0.97	0.96

Reported LED Lumen Maintenance

Data references the extrapolated performance projections for the platforms noted in a 25°C ambient and hours of LED testing (tested per IESNA LM-80-08 and reported per IESNA TM-21-11).

To calculate LLF, use the lumen maintenance factor that corresponds to the desired number of operating hours below. For other lumen maintenance values, contact factory.

Optic Type	Performance Package	TM-21 Percent Lumen Maintenance at 60,000 hrs
WFL, FL, WFR	P1 / P2 / P3 / P4	85%
MFL, HMF, MSP, NSP	P1 / P2 / P3	88%

Electrical Load

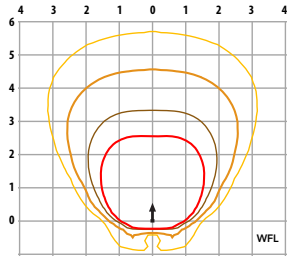
			Current (A)					
	Performance Package	System Watts (W)	120V	208V	240V	277V	347V	480V
Optic Type WFL, FL, WFR	P1	52	0.45	0.26	0.23	0.20	0.16	0.12
	P2	75	0.63	0.36	0.31	0.27	0.22	0.16
	P3	93	0.77	0.45	0.38	0.33	0.27	0.20
	P4	145	1.18	0.68	0.59	0.51	0.41	0.30
Optic Type HMF, MFL, MSP, NSP	P1	64	0.54	0.31	0.27	0.23	0.19	0.14
	P2	80	0.67	0.39	0.34	0.29	0.24	0.17
	P3	100	0.85	0.49	0.42	0.36	0.29	0.21

Photometric Diagrams

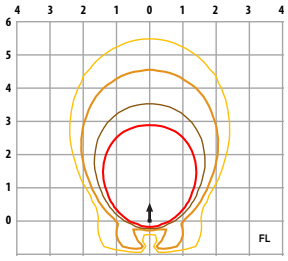
To see complete photometric reports or download .ies files for this product, visit Lithonia Lighting's D-Series Flood Size 2 homepage.

Isofootcandle plots for DSXF2. Distances are in units of mounting height (20ft).

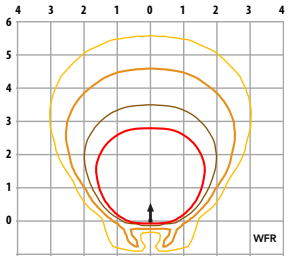
LEGEND
- 0.1 fc
- 0.25 fc
- 0.5 fc
- 1.0 fc



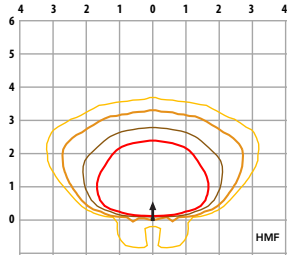
DSXF2 LED P4 40K - Tilted at 45°



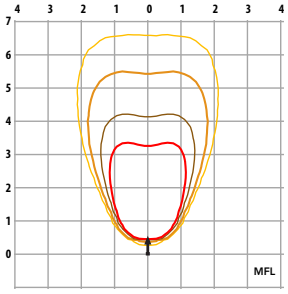
DSXF2 LED P4 40K - Tilted at 45



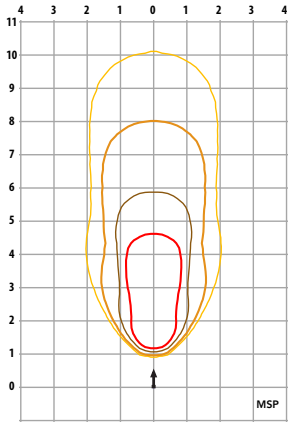
DSXF2 LED P4 40K - Tilted at 45



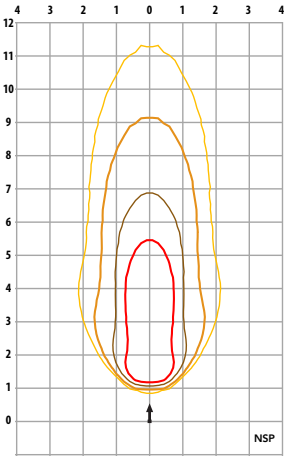
DSXF2 LED P3 40K - Tilted at 45



DSXF2 LED P3 40K - Tilted at 60



DSXF2 LED P3 40K - Tilted at 80



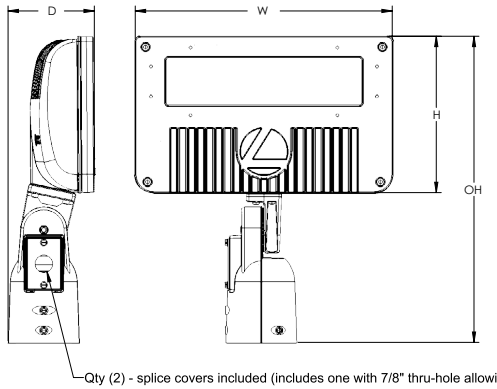
DSXF2 LED P3 40K - Tilted at 80

MH = 20ft
Grid = 20ft x 20ft

One Lithonia Way • Conyers, Georgia 30012 • Phone: 1-800-705-SERV (7378) • www.lithonia.com

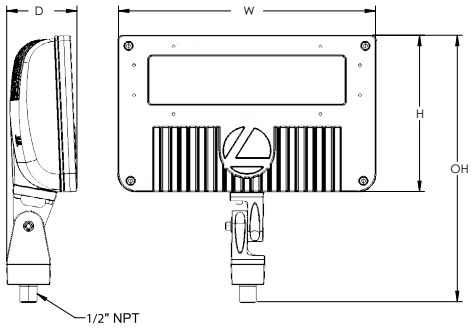
Dimensions

Adjustable Slipfitter (IS)



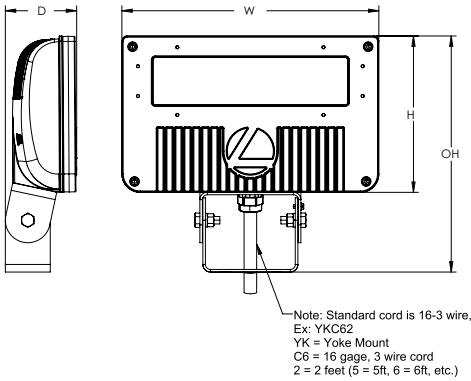
Width: 12.87" (32.7 cm)
Depth: 4.32" (11.0 cm)
Height: 7.83" (19.9 cm) main body
Overall:15.33" (39.0 cm) with arm
Weight: 12 lbs

Threaded Knuckle (THK)



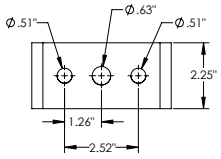
Width: 12.87" (32.7 cm)
Depth: 3.52" (8.9 cm)
Height: 7.83" (19.9 cm) main body
Overall:13.34" (33.9 cm) with arm
Weight: 10.5 lbs

Yoke (YKC62)



Width: 12.87" (32.7 cm)
Depth: 3.57" (9.0 cm)
Height: 7.83" (19.9 cm) main body
Overall:11.82" (30.0 cm) with arm
Weight: 10.5 lbs

Yoke (YK) Mounting Detail



Pole Mounting Information

Accessories including bullhorns, cross arms and other adapters are available. For the complete line of accessories available, visit the accessories tab at Lithonia's Outdoor Poles and Arms product page.
Click here to visit Accessories.

FEATURES & SPECIFICATIONS

INTENDED USE
The sleek and compact design of the D-Series floodlights reflects the embedded high performance LED technology while offering a clean aesthetic suitable for specification and general purpose floodlighting applications. Three sizes are available with seven precision optics allowing for maximum design versatility. DSXF2 delivers 7,000 to 17,000 lumens and is ideal for commercial lighting applications including new construction and replacing 175W, 250w and 400W HID floodlights. DSXF2 is ideal for area, security, facade, flagpole and signage lighting applications.

CONSTRUCTION
The DSXF2 LED floodlight features rugged die-cast aluminum construction with integral heat sink fins that optimize thermal management through conductive and convective cooling. The LED driver is mounted in direct contact with the casting to promote low operating temperature and long life. The housing and lens frame are completely sealed against moisture and environmental contaminants providing an IP66 rating. Low EPA (0.8 ft2) for optimized wind loading. DSXF2 is 1.5G vibration rated per ANSI C136.31.

FINISH
Exterior painted parts are protected by a zinc-infused Super Durable TGIC thermoset powder coat finish that provides superior resistance to corrosion and weathering. A tightly controlled multi-stage process ensures a 3 mils thickness for a finish that can withstand extreme climate changes without cracking or peeling. Standard Super Durable colors include dark bronze, black, natural aluminum, and white. Available in textured and non-textured finishes.

OPTICS
Seven unique precision-molded vacuum-metalized specular reflectors are engineered for superior field-to-beam ratios, uniformity and spacing. Light engines are available in 3000K, 4000K or 5000K (minimum 70 CRI) configurations. Optional visors offer additional versatility when shielding is required.

ELECTRICAL
Light engines consist of chip-on-board (COB) LEDs directly coupled to the housing to maximize heat dissipation and promote long life. LED lumen maintenance is L85/60,000 hours for WFL, FL and WFR optics and L88/60,000 hours for HMF, MFL, MSP and NSP optics. Class 1 electronic 0-10V continuous dimmable drivers ensure system power factor. 90% and THD <20%. Optional 10kV surge protection device meets a minimum Category C low operation (per ANSI/IEEE C62.41.2).

INSTALLATION
The die-cast integral "IS" mount features an adjustable slipfitter that mounts on a 2 3/8" OD tenon. Includes integral splice compartment offering easy installation and wiring. An extra cover plate with 7/8" through hole is provided to accommodate 1/2" water-tight fitting for power run from outside of the tenon. The "THK" adjustable knuckle mount includes a 1/2-14 NPT pipe thread. A steel yoke "YK" mount is available and includes a water tight cord grip and cord. DSXF2 features a glass lens enclosure that is protected to IP66 and is rated for lighting aimed up above 90°. Suitable for mounting within 4 feet of ground.

CONTROLS
DSXF2 features MVOLT (120-277V) and 347V button photocontrol.

LISTINGS
CSA Certified to meet U.S. and Canadian standards. Suitable for wet locations. Rated for -40°C minimum ambient.

DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN ACT
This product is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT regulations.
Please refer to www.acuitybrands.com/resources/buy-american for additional information.

WARRANTY
5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. Complete warranty terms located at:
www.acuitybrands.com/support/warranty/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	X

FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for applications requiring attractive edge-lit exit signage, universal installation and low energy consumption.

CONSTRUCTION — Extruded brushed aluminum finish.

Clear acrylic panels- letters measure 6" high with 3/4" stroke, with 100 ft viewing distance rating, based upon UL 924 standard.

For single-face clear panels, EXIT is seen as a reversed image from the back.

OPTICS — LEDs mounted on printed circuit board. The typical life of the exit LED lamp is 10 years.

The LED operating frequency is 120Hz.

ELECTRICAL — Dual voltage input capacity (120/277V).

Battery: (EL Option) – Sealed, maintenance free nickel-cadmium battery delivers 90 minutes capacity to emergency lamps. Test switch provides manual activation of 30-second diagnostic testing for on-demand visual inspection.

Self-diagnostic testing (EL Option Only) for 30 seconds every 30 days and 90 minutes annually. Diagnostic evaluation of LED light source, AC to DC transfer, charging and battery condition.

INSTALLATION — EDG – Universal mounting canopy for top or end mount. Back mount standard for single face only. Canopy provided.

EDGR – Recessed mounting. Bar hanger and brackets provided for both new or restricted ceiling access installation applications. Available for use in drop ceiling applications. Back wall mount (WM) option.

Universal directional indicators. Field selected and attached.

LISTINGS — UL damp location listed 32°-122°F (0°-50°C) standard. Meets UL924, NFPA 101 (current Life Safety Code), NEC and OSHA illumination standards. Meets all applicable FCC Title 47, Part 15, Subpart B requirements.

BUY AMERICAN ACT — Product with the BAA option is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT regulations. Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25°C. Specifications subject to change without notice.

† Exit Signs Certified in the CA Title 20 Appliance Efficiency Database.

EDG (surface mount)

EDGR (recessed mount)

LED Edge-Lit Exits

EDG
EDGR

LED Lamps

PROVIDE SELECTED FIXTURE OR ENGINEER APPROVED ALTERNATE.

Specifications

EDG (End Mount)
Length: 13-5/8 (34.6)
Depth: 5-1/2(14.0)
Height: 11-1/8 (28.3)
Shipping Weight : 4 lbs (1.8 kgs)

EDG (Top Mount)
Length: 13 (33.0)
Depth: 4-5/16 (11.0)
Height: 11-3/4 (29.8)
Shipping Weight : 4 lbs (1.8 kgs)

EDG (Back Mount)
Length: 13 (33.0)
Depth: 3 (7.6)
Height: 11-1/8 (28.3)
Shipping Weight : 4 lbs (1.8 kgs)

EDGR
Length: 13 (33.0)
Depth: 1-3/4 (4.4)
Height: 8 (20.3)
Shipping Weight : 6.8 lbs (3.1 kgs)
Shipping Weight (WM option) : 8.1 lbs (3.7 kgs)

All dimensions are inches (centimeters) unless otherwise noted.

ORDERING INFORMATION

For shortest lead times, configure products using **bolded options**.

Example: EDG 1 R EL

Family		Housing color		Number of faces		Letter color		Operations		Options	
EDG	Surface mount LED edge-lit exit	**(blank)**	Brushed aluminum	**1**	Single face	**R**	Red on clear (single face only)[1]	**(blank)**	AC only	**(blank)**	None
EDGR	Recessed LED edge-lit exit	W	White	**2**	Double face	**G**	Green on clear (single face only)[1]	**EL**	Nickel-cadmium battery	WM	Recessed wall mount[6]
						RMR	Red on mirror[2]	X2	Lamp wired on two separate AC circuits (specify 120V or 277V)[4]	BAA	Buy America(n) Act Compliant
						GMR	Green on mirror[2]	SD	Self-diagnostics[5]		
						RW	Red on white[3]				
						GW	Green on white[3]				

Accessories: Order as separate item.	
ELA US12	12" stem kit with brushed aluminum canopy[7]
ELA W US12	12" stem kit with white canopy[7]
ELA WG1	Wireguard (13 3/4"H x 15 1/4"W x 6" D, back mount only)

Notes

1 For single-face clear panels, EXIT is seen as a reversed image from the back.
2 Available with single and double face.
3 White panel standard for double and single face.
4 Not available with EL and SD options. Both circuits can be energized at the same time.
5 Available with EL option only.
6 Available on EDGR single face only
7 See spec sheet ELA-StemKits. Only available for EDG.

EDG-EDGR LED, Surface and Recessed Mount Edge-Lit Exits

SPECIFICATIONS

ELECTRICAL						
Primary Circuit						
Type	**Typical LED life**[1]	**Supply voltage**	**EDG**		**EDGR**	
			Input Watts	**Max amps.**	**Input Watts**	**Max amps.**
Red LED AC only	10 years	120	2.5	0.020	3.8	0.030
		277	2.8	0.010	4.5	0.014
Green LED AC only	10 years	120	2.2	0.020	3.8	0.030
		277	2.2	0.010	4.5	0.020
Red LED emergency	10 years	120	3.0	0.030	3.8	0.031
		277	3.1	0.010	4.5	0.015
Green LED emergency	10 years	120	2.6	0.020	3.8	0.031
		277	2.8	0.010	4.5	0.020

BATTERY (EL option)			
Sealed Nickel-Cadmium			
Shelf life[2]	Typical life[2]	Maintenance[3]	Temperature range[4]
3 years	6-8 years	none	32-122°F (0-50°C)

Notes

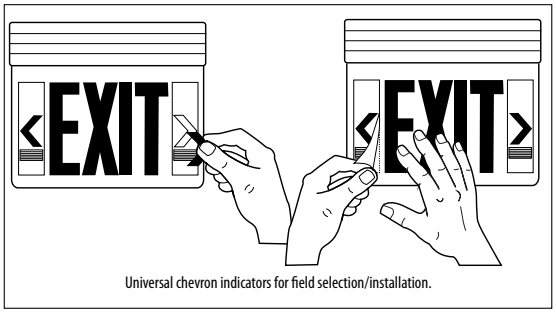
1 Based on continuous operation. The typical life of the exit LED lamp is 10 years.

2 At 77°F (25°C).

3 All life safety equipment, including emergency lighting for path of egress must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.

4 Temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

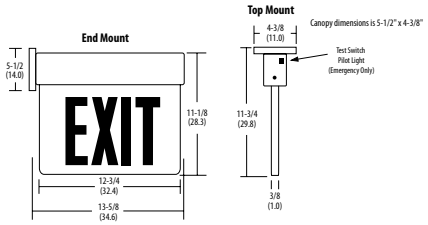
KEY FEATURES

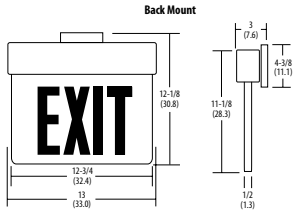


Universal chevron indicators for field selection/installation.

MOUNTING

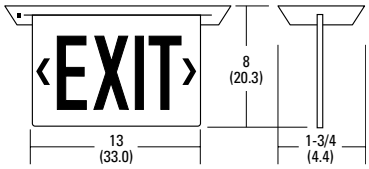
EDG

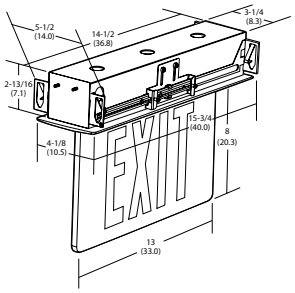




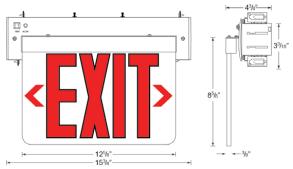
EDGR

Note: For drop ceiling applications refer to the standard installation section of the instruction sheet. Not applicable for "bracket mount" installation.





EDGR WM option



SECTION 28 3100 - FIRE ALARM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements.”

1.02 SUMMARY

A. This Section includes design and installation of a new fire alarm system.

B. Related Sections include the following:

1. Division 8 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.

1.03 DEFINITIONS

A. FACP: Fire alarm control panel.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.
D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.04 SYSTEM DESCRIPTION

A. Noncoded, addressable system; multiplexed signal transmission dedicated to fire alarm service only.
B. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.
C. Fire alarm system shall consist of the following:
    1. All new fire alarm control panel, devices, and wiring.
    2. System smoke detection above all control panels and notification appliance power supply panels.
    3. System smoke detection as required at air handling units, smoke rated transfer openings, and smoke damper locations.
    4. System smoke detection in areas identified on plans
    5. Single station combination smoke detector and carbon monoxide detector in dwelling units
    6. All flow and tamper switches to monitor fire sprinkler and standpipe systems and report appropriate alarm and supervisory signals.
    7. Manual fire alarm boxes at each building exit (prior to entering exit stairwells at each floor).
    8. Audible and visual notification appliances in all public and common areas of the building.
    9. Audible notification appliances for dwelling units
    10. Monitor modules to monitor single station detectors in each dwelling unit and report supervisory signal to FACP.
    11. Elevator Recall

1.05 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72.
B. Comply with NFPA 70.
C. Comply with NFPA 720.
D. A complete functional system meeting the requirements of this specification, including alarm initiating devices and notification appliances at locations and ratings to meet the requirements of the Authorities Having Jurisdiction and all applicable codes shall be provided.
E. Coordinate and avoid conflicts with casework, markerboards, feature walls, and other areas where fire alarm devices would interfere with furnishings, finishes, etc.
F. Fire alarm system vendor shall provide sound pressure level calculations demonstrating compliance with NFPA 72 and establish quantities and tap settings of audible devices.
G. No additional charges for work or equipment required for a code compliant system approved by the Authority Having Jurisdiction will be allowed.
H. Obtain and refer to mechanical drawings for smoke damper locations, smoke rated transfer openings, and air handling equipment CFM's. Provide smoke detection as required by applicable codes.
I. Premises protection includes B Type, R-3 Type, S-1 Type, and S-2 Type building use group.
    1. Refer to drawings for complete code analysis including construction type, use groups, special occupancy types, rated walls, smoke barriers and partitions, etc.
J. System functional performance shall be as indicated on the fire alarm matrix on the drawings.

1.06 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings:
    1. Shop Drawings shall be prepared by persons with the following qualifications:
        a. Trained and certified by manufacturer in fire alarm system design.
        b. Fire alarm certified by NICET, minimum Level III.
    2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
    3. Device Address List: Include address descriptions that will appear on the FACP display.
    4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.

5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
6. Batteries: Provide battery sizing calculations. Battery size shall be a minimum of 125% of the calculated requirement.
7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
8. Voice/Alarm Signaling Service: Equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
9. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show device layout, size and route of cable and conduits.

C. Qualification Data: For Installer.
D. Field quality-control test reports.
E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.
F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.
G. Documentation:
1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and Authorities Having Jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
a. Hard copies on paper to Owner, Architect, and Authorities Having Jurisdiction.
b. Electronic media may be provided to Architect.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
B. Installer Qualifications: Work of this Section be performed by a UL-listed company.
C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level II.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. FACP and Equipment:
a. Edwards Systems Technology Inc.
b. NOTIFIER; a Honeywell Company.
c. Siemens Building Technologies, Inc.; a Cerberus Division.
d. SimplexGrinnell LP; a Tyco International Company.
e. Gamewell-FCI; a Honeywell Company.
f. National Time & Signal.
g. Xtralis.

2.02 FACP

A. General Description:
1. Modular, power-limited design with electronic modules, UL 864, 9th edition, listed.
2. Addressable initiation devices that communicate device identity and status.

a. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.
4. Mounting: Flush.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.

C. Circuits:
1. Signaling Line Circuits between control panels: NFPA 72, Class A, Style 7
2. Signaling Line Circuits from control panel to devices: NFPA 72, Class B, Style 4.
a. System Layout: Install no more than 50 addressable devices on each signaling line circuit.
3. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
4. Actuation of alarm notification appliances, emergency voice communications, annunciation, elevator recall, shall occur within 10 seconds after the activation of an initiating device.
5. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

D. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel FACP indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.

F. Elevator Controls: Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shuts down elevators associated with the location without time delay.
1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.

G. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

H. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP after initiating devices are restored to normal.
1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

I. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.
1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones, or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall be UL 1711 listed.
a. Allow the application of and evacuation signal to indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
b. Programmable tone and message sequence selection.
c. Standard digitally recorded messages for "Evacuation" and "All Clear."

d. Generate tones to be sequenced with audio messages of the type recommended by NFPA 72 and that are compatible with tone patterns of the notification-appliance circuits of the FACP.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones.

3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

K. Service Modem: The dial-in port shall allow remote access to the FACP for programming changes and system diagnostic routines. Access by a remote terminal shall be by encrypted password algorithm.

L. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator transmitter shall be powered by the 24-V dc source.

1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."

M. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.

1. Battery and Charger Capacity: Comply with NFPA 72.

N. Surge Protection:

1. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

O. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.03 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP. Double action pull stations shall meet ADA guidelines.

2. Station Reset: Key- or wrench-operated switch.

3. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.04 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.

4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

5. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.

2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

a. Sensor: LED or infrared light source with matching silicon-cell receiver.

b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
   a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where required.
7. Each sensor shall have multiple levels of detection sensitivity.
8. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
9. Relay Fan Shutdown: Provide two (2) sets of contacts rated to interrupt fan motor-control circuit.

2.05 NONSYSTEM SMOKE DETECTORS

A. Single-Station Smoke Detectors:
   1. UL 217 listed, suitable for NFPA 101, Section 9.6.2.9 occupancies, operating at 120-V ac. , with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.
   2. Auxiliary Relays: One Form C rated at 0.5 A.
   3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.
   4. Visible Notification Appliance: 177 candela strobe.
   5. Heat sensor, 135 deg F combination rate-of-rise and]fixed temperature.
   6. Test Switch: Push-to-test, simulates smoke at rated obscuration.
   7. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
   8. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   9. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
   10. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

2.06 HEAT DETECTORS

A. General: UL 521 listed.
B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.
   1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
   1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
D. Continuous Linear Heat-Detector System: Consists of detector cable and control unit.
   1. Detector Cable: Rated detection temperature 155 deg F. Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated

with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.

2. Control Unit: Two-zone or multizone unit as indicated. Provides same system power supply, supervision, and alarm features as specified for the central FACP.
3. Signals to the Central FACP: Any type of local system trouble is reported to the central FACP as a composite "trouble" signal. Alarms on each detection zone are individually reported to the central FACP as separately identified zones.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.07 SYSTEM CARBON MONOXIDE DETECTORS

A. General Description:
1. UL 2075 listed, operating at 24-V dc, nominal.
2. Provide means for addressable connection to fire-alarm system.
3. Detector must communicate detector status (normal, alarm, or trouble) to the FACP.
4. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Detector must provide alarm contacts and trouble contacts.
6. Mounting: Adapter plate for outlet box mounting.
7. Testable by introducing test carbon monoxide into sensing cell.
8. Locate, mount, and wire in accordance with manufacturer's written instructions.
9. Test button simulates alarm condition.

2.08 NONSYSTEM CARBON MONOXIDE DETECTORS

A. Single-Station Carbon Monoxide Detectors:
1. UL 2034 listed, operating at 120-V ac., with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.
2. Detector must provide trouble alarm when nearing end-of-life, or internal faults.
3. Detector must provide alarm contacts and trouble contacts.
4. Mounting: Adapter plate for outlet box mounting.
5. Testable by introducing test carbon monoxide into sensing cell.
6. Locate, mount, and wire in accordance with manufacturer's written instructions.
7. Test button simulates alarm condition.

2.09 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
2. Finishes:
a. Wall mounted appliances: Provide white finish with red lettering.
b. Ceiling Mounted Appliances: Provide white finish.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
1. Rated Light Output: 15, 30, 60, 75, 110, 135, 185 candela as required to meet NFPA 72 requirements.
2. Strobe Leads: Factory connected to screw terminals.

2.10 REMOTE STATUS AND ALARM INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.11 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate.
   1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
   2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
   3. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.12 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

2.13 ADDRESSABLE CONTROL MODULE

A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:
   1. Communication interaction with the analog signaling circuit having the capability of initiating a control function to an auxiliary device based on a specified event.
   2. Provide NO/NC contact pairs rated at 2 amps 120 VAC or 24 VDC.

2.14 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled according to UL 632.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.15 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Fire alarm wire and cable shall be as specified by the system manufacturer including conductor gage, conductor quantity, conductor twists and shielding required to meet NFPA class and style performance specified.

C. Signaling Line Circuits and other power limited fire alarm circuits (PLFA):
   1. PLFA circuits installed in conduit or raceway: U.L. Listed type FPL
   2. PLFA circuit cable installed exposed in accessible ceiling spaces, risers and elsewhere: U.L. Listed type FPLP.
   3. PLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Circuit integrity cable, NFPA 70 Article 760, Classification CI, UL listed as Type FPL, FPLR or FPLP as required, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.

D. Non-Power-Limited Fire Alarm Circuits (NPLFA):
   1. NPLFA circuits installed in conduit: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
      a. Low-Voltage Circuits: No. 16 AWG, minimum.
      b. Line-Voltage Circuits: No. 12 AWG, minimum.
   2. NPLFA circuit cable installed exposed in ceiling spaces, risers and elsewhere: Multi-conductor cable, U.L Listed type NPLFP.
   3. NPLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Multi-conductor cable, U.L Listed type NPLFP-CI
   4. NPLFA circuit cable installed exposed in ceiling spaces, shafts and elsewhere: Multi-conductor Armored Cable, NFPA 70 Type MC, copper conductors, copper drain wire, aluminum or steel armor

with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Smoke or Heat Detector Spacing:
   1. Smooth ceiling spacing shall not exceed 30 feet or the listed spacing of the detectors, whichever is less.
   2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
   3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct.

D. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

E. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

F. Single-Station Carbon Monoxide Detectors: Where more than one carbon monoxide detector is installed within a dwelling or suite, they shall be connected so that the operation of any carbon monoxide detector causes the alarm in all carbon monoxide detectors to sound.

G. Audible Alarm Notification Appliances: Install wall mounted appliances not less than 6 inches below the ceiling.

H. Visible Alarm Notification Appliances: Install wall mounted appliances at 96” AFF or 6 inches below the ceiling, whichever is less.

I. Coordinate ceiling mounted appliances with reflected ceiling plans. Do not install visual appliances where pendant mounted or suspended lighting fixtures will obstruct intended viewing angles.

J. Install wall mounted and ceiling mounted notification appliances flush on recessed j-box or back box for all new work and on existing gyp-board partition walls.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. FACP: Surface mounted with tops of cabinets not more than 72 inches above the finished floor.
   1. Install smoke detector above panel. Install on ceiling for ceilings under 10 ft. For ceilings above 10’, wall mount a smoke detector listed for releasing service 10’ AFF or 1’ below finished ceiling (whichever is lower).

M. Provide all 120V branch circuits for all control panels, sub panels, and ancillary equipment required for the system.

3.02 WIRING INSTALLATION

A. Install wiring according to the following:
   1. NECA 1.
   2. TIA/EIA 568-A.

B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes."
   1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section “Electrical Identification."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.04 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.06 PROGRAMMING

A. Coordinate final address descriptions for alarm, supervisory and trouble indication that appear on FACP and Annunciator displays with the Owners representative. This shall include all room names, room numbers, building areas for fire protection zones, exit door descriptions and similar items. This coordination shall take place and be implemented in the programming prior to Demonstration and Owner Training.

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

C. Semiannual Test and Inspection: Six months after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

D. Annual Test and Inspection: One year after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections.

3.08 WARRANTY

A. All newly installed equipment shall be warranted by the contractor for a period of one year following acceptance. The warranty shall include parts, labor, prompt field service, pickup and delivery.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 28 3100

SECTION 32 3 3

POST-TENSIONED CONCRETE SPORT COURT

PA T 1 - ENE AL

1.1 SUMMA

A. Section includes:
1. Concrete Paving for Sport Court
2. Post-tensioned Concrete for Sport Court

B. elated equirements:
1. 32 17 23 - PA EMENT MA KIN S
2. 31 20 00 EA TH MO IN (See Civil s Plans)

1.2 DEFINITION

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. /C atio: The ratio by weight of water to cementitious materials.

1.3 P EINSTALLATION MEETIN S

A. Preinstallation Conference: Conduct conference at Project site.

1. eview methods and procedures related to post-tension concrete, including but not limited to, the following:

a. Concrete mixture design.
b. uality control of post-tensioned concrete materials and post-tensioned concrete paving construction practices.
c. Post-tensioned concrete design.

2. equire representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.
b. Post-tensioned concrete paving Subcontractor.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Court contractor shall furnish a Shop Drawing for the Post-tensioned slab. The shop drawing shall be submitted to the Consultant at a minimum of 10 days prior to installation.

C. Design Mixtures: For each concrete paving mixture include alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

D. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection, provide a sample to the Consultant.

1.5 INFO MATIONAL SUBMITTALS

A. ualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Post-tension accessories
5. Admixtures.
6. Curing compounds.
7. Applied finish materials.
8. Bonding agent or epoxy adhesive.

C. Field quality-control reports.

1.6 UALIT ASSU ANCE

A. eady-Mix-Concrete Manufacturer ualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to N MCA's Certification of eady Mixed Concrete Production Facilities (uality Control Manual - Section 3, Plant Certification Checklist).

B. Post-tensioned Concrete ualifications: A firm experienced in the installation and design of post-tensioned concrete slabs with experience and necessary licensure for building sport courts in the state of Michigan.
1. The work shall conform to the standards of the American Sports Builders Association (ASBA) for basketball court construction.
2. All steel tendon installation, concrete work, and stressing of tendons shall be done by selected contractor. This provision intent is to provide continuity and one source responsibility for the integrity of the post-tensioned slabs.
3. Court contractor shall have a minimum of 5 years of experience building post-tensioned concrete courts.
4. The court contractor must provide references for three (3) similar post-tensioned concrete sport courts they have built.
5. Contractor shall have a PTI Level 1 Unbonded Certified Field Technician on site. Proof of certification shall be required of successful bidder.

C. Testing Agency ualifications: ualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests must be qualified as ACI Concrete Field-Testing Technician, rade 1, according to ACI CP-1 or an equivalent certification program.

1.7 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold- eather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. hen air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot- eather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, post-tension reinforcement accessories, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PA T 2 - P ODUCTS

2.1 CONC ETE, ENE AL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

2.2 FO MS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for any curves with a radius of 100 feet (30.5 m) or less.

B. Form- elease Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 SAND BASE

A. eneral equirements: The sand base shall be installed beneath the post-tension concrete slab to provide uniform support, promote drainage, and facilitate proper load distribution. The sand base material shall conform to the following specifications and shall be approved by the project Consultant prior to installation.

B. Sand Material: The sand used for the base shall meet the following criteria:
   1. Sand shall adhere to gradation, fines, and all other standards for MDOT Class II granular material. See Preparation section for compaction rates.

2.4 TENSIONIN TENDONS AND ANCHO S

A. Post-tensioning tendons and anchorages shall conform to the PTI uide Specifications for Post-tensioning Materials .

B. The tensioning tendons shall consist of one-half inch (1/2) diameter, 7-wire, stress relieved tendons, having a guaranteed ultimate tensile strength of 270,000 PSI (270 Kips). Tendons shall conform to ASTM-416. Tendons shall be fabricated to proper length for each slab, coated with a permanent rust preventative lubricant and encased in sheathing. Any damage to sheathing shall be repaired with tape prior to concrete placement. A maximum of six inches (6) of exposed tendons is permitted at the dead-end anchor. Any damaged tendons shall be removed and replaced prior to concrete pour.

C. Calculations verifying minimum tendon stress required to achieve minimum residual compressive force of 150 psi at center of slab.

D. Anchorage for post-tensioning tendons shall be monotendon-type anchor system with current ICBO approval using a ductile iron casting of at least 2.25 inches by 4.5 inches of bearing. Pocket-formers shall be used on all stressing ends. The pocket-former shall provide adequate concrete coverage for the anchor as required by project details. Coating pocket-formers with oil or similar materials for ease of removal is acceptable. All dead end anchorages shall be shop fabricated, pre-seated wedges. Fabrication and manufacture of the unbonded system shall be in accordance with the guide specifications as outlined by the post-tensioning institute.

E. All tendons shall be supported on plastic chairs and loosely tied as shown in drawings at all intersections (too tightly tied, tendon friction will increase with tensioning) to prevent vertical and horizontal movement during concrete placement. Tendons shall be placed as shown in drawings. See drawing details for spacing.

F. Concrete must be well consolidated, especially in the vicinity of tendon anchorages.

. Along the thickened perimeter section, the tendons are anchored deeper in the concrete from the surface of the slab. See details for depth. Two 4 rebar lie longitudinally around the court beam directly inside the tendon anchor on top of the tendons. Overlapping should be a minimum of three (3) inches and should not conflict with any anchors.

H. Tendons should undergo a pre-stress and final-stressing per PTI standards and as outlined further in the specifications and drawings.

I. Tendons should be anchored at 28.9 KIPS but may be initially stressed at 33 KIPS. A 12 x36 area should be allowed for stressing equipment clearance near each anchor as shown in the drawings. The stressing process generates tremendous pressures and extreme care should be taken to prevent injury from operator error or failure of equipment or materials.

. Contractor shall submit shop drawings of tendon layout, spacing and anchoring for approval prior to construction.

2.5 APO BA IE

A. Use minimum 6 mil thick polyethylene sheeting meeting the requirements of ASTM E 1745.

B. The vapor barrier shall consist of two (2) layers and shall be installed prior to the installation of any steel and/or tendons. Overlap polyethylene sheets at least 12 and tape joints. Once in place, no vehicular traffic should be allowed on the vapor barrier nor any other object which could puncture the barrier or otherwise compromise the integrity of the surface. All concrete shall be placed using a concrete pump-truck.

2.6 STEEL EINFO CEMENT

A. Epoxy-Coated einforcing Bars: ASTM A775/A775M with ASTM A615/A61M, rade 60 (4) backup bars.

B. Bar Supports: Bolsters, plastic chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to C SI's Manual of Standard Practice from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

C. Epoxy epair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.7 CONC ETE MATE IALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project. Fly ash shall not be permitted as a supplementary cementitious material (SCM). The proportion of SCMs shall not exceed 25 of the total cementitious content by weight unless otherwise specified by the Consultant.

1. Portland Cement: ASTM C150/C150M, Portland cement Type I/II

2. Silica Fume: ASTM C1240, 5-10 of the total cementitious content by weight.
3. Slag Cement: ASTM C989/C989M, rade 100 or 120.

4. The cement shall be stored in a dry, weatherproof facility to prevent moisture absorption and contamination. No cement that has become caked or has deteriorated in any way shall be used.

B. Fine and Course Aggregates:
   1. The fine aggregate shall meet all the requirements of Section 902 of the Michigan Department of Transportation (MDOT) specification for 2NS-Natural Sand.
   2. The course aggregate shall meet all the requirements of Section 902 of the Michigan Department of Transportation (MDOT) specification for No. 6A Coarse Aggregate. Nominal size for concrete work at 5 thickness should not exceed 1 ½ .

C. Air-Entraining Admixture: ASTM C260/C260M.

D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

   1. ater- educing Admixture: ASTM C494/C494M, Type A.
   2. etarding Admixture: ASTM C494/C494M, Type B.
   3. ater- educing and etarding Admixture: ASTM C494/C494M, Type D.
   4. High- ange, ater- educing Admixture: ASTM C494/C494M, Type F.
   5. High- ange, ater- educing and etarding Admixture: ASTM C494/C494M, Type .
   6. Plasticizing and etarding Admixture: ASTM C1017/C1017M, Type II.

E. ater: Potable and complying with ASTM C94/C94M.

2.8 CU IN MATE IALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

B. Moisture- etaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. ater: Potable.

D. Evaporation etarder: aterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, aterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

2.9 ELATED MATE IALS

A. oint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types I and II, non-load bearing for bonding hardened or freshly mixed concrete to hardened concrete.

D. Chemical Surface etarder: ater-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (3 to 6 mm).

2.10 CONC ETE MI TU ES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. hen automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Fiber einforcement:
1. Synthetic Fiber, Monofilament Fibers: Monofilament polypropylene fibers Consultanted and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.
   a. The contractor shall provide documentation verifying the fiber complies with the specified standards and is appropriate for use in the post-tensioned concrete application.
2. Fiber Dosage: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. (0.90 kg/cu. m)
3. Mixing Procedures: Fibers shall be introduced into the concrete mix at the batching plant or directly into the ready-mix truck as per the manufacturer's guidelines. Care shall be taken to ensure even distribution of fibers throughout the mix without clumping. The contractor shall monitor the mixing process to prevent any disruption to the post-tensioning operation and ensure that the workability and ability to finish the concrete are not adversely affected.

C. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa)
2. Maximum /C atio at Point of Placement: 0.45
3. Slump Limit: 4 inches (100 mm)

D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content, 1-inch (25-mm) Nominal Maximum Aggregate Size: 6 percent plus or minus 1 percent.

2.11 CONC ETE MI IN

A. eady-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the ork.

1. hen air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the ork, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

2.12 PLACIN

A. A full court shall be placed in one continuous operation. The post-tensioned concrete slab will be placed with a laser screed capable of providing a surface to □ in 10 at a 1 slope. Finish surface shall not have a water holding area greater than 1/8 deep (cover a nickel). This is to be determined by the flooding the court with water, allowing it to drain for 1 hour on a 70 F or warmer day.

PA T 3 - E ECUTION

3.1 E AMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with
3. a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
4. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) according to requirements in Section 31 20 00 Earth Moving.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 P EPA ATION

A. emove loose material from compacted subbase prior to placement of Base Course.

B. Subgrade: The area will be graded to the required depth to accommodate the base and concrete thickness and provide a uniform one percent (1.25) slope at plus or minus one tenth of a foot (.1) in one plane as shown in the drawings. Scarify and compact top 8 inches of subgrade to ninety percent (90) of standard density (AASHTO T-99) at optimum moisture. All fills will be placed in maximum six-inch (6) layers and will be smooth and well compacted and to form a uniform plane. The contractor will alert the owner of any soft spots or structures that could affect the stability of the slab.

C. Sand Base: The base material shall be placed with automatic laser-regulated equipment capable of providing a true plane to plus or minus one-quarter inch (1/4). The depth of the fine grade base material shall be sufficient to develop one-quarter inch (1/4) accuracy. Place in one layer and compact to ninety five percent (95) of standard density (AASHTO T-99) at optimum moisture content. Consultant shall perform density testing on the granular base to verify that the compaction meets the project specifications.

D. Fine rade Base: Place with automatic laser-regulated equipment capable of providing a true plane to plus or minus one-quarter inch (1/4). Place in one layer and compact to ninety five percent (95) of standard density (AASHTO T-99) at optimum moisture. rade fine grade base material to within one-quarter inch (1/4) accuracy.

E. efer to Site Preparation 31 20 00 for further information on sub-base and base prep.

F. Place vapor barrier.

. Coordinate with Isolation oints at perimeter of slab where necessary.

3.3 ED E FO MS AND SC EED CONST UCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Forms shall be accurately set to the lines and to plus or minus one-quarter inch (1/8) of finished grades indicated on drawings and be securely staked to prevent settlement or movement during placement of concrete.

C. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 TENSIONIN TENDONS AND ANCHO S

A. All tendons shall be supported on plastic chairs and loosely tied two inches (2) high at all intersections (too tightly tied, tendon friction will increase when tensioning) to prevent vertical and horizontal movement during concrete placement. Tendons shall be placed as Consultanted. See drawing details for tendon spacing.

B. Install tendons and anchors at locations shown on plans. Locate Interior tendons (away from edge of slab or opening) at the approximate location dimensioned on plans. Tendon locations not dimensioned on plans shall be placed at approximately equal spaces between dimensioned control points.

C. All tendon overlaps shall be centered in depth in concrete slab unless noted otherwise.

D. Secure all tendons at each intersection with the appropriate plastic chair or Dobie blocks. ertical tendon dimensions shall vary not more than 1/8 from the dimensions shown on the drawings. Plastic chairs which provide saddle or side clips for the tendons need only be tied at every third tendon intersection. Dobie block or other chairs which allow tendons to move laterally shall be tied at each tendon intersection. Tie all tendon intersections at the perimeter of the slab.

E. emove plastic tendon sheathing within 3 inches of back of anchor. Secure the dead end and stressing end anchors to the form boards with nails. Provide proper concrete coverage per project details.

F. ithin the thickened perimeter, tendons are anchored approximately 3.5 down from the surface of the slab see details. Two 4 rebar shall be placed longitudinally around the court beam directly inside the tendon anchor, one under and one over the tendon(s) refer to drawing details. Overlapping should be a minimum of three (3) inches.

3.5 INSTALLATION OF STEEL EINFO CEMENT

A. eneral: Comply with C SI's Manual of Standard Practice for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Epoxy-Coated einforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. epair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.

F. Placement of steel reinforcement shall be coordinated with placement of post-tensioning tendons proper tendon placement has priority.

3.6 OINTS

A. eneral: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. hen joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Isolation oints: Form isolation joints of pre-formed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.

2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. here more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. emove protective cap after concrete has been placed on both sides of joint.

C. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch (6-mm) radius. epeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.7 CONC ETE PLACEMENT

A. A full court shall be placed in one continuous operation without intervening joints of any kind. The slab will be placed with a fourteen- and one-half foot (14.5) mechanical laser screed capable of providing a surface to 1/8 in 10 at a 0.83 slope.

B. Concrete contractor shall ensure that workmen exerciser great care so as not to disturb locations of tendons during concrete placement.

C. Before placing concrete, inspect and complete formwork installation, post-tensioning tendons and anchors, steel reinforcement, and items to be embedded or cast-in.

D. emove snow, ice, or frost from subbase surface, post tensioning tendons and anchors, and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

E. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

F. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

H. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, post-tensioning tendons and anchors, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating post-tensioning reinforcement, dowels, and joint devices.

I. Screed paving surface with a straightedge and strike off.

. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.8 TENSIONIN TENDONS AND ANCHO S

A. After the forms are removed and the concrete has set to a minimum of 1,700 PSI, the half stress tensioning procedure may begin. Approximately one (1) week later, each tendon may be tensioned to a maximum of eighty percent (80) ultimate breaking strength, and anchored a minimum of seventy percent (70) ultimate breaking strength.
   a. 100 Ultimate breaking strength 41.3 Kips
   b. 80 Ultimate breaking strength 33.0 Kips
   c. 70 Ultimate breaking strength 28.9 Kips

B. The tendon ends shall be cut off and cone holes grouted flush with edge of slab. rout shall be non-shrink grout.

3.9 FLOAT FINISHIN

A. eneral: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. efloat surface immediately to uniform granular texture.
   1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to backboards (from sideline to sideline), to provide a uniform, fine-line texture.

3.10 CONC ETE P OTECTION AND CU IN

A. eneral: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation etarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture-retaining-cover curing as follows:

   1. Moisture- etaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, with sides and ends lapped at least 12 inches , and sealed by waterproof tape or

adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

3.11 PA IN TOLE ANCES

A. Comply with tolerances in ACI 117 (ACI 117M) and as follows:

1. Elevation: 3/4 inch
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch.
3. Surface: ap below 10-feet- long unleveled straightedge not to exceed 1/2 inch .
4. oint Spacing: 3 inches.
5. oint idth: Plus 1/8 inch, no minus.

3.12 FIELD UALIT CONT OL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

    a. hen frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test to be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results to be reported in writing to Consultant, concrete manufacturer, and Contractor within 48 hours of testing. eports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting

agency, location of concrete batch in ork, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Consultant but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Consultant.

. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.13 EPAI AND P OTECTION

A. emove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. emove work in complete sections from joint to joint unless otherwise approved by Consultant.

B. Drill test cores, where directed by Consultant, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. hen construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 32 23

PA□E ENT AR IN S

PA T 1 - ENE AL

1.1 SUMMA

A. Section Includes:
1. Painted markings applied to concrete surfaces.

1.2 ELATED DOCUMENTS

A. 32 13 13 - POST-TENSIONED CONC ETE SPO T COU T

1.3 P EINSTALLATION MEETIN S

A. Preinstallation Conference: Conduct conference at Project site.

1. eview methods and procedures related to marking concrete surfaces including, but not limited to, the following:

a. Concrete-surface aging period before application of pavement markings.
b. eview requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.
1. Pavement-marking paint, latex.

B. etain Samples Paragraph below for single-stage Samples, with a subordinate list if applicable.

C. Samples: For each exposed product and for each color and texture specified on rigid backing, 8 inches square.

1.5 UALIT ASSU ANCE

A. egulatory equirements: Comply with materials, workmanship, and other applicable requirements of MDOT (Michigan Department of Transportation) and ASBA (American Sports Builders Association) for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F, and not exceeding 95 deg F.

PA T 2 - P ODUCTS

2.1 MANUFACTU E S

A. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PA EMENT-MA KIN PAINT

A. Pavement-Marking Paint, Latex: MPI 97, latex traffic-marking paint.

1. Color: hite

PA T 3 - E ECUTION

3.1 E AMINATION

A. erify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PA EMENT MA KIN

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete surfaces to age for a minimum of 60 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal. (0.72 kg/L).

3.3 P OTECTIN AND CLEANIN

A. Protect pavement markings from damage and wear during the remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 32 2 00
FINE RADIN LA N SEEDIN SITE STA ILI ATION

PART - ENERAL

0 SU AR

A Provide all fine grading and seeding where shown on Drawings, as specified herein and as necessary for a complete and proper installation.
ork shall include but not be limited to:
1. Placing topsoil for landscape beds, rain gardens, Microclover and lawn areas.
2. Fine grading for landscape beds, rain gardens, Microclover and lawn areas.
3. Installing Microclover Seed
4. Installing lawn mix with the addition of the following seeds:
   a. Dutch Micro Clover
   b. iolets

02 RELATED DOCU ENTS

A. Attention is directed to Bidding and Contracting equirements, Drawings and eneral Provisions of the Contract, including eneral Conditions and the ayne County Standard Specifications for Construction, which are hereby made part of this Section.
. elated sections:
1. Site Preparation 31 10 00
2. Erosion and Sedimentation Controls 31 25 00
3. Earth Moving 31 20 00
4. Plants 32 93 00

03 REFERENCE SPECIFICATION

A **AOSA -**Association of Official Seed Analysis: ules for testing Seeds, ournal of Seed Technology, 1991 Edition
TAPPI-Technical Association of the Pulp and Paper Industry

C **AOAC -** Official Methods of Analysis, Association of Official Analytical Chemists.

D Materials and work covered under this Section shall be in accordance with MDOT (2020 edition), ayne County, Standard Specifications for Construction unless otherwise indicated. If a conflict exists between specifications, the more rigorous shall govern.

0 UALIT ASSURANCES

A Soil amendments: Copies of invoices shall be provided to the CONSULTANT. Samples must be provided if requested by the CONSULTANT.
Seed: Provide the CONSULTANT with manufacturer's certification of compliance to the Specifications prior to seeding.

C The CONT ACTO shall notify the CONSULTANT of seed sources 30 days after the contract award.

D CONT ACTO shall review seed sources with CONSULTANT prior to ordering and shall submit an invoice following purchase and delivery of the seed.

E Installation of seed shall be carried out by CONT ACTO and their employees who are thoroughly experienced and skilled in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this section. The CONT ACTO shall have a minimum of five (5) years documented experience in comparable work.

F rading and seeding layout shall be reviewed by the CONSULTANT prior to completion.

0 SU ITTALS

A The CONT ACTO shall submit to the CONSULTANT sources for seed 30 days after contract award.
The CONT ACTO shall submit to the CONSULTANT a plan and schedule for seeding at least two (2) weeks prior to the scheduled commencement of work.

C The CONT ACTO shall submit to the CONSULTANT results of the soils analysis and starter fertilizer recommendation dictated in TOPSOIL section of this Specification.

0 DELI□ER□ STORA E AND ANDLIN

A Soil amendments shall be kept dry.
Seed shall be delivered in original sealed containers, labeled in accordance with State egulations and the US Department of Agriculture ules and egulations under the Federal Seed Act. Seed shall be stored in such a manner that it will be protected from damage by heat, moisture, rodents, or other causes.

0 SEEDIN TI E

A Permanent lawn and Microclover seeding shall be done between May 1 and une 15, or between August 15 and September 15 or as otherwise approved by the CONSULTANT. Erosion control matrix can be seeded in the fall prior to the spring planting or within the same planting season, as conditions necessitate for erosion control and establishment of the permanent seed matrices.

PART 2 - PRODUCTS

2 0 STARTER FERTILI□ER

A Starter fertilizer for lawn seed, sod, and Microclover seed: Starter fertilizer shall be Milorganite (6-2-0), available through hino Seed and Landscape Supply, Brighton, Michigan (800.482.3130), or approved substitute.

2 02 LA□ N SEED

A Apply lawn seed at a species rate of 250lb/acre.
The Proposed lawn is to be seeded with a lawn mix (below), then overseeded with a mix (below).

C Lawn seed shall be TH Mix (Heavy Soil). Seed Supplier: Seed is available through hino Seed 850 N Old US 23 Brighton, MI 48114 (800.482.3130).

D Lawn overseed shall be Bee Lawn Seed Mixture (Flowers Only). Seed Supplier: Seed is available through Twin City Seed Co., 7265 ashington Ave S, Edina, MN (800.545.TU F).

E Apply overseed at a rate of 2.5lb/1,000sqft (Two and a half pounds per thousand square feet).

2 03 ICROCLO□ER SEED

F Apply Microclover seed at a species rate of 1lb/1000sqft (1 pound per 1,000 square feet).

A Microclover areas on the plans are to be seeded with a Microclover seed mix (below).
Microclover seed shall be the Microclover blend from BioAg. Seed Supplier: Seed is available through ocky Mountain BioAg 3045 Aerotech Parkway, Unit 6, Montrose, CO 81401 (877.874.2334).

2 0 EROSION CONTROL SEED ATRI□

A Apply erosion control seed matrix at a species rate of pounds per acre as indicated on the Drawings.
Seed sources for the erosion control seed matrix are available through hino Seed and Landscape Supply, Brighton, Michigan (800.482.3130).

2 0 ULC □□LA□ N AND ICROCLO□ER SEED-DR□

A Material shall be straw. It shall be natural and suited for horticultural use and not contain lumps, roots or other foreign matter over one inch in diameter. It shall be free of noxious weeds. Mulch shall not contain more than 35-percent moisture by weight.

2 0 ULC □□□LA□ N AND ICROCLO□ER - □DROSEED

A Material shall be hinoTurf or AmTurf reen Star Plus, paper mulch with binder or approved substitution.

2 0 □DOSEED TURF SLURR□ I□

A Mix shall consist of:

1. Fertilizer: 1300 lbs per acre
2. Mulch: 2000 lbs per acre
3. Lawn Seed: 5.7 lbs per 1,000 square feet or 250 lbs. per acre
4. Microclover Seed: 1 lbs per 1,000 square feet or 44 lbs. per acre

2 0 □ ATER

A Source: If not available on site, shall be provided by the CONT ACTO . CONT ACTO may rent a hydrant meter from Oakland County s field operations unit, and must install backflow preventer on the meter assembly. ent is 1000 with the fee being applied to water use counted by the hydrant meter. Any unused portion of the rental fee returned to the CONT ACTO at the time the CONT ACTO returns the meter assembly to the O NE . If the CONT ACTO exceeds the rental amount at time of return, the CONT ACTO shall pay Customer Service the difference.

uality: ater supplied by the CONT ACTO shall be free of substances harmful to plant growth.

2 0 TOPSOIL

A Follow requirements outlined in the SITE P EPA ATION 31 10 00 Section, or see Civil Engineer s plans for information on existing topsoil.

Existing topsoil that has been stripped and stockpiled shall be re-spread on the finished sub grade. It shall be free of any admixture of subsoil, stones larger than one (1) inch, clods of hard earth, plants or roots, sticks, concrete, asphalt, or other extraneous material. It shall contain no toxic materials.

C uantity: The CONT ACTO shall be responsible for estimating the quantity of topsoil stockpiled, and the quantity of imported topsoil necessary to obtain the specified depth of topsoil to be re-spread. The CONT ACTO shall report any discrepancy between work on the Plans and in the Specifications to the CONSULTANT.

D Depth of topsoil for various planting conditions are as follows:

a. Lawn and Microclover areas: 4
b. ain ardens: 12
c. Planting bed areas: 6

E Imported topsoil shall be friable sandy loam capable of supporting optimal plant growth and development. It shall be free of clay lumps, subsoil, invasive weeds and seeds, stones, sticks and other extraneous materials.

F Analysis for existing and any necessary imported topsoil for planting areas shall be done at the CONT ACTO S expense and shall be submitted to O NE /CONSULTANT for approval prior to use.

a. The structural topsoil analysis for PLANTIN A EAS shall include the following and be within the listed parameters:
b. 1. Clay content: 5-15
c. 2. pH range: 6.0-7.5
d. 3. Organic matter content: 5-10
e. Testing for topsoil for Planting areas may be performed through A L reat Lakes Laboratories, Inc., Fort ayne Indiana 260.483.4759.

2 0 CO POST

A Compost shall be used only from a facility registered within the State of Michigan that provides regular testing, or as approved by CONSULTANT.

2 0 EROSION CONTROL LAN ET

A Erosion control blanket shall be North American reen Straw Erosion Control Blanket S150 BN, 100 biodegradable, jute netted or approved substitution.
Pegs shall be of sound wood and sized per MDOT Standard Specifications, latest edition.

C Erosion control blanket supplier: Erosion control blanket is available through Price and Company, Inc., yoming, Michigan (616.530.8230).

PART 3 - E□ECUTION

3 0 SU RADE PREPARATION

A In landscape bed areas: Upon completion of rough grading, the CONT ACTO shall de-compact and scarify the subgrade, to a minimum depth of two (2) inches.
Subgrade depth in rain gardens: 12

C Subgrade depth in lawn and Microclover areas: 4

D Subgrade depth in planting beds: 6

3 02 PLACIN TOPSOIL □□□ FINE RADIN

A epair topsoil as directed by the CONSULTANT so that finish grades are met.
Topsoil shall be placed to a minimum depth of four (4) inches for lawn/Microclover areas, six (6) inches depth for planting areas and twelve (12) inch depth for rain gardens, so that the finish surface is a fine seedbed, varying not more than one (1) inch in ten (10) feet.

C Final grades will be reviewed by the CONSULTANT prior to demobilization/completion.

3 03 □DROSEEDIN FOR LA□ N

A Mixing:

1. Mix location: Perform slurry preparation at job site.
2. Adding water: Add water to the tank when the engine is at half throttle. hen the water level has reached the height of the agitator shaft, establish good re-circulation and add seed.
3. Seed: Do not allow seed to remain fore than 30 minutes is slurry.
4. Fertilizer: Add fertilizer without mulch. Commence spraying immediately when the tank is full.
5. Mulch: Apply mulch in a separate operation after seed and fertilizer have been applied.

Application:

1. Apply specified slurry mix in a sweeping motion to form a uniform mat at the specified rate
2. Keep hydroseeding within designated areas and keep from contact with other plant materials
3. Apply seed and mulch in two separate operations.

3 0 SEEDIN AND FERTILI□IN FOR LA□ N AND ICROCLO□ER

A Application:

1. Sow the seed using a mechanical seeder such as a lawn maker or brillion. A cultipacker or approved similar equipment may be used to cover the seed and form the seedbed in one operation.
2. Sow at the species rate of pounds per acre as indicated on the drawings.
3. Lines of seed shall be perpendicular to slopes to reduce rapid surface water run-off. If this option is chosen fertilize prior to seeding operations.

Fertilizing:

1. The City of Ann Arbor has adopted an ordinance limiting phosphorus in fertilizer. Applications of fertilizer beyond the initial topsoil and seeding shall be a fertilizer with no phosphorus.
2. Apply starter fertilizer with a mechanical spreader prior to seeding operation as necessary to promote optimal growth.
3. Thoroughly incorporate fertilizer into topsoil to a depth of two (2) inches.
4. Immediately before sowing lawn/Microclover seed, CONT ACTO shall rework the surface until it is fine, pulverized seed bed, varying not more than one (1) inch in ten (10) feet.

3 0 □ EEDS

A Invasive grasses such as crabgrass, smooth brome, reed canary, quack grass or other invasive grasses and/or forbs shall be spot controlled beginning in May with Herbicide-A (or approved substitution) until the end of the first full growing season and/or before the plants set seed. Herbiciding maintenance shall not threaten any adjacent planting areas. Alert the CONSULTANT if a conflict between lawn/Microclover maintenance and the health of the planting areas exists.

3 0 EROSION CONTROL LAN ET INSTALLATION

A Install erosion control blanket per manufacturer s specifications in locations indicated on Plans. In addition, erosion control blanket shall be installed where the CONT ACTO feels it necessary to stabilize the site. Additional blanket beyond what is indicated on the Plans shall be provided and installed at the expense of the CONT ACTO .
Begin at top of the slope by anchoring the blanket in a 6-inches deep x 6-inches wide trench. Backfill and compact the trench after staking.

C oll the blankets down the slope in the direction of the water flow.

D The edges of parallel blankets must be staked with approximately two (2)-inch overlap. hen blankets must be spliced down the slope, place blankets end over end (shingle style) with approximately six (6)-inch overlap. Stake through overlapped area, approximately 12 inches apart.

E In general, stake blanket approximately one (1) stake per one (1) square foot.

3 0 ULC IN

A Lawn/Microclover seeded areas shall be mulched per MDOT Specifications, latest edition.

3 0 ESTA LIS ENT AND ACCEPTANCE LA□ N □□□ ICROCLO□ER

A The O NE will water and maintain lawn for this project. O CONT ACTO may use building water to maintain lawn/Microclover for this project.

END OF SECTION

SECTION 32 3 00
PLANTS

PART - ENERAL

0 SU AR

A Provide Planting where shown on drawings as specified herein, and as needed for a complete and proper installation.
ork shall include:
1. Tree and shrub planting
2. Perennial, and groundcover planting
3. Landscape bed steel edging

02 RELATED DOCU ENTS

A Attention is directed to Bidding and Contracting requirements, drawings and general provisions of the Contract, including eneral Conditions and Division 1 Specification sections, which are hereby made part of this section.
elated Sections:
1. Fine rading, Lawn Seeding and Site Stabilization 32 92 00
2. Plant Maintenance and uarantee Period 32 93 20

03 REFERENCE SPECIFICATIONS

A **AOSA -**Association of Official Seed Analysis:
ules for testing Seeds, ournal of Seed Technology, 1991 Edition
C **TAPPI-**Technical Association of the Pulp and Paper Industry
D **AOAC -** Official Methods of Analysis, Association of Official Analytical Chemists.
E Materials and ork covered under this Section shall be in accordance with MDOT (2012 edition), ashtenaw County, and City of Ann Arbor standards and specifications unless otherwise indicated. If a conflict exists between specifications, the more rigorous shall govern.

0 UALIT ASSURANCE

A CONT ACTO shall provide CONSULTANT with a list specifying sources of plant material.
Inspection: The CONSULTANT may inspect plants at place of growth or on site prior to planting. ejected material shall be immediately removed from site. Material damaged during planting may be rejected after planting. Material approved at place of growth, but damaged during transportation may also be rejected.
C Installation of plants shall be carried out by Contractors and their employees who are thoroughly experienced and skilled in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this section. The CONT ACTO shall have a minimum of five (5) years documented experience in comparable work.

0 DELI ER STORA E AND ANDLIN

A Plant material delivery shall be the same day as planting. No plants shall be stored at the site without permission of the CONSULTANT. Plants shall be carefully loaded and unloaded so as not to damage branching or root mass. Dropping of material will not be allowed. Plants in full leaf shall be thoroughly wetted down and completely covered with a wet tarp during transportation.
All plant roots must be kept in a moist condition.
C. Digging and Handling Plant Material: Digging shall be during the dormant season, preferably between 1 October and 1 May. Plant material which is poorly packed, or which arrives with the roots in a dry condition, as a result of improper packing, delay in transit, or from any other cause, will not be accepted. Stock shall be handled in such a manner that the roots shall remain intact, the branches unbroken, and the bark intact

and not loosened from the wood. Stock shall be protected from drying and from temperatures below 50°F and in excess of 90°F prior to planting.

0 SU ITTALS

A The CONT ACTO shall submit to the CONSULTANT sources for all plant material 30 (thirty) days after contract award

PART 2 - PRODUCTS

2 0 PLANTS

A Material shall be of the size, genus, species, variety and any other special designation as shown and scheduled for on the drawings, on the attached Proposal Form or in these Specifications. No substitution of species, variety or size shall be accepted without written approval from the CONSULTANT and O NE . Plant material shall be nursery grown, under climatic conditions similar to those in the locality of the project.

uality: Plants shall comply with the recommendations and requirements of ANSI Z60.1 American Standard for Nursery Stock. Plants shall be healthy, vigorous stock, grown in a recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae and defects such as knots, sunscald, injuries, abrasions, or disfigurement.

1. Plants balled with plastic burlap will not be accepted.

C Labeling: All plants shall be labeled with securely-attached waterproof tab bearing legible designation of botanical and common name.

D Formal arrangements if/where shown on planting plan shall have trees selected for uniform height and spread.

2 02 TOPSOIL

A Topsoil shall be as described in - FINE ADIN , LA N SEEDIN and SITE STABILIZATION Section (32 92 00) - of these specifications.

2 03 FERTILI ER

A Fertilizer shall be slow release, at minimum 50 derived from a natural, organic source, 12-0-6 or approved substitution.

2 0 CO POST

A Compost shall be used from one of the following options:

a. Ann Arbor Compost Center: 4170 Platt d, Ann Arbor, Mi 48108. (410)-849-6117.
b. City of Ann Arbor, available from City of Ann Arbor Materials ecovery Facility 1(734) 971-8600.
c. Alternative source approved of by CONSULTANT.

2 0 TOPSOIL I

A. See Topsoil as defined in Fine rading, Lawn Seeding and Site Stabilization 32 92 00

2 0 PRE-PLANTIN SUPPORT

A Material for support through transplanting shock shall be Bio-Plex Technical Transplant Concentrate and Plant Enhancer or approved substitution. This product is available through Bio-plex, Inc., 1.800.441.3573

2 0 ATER

A Source: If not available on site, water shall be provided by the CONT ACTO

uality: ater supplied by the CONT ACTO shall be free of substances harmful to plant growth.

2 0 ULC

A Material around isolated trees and in planting bed areas shall be shredded hardwood bark free of weeds, soil, sticks or trash, and shall have a uniform appearance. A sample shall be approved by CONSULTANT prior to application.

1. Colored or dyed mulch will not be accepted.

2 0 LOCATION STA ES

A Stakes for plant locations shall be 1 2 3 , and supplied by the CONT ACTO .

2 0 TREE SUPPORT

A Stakes for tree support shall be 2 x 2 hardwood stakes or approved equal driven 6-8 outside of the rootball.

Support shall be 2 -3 wide belt-like nylon or plastic straps DO NOT USE rope or wire encased in a hose.

C Tree support should include any transplanted trees.

2 STEEL LANDSCAPIN ED IN

A. Steel Landscaping Edging shall be painted DU AED E, 3/16 thick x 4 depth with interlocking joints, corner joints and steel stakes, as manufactured and supplied by The .D. usssell Company, 1.800.888.9708, or approved substitution.

. Color shall be determined by CONSULTANT prior to ordering.

PART 3 - E□ECUTION

3 0 PLANTIN SUPPORT

A If trees and/or shrubs are planted from May through August, or when there are drought conditions during September through April, the CONT ACTO shall provide planting support to each balled and burlapped specimen with Bio-Plex Technical Transplant Concentrate and Plant Enhancer (per manufacturer s instructions on label) by means of:

1. A foliar application (through spray) upon receipt of trees and shrubs
2. A root application (through tree gators) upon planting of trees and shrubs

3 02 LA□OUT

A Locations of trees, shrubs, perennials and groundcover shall be established by the CONT ACTO according to plans.

Locations for trees and shrubs shall be identified with stakes. Different species shall be clearly labeled and marked with different color ribbon, paint or permanent marker on the stake.

C The location of the grant funded replacement tree shall be staked by the CONSULTANT, the location of which does not appear on plans.

D Perennials, ornamental grasses shall be laid out in their containers on top of the ground.

E roundcover zones shall be laid out by paint.

F eview: The CONT ACTO shall notify the CONSULTANT when staking and layout is completed and allow two working days for modifications and notice to proceed with planting.

3 03 TREE □□□ S RU PLANTIN

A Balled and/or container stock as per detail:

1. Set plants plumb.
2. **STOC**
   a. emove all bindings and burlap from top one half of ball and remove from site.
   b. Cut wires of basket and fold completely down into hole.

   CONTAINER STOC
   a. emove all containers and packaging material before planting and remove from site.
3. Backfill with topsoil mix. ater and foot compact at intervals. Do not damage root structure.

4. Mulch to a depth as shown on the details and soak the mulch with water. Thoroughly soak root ball with water.
5. Prune all dead wood at first live lateral bud in accordance with standard horticultural practices using sharp instruments cleaned frequently. If necessary, any additional pruning will be directed by the CONSULTANT. Do not prune terminal leader or branch tips. A plant s natural form shall not be compromised by any pruning activities. Promptly remove all pruned material from site.
6. STAKE all trees as follows:
   a. Stakes shall be driven 6 -8 outside of the rootball.
   b. Loosely stake tree to allow for trunk flexing.
   c. Attach support straps around tree trunk just below first branch of tree (2 per tree on opposite sides of the tree).
   d. emove all tree support after one year.
7. emove all nursery applied tree wrap, tape or string from trunk and crown. emove any tags or labels and remove from site.

3 0 PERENNIAL □□□ ROUNDCO□ER PLANTIN

A Container stock as per detail:
1. emove all containers and packaging material before planting and remove from site.
2. Set plants plumb.
3. Backfill with topsoil mix. Do not damage root structure.
4. Mulch to a depth as shown on the details and soak the mulch with water. Thoroughly soak root matter with water.

END OF SECTION

SECTION 32 3 20
PLANT AINTENANCE □□□ UARANTEE PERIOD

PART - ENERAL

0 SU AR□

A The CONT ACTO shall furnish all labor, materials, equipment, transportation, services and necessary appurtenant work as required to complete the work as shown on the Plans and/or as specified herein.

Extent of work shall include but not be limited to:

1. Disease and insect control
2. Pruning
3. Fertilizer Application
4. Mulching
5. emoval of plant support and tags (if any)
6. atering
7. uarantee of Plant Material for one year

02 RELATED DOCU ENTS

A. Attention is directed to Bidding and Contracting requirements, drawings and general provisions of the Contract, including eneral Conditions and Division 1 Specification sections, which are hereby made part of this section.

. elated Sections:

1. Fine rading, Lawn Seeding and Site Stabilization 32 92 00
2. Plants 32 93 00

03 REFERENCE SPECIFICATION

A. Materials and ork covered under this Section shall be in accordance with MDOT (2012 edition), ashtenaw County, and City of Ann Arbor standards and specifications unless otherwise indicated. If a conflict exists between specifications, the more rigorous shall govern.

0 UALIT□ ASSURANCE

A Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

0 DEFINITIONS

A Definition of Period for lawn, Microclover, and plant material: The Plant Maintenance and uarantee Period begins the spring following planting and continues until the end of that growing season. A growing season is defined as the beginning of April through mid-November. If planting is not completed prior to the end of May, the First Maintenance and uarantee Period includes the remainder of that growing season plus the next growing season.

Definition of Period for Planting Areas: The Maintenance and uarantee Period begins the spring following planting and continues until the end of that growing season. A growing season is defined as the beginning of May through mid-November. If planting is not completed prior to the end of May, the First Maintenance and uarantee Period includes the remainder of that growing season plus the next growing season.

0 SC EDULE

A Schedule: A minimum of one visit is required for each of the following time periods during the uarantee period. During each visit, CONT ACTO shall complete all necessary tasks to comply with the requirements outlined in these specifications.

1. 1 April to 15 April
2. 1 May to 15 May
3. 1 une to 15 une

4. 1 uly to 15 uly
5. 1 August to 15 August
6. 1 September to 15 September
7. 1 November to 15 November

erification of visits, in the form or reports and certified payroll covering visits, shall be provided to the O NE .

0 DELI□ER□ STORA E AND ANDLIN

A Packaged materials shall be delivered in original containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and storage.

PART 2 - PRODUCTS

2 0 PESTICIDES ER ICIDES

A Materials shall comply with Local, State and Federal regulations.
Common IPM (Integrative Pest Management) practices shall be followed. Pesticides and herbicides shall be used as a last resort.

2 02 FERTILI□ER

A Materials shall conform to the standards of the Association of Agricultural Chemists and shall comply with State and Federal regulations.
Fertilizer for woody plants shall be an organic, slow release with a ratio of 3-1-2 or 3-1-1 or approved substitution.

C Maintenance fertilizer for lawn and Microclover shall contain no phosphorus, shall be derived from an organic product, and slow release with a ratio of 27-0-12 or approved substitution. Fertilizer available from Downtown Home and arden, 734-662-8122.

D There shall be no fertilizer applied to planting areas.

2 03 □ ATER

A Source: If not available on site, shall be provided by the CONT ACTO .
uality: ater supplied by the CONT ACTO shall be free of substances harmful to plant growth.

2 0 ULC

A Material shall be shredded hardwood bark free of weeds, soil, sticks or trash, of a uniform appearance.
1. Colored or dyed mulch will not be accepted.

PART 3 - E□ECUTION

3 0 DISEASE □□□ INSECT CONTROL

A Monitoring for diseases and insects shall be the responsibility of the CONT ACTO .
The CONT ACTO shall monitor all plants at all times for disease and insect problems. Treatment shall take place in accordance with common IPM practices.

C Pesticides shall only be used when and where necessary as approved by the O NE .
Manufacturer s directions and precautions must be followed literally. Applicators shall be licensed by the State of Michigan. Applicators shall be knowledgeable in the application of pesticides and appropriate equipment used. Excess pesticides shall be properly removed from the site.

3 02 PRUNIN

A Prune all dead wood at first live lateral bud in accordance with standard horticulture practices using sharp instruments cleaned frequently. Pruning shall enhance plant development and ornamental qualities. Do not prune terminal leader or branch tips. A plant s natural form shall not be compromised by any pruning activities.
Additional pruning may be required at the request of the O NE in order to decrease public liability factors.

C emove immediately after pruning all dead, broken and diseased growth and other pruning debris from the site and dispose of in an environmentally sensitive manner.

D Plant material that is topped by the CONT ACTO shall be replaced at the CONT ACTO s expense.

3 03 AINTENANCE FERTILI ER APPLICATION

A Application shall be according to manufacturer s directions.

oody Plants

1. Maintenance Fertilizer application for woody plants shall occur in November of the Second Maintenance and uarantee Period
2. Topdress at a rate of 1 pound of nitrogen per 1,000 square feet.

C Lawn and Microclover

3. Maintenance Fertilizer application for lawn and Microclover shall occur in May and October of the First and Second Maintenance and uarantee Periods. For Spring seeding, commencement of maintenance fertilizer shall begin the subsequent fall. For Fall seeding, commencement of maintenance fertilizer shall begin the subsequent spring.
4. For May fertilizing, topdress at a rate of half (.5) a pound of nitrogen per 1,000 square feet.
5. For October fertilizing, topdress at a rate of one and a half (1.5) pounds of nitrogen per 1,000 square feet.

3 0 ORNA ENTAL RASS AINTENANCE

A Timing: April maintenance visit.
Cut all dead grass from previous season s growth to a height of eight (8) inches to promote new season s growth and allow for overwintering solitary bee survival.

C emove dead grass immediately after cutting all dead growth and other pruning debris from the site and dispose of in an environmentally sensitive manner.

3 0 EEDIN

A Frequency shall be every visit.
Methods: eeds shall be removed by hand. Before application of any herbicide the CONT ACTO shall receive approval of the O NE . A selective herbicide shall be applied according to manufacturer s directions.

3 0 ULC IN

A Monitoring: All mulch beds shall be reviewed in une and September for each Maintenance and uarantee Period. Any beds that do not meet the following conditions shall be replenished.

1. Depth shall be two (2) inches typical shredded hardwood bark for individual trees and shrub planting areas.
2. Depth shall be two (2) inches typical shredded hardwood bark for perennial, ornamental grass and wall stabilization planting areas.
3. Do not allow mulch to be deeper than four (4) inches.
4. Keep mulch four (4) inches away from root collar of trees.

3 0 RE O AL TREE SUPPORT TA S

A epair all damaged guys and stakes during First Maintenance and uarantee Period emove all stakes, guys, labels and support material at the end of the First Maintenance and uarantee Period and remove from site.

3 0 ATERIN

A Monitor all plants during site visits for water stress.
ater as required to keep all plants in optimum health this may exceed the time windows outlined in the schedule. For all plantings, apply water in a slow trickle to allow water to penetrate down into root zone of plant.

C Native plugs in the deepest ponding area may require more watering than other planting areas.

D Adjust frequency and length of time for watering cycles according to changing soil and weather conditions. The CONT ACTO is responsible for watering as necessary for plant survival at no additional cost to the O NE .

3 0 EED CONTROL ALL PLANTIN SEEDIN AREAS

A eeding of all planting areas shall occur prior to invasive weed species (Sweet Clover, Burdock, ild Carrot, Purple Knapweed, Purple Loosestrife, Canada Thistle, Phragmites, etc.) setting their seed or as determined by CONSULTANT.
Post planting management procedures for rain garden planting area may consist of, but are not limited to the following:

1. Pull invasive weed species to remove root.
2. Spring or fall dormant seasons application of a non-selective herbicide to control invasive weeds. As directed by the O NE . Follow ashtenaw County signage requirements following herbicide application.
3. Summer application of a selective herbicide to control invasive weeds. As directed by the O NE . Follow ashtenaw County signage requirements following herbicide application.
4. A late winter/early spring burn to encourage native plants, control invasive weeds and prevent excessive build-up of thatch. This may take place outside of outlined maintenance visit times if optimum burning conditions exist. Any burn plans must be coordinated with the O NE .

C Acceptance will be when all the above requirements have been met.

3 0 SPRIN CLEAN-UP

A During the first spring maintenance visit at least 6 months after planting, the CONT ACTO is responsible to cut all standing dead vegetation and remove it from the site.

3 UARANTEE ATERIAL

A esponsibilities: The CONT ACTO shall replace, at no cost to the O NE , all dead vegetation during the uarantee Period.
udgment of the plant s health will be the CONSULTANT S or the O NE S.

C Planting methods shall be the same as specified herein and in the planting details unless directed by the CONSULTANT.

D Limits: Plants replaced during the Maintenance and uarantee Periods are only under guarantee during those periods.

END OF SECTION