SCHEDULE - CEILING TYPES

MARK	DESCRIPTION	BOD MANUFACTURER	BOD MODEL	COMMENTS
CLG-1	2x2 ACOUSTICAL CEILING TILE	USG	MARS HIGH-NRC PANELS 88137, FLAT WHITE 050	
CLG-1A	2x2 ACOUSTICAL CEILING TILE	USG	MARS HIGH-NRC PANELS 88137, FLAT WHITE 050	SOUND ATTENUATION BLANKETS ACROSS THE TOP OF THE CEILING
CLG-2	5/8" GWB ON 3 5/8" METAL STUDS @ 16" O.C.	N/A	N/A	
CLG-2A	5/8" GWB ON 3 5/8" METAL STUDS @ 16" O.C.	N/A	N/A	SOUND ATTENUATION BLANKETS ACROSS THE TOP OF THE CEILING
CLG-3	2x2 CLEANABLE CEILING TILE	ARMSTRONG	KITCHEN ZONE 673, WHITE (WH)	
CLG-8	12" WIDE VENTED METAL PANEL SOFFIT	PAC-CLAD	FLUSH SOLID	AT ALL EXTERIOR OVERHANGS. COLOR "SIERRA TAN. COLOR CHANGING LED POD LIGHTS AT ALL EXTERIOR SOFFIT LOCATIONS. SEE ELECTRICAL.
EXP.	EXPOSED CEILING	N/A	N/A	EXPOSED STEEL FRAMES TO BE PAINTED HPC-2 AND EXPOSED METAL DECK TO BE PAINTED HPC-3

GENERAL CEILING NOTES

1	UNDERSIDE OF EXPOSED STRUCTURE, PIPING, AND DUCTWORK IN ALL ROOMS, STAIRWAYS, AND OTHER SPACES SHALL BE PAINTED UNLESS NOTED OTHERWISE. CONTRACTOR SHALL COORDINATE COLOR SELECTION WITH THE ARCHITECT PRIOR TO PAINTING OR PRIMING, TYP.
2	CONTRACTOR SHALL COORDINATE FINAL FIELD LOCATION OF ALL EXIT SIGNS AND EMERGENCY LIGHTING WITH ARCHITECT PRIOR TO ROUGH-IN, TYP.
3	THE CONTRACTOR SHALL PROVIDE SPRINKLER SYSTEM SHOP DRAWINGS TO THE ARCHITECT FOR APPROVAL WHERE SPRINKLERS ARE REQUIRED BY CODE (SEE CODE SHEET). DRAWINGS SHALL INDICATE HEAD LOCATIONS, HEAD TYPES, AND PIPING DISTRIBUTION. IN EXPOSED OCCUPIED AREAS MAINS SHALL BE ROUTED THROUGH AREAS WITH ACCESSIBLE FINISHED CEILINGS TO THE MAXIMUM EXTENT FEASIBLE. WHERE CEILINGS ARE FINISHED ALL HEADS SHALL BE EQUIPPED WITH CONCEALMENT COVERS. SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION.
4	***APPARATUS BAYS ONLY*** CONTRACTOR SHALL PROVIDE COORDINATION DRAWINGS WITHIN THE APPARATUS BAY AREA INDICATING, WHERE APPLICABLE, THE VEHICLE EXHAUST SYSTEMS, SPRINKLER SYSTEM, OVERHEAD DOOR TRACKS, HEATERS (INCLUDING COMBUSTIBLE CLEARANCE REQUIREMENTS), LIGHTING, RETRACTABLE DROP DOWN CORDS, INTERIOR STORMDRAIN PIPING, FANS. COORDINATION DRAWINGS AT A MINIMUM SHALL INCLUDE PLANS AND BOTH LONGITUDINAL AND TRANSVERSE SECTIONS THROUGH THE BAYS INDICATING THE LOCATION AND ELEVATION OF BAY SYSTEM COMPONENTS.
5	SPRINKLER LOCATIONS DEPICTED HEREIN ARE DIAGRAMMATIC AND ARE SHOWN FOR DESIGN INTENT ONLY.
6	ON ACT CEILINGS IN FIRE-RATED AREAS INSTALL HOLD DOWN CLIPS ON ACOUSTIC PANELS WEIGHING LESS THAN 1 LB. PER SQ. FT. PER SPEC.
7	ALL MECHANICAL, ELECTRICAL, PLUMBING, AND SPRINKLER WORK TO OCCUR IN AREAS WHERE THE STRUCTURE IS EXPOSED SHALL BE EXECUTED IN A COORDINATED, NEAT AND WORKMANLIKE MANNER. AT A MINIMUM ALL WIRING SHALL BE RUN THOUGH CONDUITS, PIPE AND DUCT INSULATION SHALL BE NEATLY INSTALLED AND PAINTABLE. ALL PIPES AND DUCTS SHALL BE RUN EITHER PERPENDICULAR OR PARALLEL TO WALL CONSTRUCTION AND SHALL BE INSTALLED AT THE SAME NOMINAL ELEVATION OR SLOPE. ALL MATERIALS AND INSTALLATION METHODS SHALL COMPLY WITH APPLICABLE CODES AND STANDARDS. WHERE MECHANICAL, ELECTRICAL, AND PLUMBING DRAWINGS INDICATE OTHER REQUIREMENTS THE GREATER QUALITY SHALL PREVAIL.
8	WHERE CEILINGS ARE EXPOSED ALL TIES, CABLES, AND SUPPORTS FOR CLOUDS, ELECTRICAL, MECHNICAL EQUIPMENT AND OTHER APPURTENANCES SHALL BE INSTALLED IN A NEAT, ORGANIZED AND WORKMANLIKE MANNER. VISIBLE TIES SHALL BE PLUMB/TRUE/SQUARE TO ELEMENTS, TIGHTLY WRAPPED, WITH EXCESS WIRE NEATLY CUT.
9	CONTRACTOR SHALL COORDINATE THE COLOR AND FINISH OF ALL CEILING MOUNTED EQUIPMENT SUCH AS DIFFUSERS, RETURNS, SPEAKERS, ETC. WITH THE ARCHITECT TO ENSURE THERE ARE NO STARK CONTRASTING COLORS.
10	WHERE ACT GRID LAYOUT AT EDGE CONDITIONS FOR 2X2 TILES REQUIRE TILES TO BE CUT TO LESS THAN 3", UTILIZE A 2X4 TILE IN LIEU OF THE 2X2 TILE. OMIT CEILING GRID CROSS MEMBERS AS REQUIRED. NO TILE SHALL EXCEED 27" OR BE LESS THAN 3" AT PERIMETER CONDITIONS. IT IS THE CONTRACTORS RESPONSIBILITY TO COORDINATE GRID MAINS AS REQUIRED TO ACHIEVE THIS DESIGN INTENT.



1 FIRST FLOOR REFLECTED CEILING PLAN
1/8" = 1'-0"

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SEAL:

I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ARCHITECT UNDER THE LAWS OF THE STATE OF PENNSYLVANIA.

LICENSE NUMBER: #RA405311
EXPIRATION DATE: 6-30-2027

EXETER TOWNSHIP EMERGENCY SERVICES FACILITY 70 GIBRALTAR ROAD READING, PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
4	2026-11-05

LAST PROJECT REVISION: No 4 | 2026-11-05

REFLECTED CEILING PLAN

SHEET NUMBER:

A800

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GENERAL STRUCTURAL NOTES

A. BUILDING CODES AND STANDARDS

1. THE FOLLOWING CODES AND STANDARDS, INCLUDING ALL SPECIFICATIONS REFERENCED WITHIN, SHALL APPLY TO THE DESIGN, CONSTRUCTION AND QUALITY CONTROL OF ALL WORK PERFORMED ON THE PROJECT.
   a. "INTERNATIONAL BUILDING CODE - 2021" INTERNATIONAL CODE COUNCIL, INC.
   b. "MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES", (ANSI/ASCE 7) AMERICAN SOCIETY OF CIVIL ENGINEERS.
2. ADDITIONAL DESIGN STANDARDS FOR MATERIALS SHALL BE FOUND IN THE APPROPRIATE SECTIONS THAT FOLLOW. SEE THOSE SECTIONS FOR THE APPLICABLE CODES.

B. DESIGN LOADS

1. GRAVITY - SUPERIMPOSED DEAD LOADS

a. ROOF (STEEL FRAMED)	
ROOFING (NO BALLAST)	2 PSF
INSULATION	2 PSF
METAL DECK	2 PSF
JOISTS	3 PSF
MECHANICAL/ELECTRICAL	4 PSF
SPRINKLERS	2 PSF
CEILING	5 PSF
TOTAL	20 PSF
b. ROOF (PRE-ENGINEERED METAL BUILDING(PEMB)) COLLATERAL	8 PSF
c. FLOORS (STEEL FRAMED)	
FLOORING	2 PSF
4" CONCRETE SLAB ON DECK	40 PSF
FRAMING	3 PSF
MECHANICAL/ELECTRICAL	4 PSF
SPRINKLERS	2 PSF
CEILING	2 PSF
TOTAL	53 PSF

2. GRAVITY - FLOOR LIVE LOADS

a. SLAB-ON-GROUND	100 PSF
b. LOBBIES/STAIRS/EXIT CORRIDORS	100 PSF
c. MEZZANINE	60 PSF

3. GRAVITY - ROOF LIVE LOADS

a. LIVE LOAD	20 PSF (NOT REDUCIBLE)
b. SNOW LOAD (PLUS DRIFTING WHERE APPLICABLE)	
1) GROUND SNOW LOAD (Pg)	30 PSF
2) SNOW EXPOSURE FACTOR (Ce)	1.0
3) SNOW LOAD IMPORTANCE FACTOR (Is)	1.2
4) THERMAL FACTOR (Ct)	1.0
5) SLOPE FACTOR(s), (Cs)	1.0
6) FLAT ROOF SNOW LOAD (Pf)	30 PSF (NOT REDUCIBLE)
7) DRIFT SURCHARGE LOADS	SEE PLAN ON S202

4. LATERAL LOADS - WIND

a. ANALYSIS PROCEDURE	ASCE 7 / IBC
b. ULTIMATE DESIGN WIND SPEED (3 SECOND GUST)	128 MPH
c. NOMINAL WIND SPEED	97.6 MPH
d. RISK CATEGORY	II V
e. EXPOSURE CATEGORY	C
f. INTERNAL PRESSURE COEFFICIENT	±0.18

g. COMPONENTS AND CLADDING (ULTIMATE) 1.0W, 10 SQ. FT.

ELEMENT	EXPOSURE	PRESSURE
ROOF	1	74.4 PSF
ROOF	2	108.5 PSF
ROOF	3	128.9 PSF
WALLS	4	43.7 PSF
WALLS	5	53.9 PSF

h. NET WIND UPLIFT (ULTIMATE) 250 SQ. FT.

1) FIELD OF MAIN ROOF	10 PSF
2) EDGES OF MAIN ROOF. EDGE DISTANCE = 10'	54 PSF
3) CANOPIES	15 PSF

5. LATERAL LOADS - SEISMIC

a. SEISMIC IMPORTANCE FACTOR (Ie)	1.5
b. RISK CATEGORY	II V
c. SPECTRAL RESPONSE ACCELERATION FOR SHORT PERIOD (Ss)	0.176
d. SPECTRAL RESPONSE ACCELERATION FOR 1-SECOND PERIOD (S1)	0.047
e. SPECTRAL RESPONSE COEFFICIENT (SDS)	0.153
f. SPECTRAL RESPONSE COEFFICIENT (SD1)	0.047
g. SITE CLASS	C
h. SEISMIC DESIGN CATEGORY	A
i. BASIC SEISMIC FORCE RESISTING SYSTEM(S)	STRUCTURAL STEEL SYSTEMS NOT SPECIFICALLY DETAILED FOR SEISMIC RESISTANCE
j. RESPONSE MODIFICATION FACTOR(S) (R)	3
k. SEISMIC RESPONSE COEFFICIENT(S) (Cs)	0.078
l. ANALYSIS PROCEDURE	EQUIVALENT LATERAL FORCE PROCEDURE
m. BASE SHEAR (ULTIMATE)	PER PEMB MANUFACTURER

6. LATERAL LOADS - EARTH PRESSURE (SERVICE LEVEL)
   a. LATERAL EQUIVALENT FLUID PRESSURE
      1) AT REST CONDITION (BRACED WALLS) 60 PSF/FT OF DEPTH
      2) ACTIVE CONDITION (CANTILEVERED WALLS) 45 PSF/FT OF DEPTH
7. THE STRUCTURE HAS BEEN DESIGNED FOR THE DEAD, LIVE AND LATERAL LOADS INDICATED ABOVE. ANY INCREASE OF LOADS DUE TO CHANGE IN USAGE OR CONSTRUCTION MATERIALS, ETC. SHALL HAVE THE WRITTEN APPROVAL OF THE STRUCTURAL ENGINEER. THE CONTRACTOR IS CAUTIONED AS TO NOT STORE ANY CONSTRUCTION MATERIALS OR UNDERTAKE ANY CONSTRUCTION OPERATIONS WHICH WILL EXCEED THE DESIGN LIVE LOAD CAPACITIES NOTED.
8. WEIGHT OF EQUIPMENT SHOWN ON THE STRUCTURAL DRAWINGS HAS BEEN CONSIDERED IN THE FRAMING DESIGN. ANY ADDITIONAL EQUIPMENT NOT SHOWN ON THE STRUCTURAL DRAWINGS AND EXCEEDING 300 POUNDS SHALL BE BROUGHT TO THE ENGINEER'S ATTENTION FOR APPROVAL PRIOR TO INSTALLATION. COORDINATE ALL WORK WITH ARCHITECTURAL, MECHANICAL, ELECTRICAL AND PLUMBING DRAWINGS.

C. CONSTRUCTION

1. GENERAL
   a. THESE DRAWINGS REPRESENT THE COMPLETED PROJECT WHICH HAS BEEN DESIGNED FOR THE STRUCTURE DEAD LOADS AND FOR THE SUPERIMPOSED LIVE LOADS INDICATED IN THE DESIGN LOADS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE ALLOWABLE CONSTRUCTION LOADS AND TO PROVIDE PROPER DESIGN AND CONSTRUCTION OF FALSEWORK, FORMWORK, TEMPORARY BRACING, SHEETING AND SHORING, ETC.
   b. THE STABILITY OF THE STRUCTURE IS DEPENDENT UPON THE DIAPHRAGM ACTION OF THE ROOF AND FLOORS. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE METHODS OF CONSTRUCTION AND SHALL PROVIDE ALL GUYS, BRACING AND SHORING REQUIRED TO ACCOMMODATE ALL INTERIM LOADING CONDITIONS FOR GRAVITY AND LATERAL RESISTING SYSTEMS, INCLUDING BUT NOT LIMITED TO, SIDE LOADED CONDITIONS AND/OR CONDITIONS RESULTING IN TEMPORARY UNRESTRAINED MEMBERS SUBJECT TO TORSIONAL LOADS DURING CONSTRUCTION.
   c. IMPLEMENTING JOB SITE SAFETY AND CONSTRUCTION PROCEDURES AND ALL OSHA REGULATIONS ARE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
   d. IN CASE OF CONFLICT BETWEEN THE GENERAL NOTES, SPECIFICATIONS, AND DRAWINGS, THE MOST RIGID REQUIREMENT SHALL GOVERN.
   e. STRUCTURAL DOCUMENTS ARE NOT STAND-ALONE DOCUMENTS. THE ARCHITECTURAL DRAWINGS SHALL BE USED IN CONJUNCTION WITH THE STRUCTURAL DRAWINGS FOR DIMENSIONS, ELEVATIONS, SECTIONS, AND DETAILS. REPORT DISCREPANCIES IMMEDIATELY TO THE ARCHITECT AND THE STRUCTURAL ENGINEER. DO NOT SCALE DRAWINGS FOR THE PURPOSE OF ESTABLISHING DIMENSIONS NOR FOR DETAILING.
   f. BY SUBMITTING A BID FOR THE PROJECT, THE CONTRACTOR AGREES THEY HAVE COMPLETELY REVIEWED AND FULLY UNDERSTAND THE REQUIREMENTS OF THE CONTRACT DOCUMENTS AND ARE QUALIFIED TO SUCCESSFULLY COMPLETE ALL PROJECT REQUIREMENTS TO THE SATISFACTION OF THE OWNER. CONTRACTOR'S FAILURE TO EVALUATE POTENTIAL SITE OR OTHER LIMITATIONS OR OTHERWISE COORDINATE THEIR WORK WITH ALL TRADES DOES NOT RELIEVE THE CONTRACTOR'S RESPONSIBILITY TO SUCCESSFULLY COMPLETE THE WORK. THE CONTRACTOR SHALL INCUR ALL COSTS ASSOCIATED WITH WORK THAT HAS NOT BEEN COORDINATED.
   g. DRAWINGS IN DIGITAL FORMAT, INCLUDING, BUT NOT LIMITED TO AUTOCAD OR REVIT, ARE FOR CONVENIENCE ONLY AND DO NOT CONSTITUTE CONTRACT DOCUMENTS. PROVIDENCE OFFERS NO WARRANTIES, EXPRESSED NOR IMPLIED, REGARDING THE ACCURACY OF SUCH DIGITAL FILES. CONTRACT BINDING DOCUMENTS ARE THE DESIGN DRAWINGS IN "PORTABLE DOCUMENT FORMAT" (PDF) ONLY.
   h. DRAWINGS LABELED AS "ISSUED FOR PERMIT" OR OTHER PROGRESS DESIGNATION, AND NOT SPECIFICALLY LABELED AS "ISSUED FOR CONSTRUCTION", SHALL NOT BE CONSIDERED AS CONSTRUCTION DOCUMENTS NOR ISSUED FOR CONSTRUCTION PURPOSES.
   i. THE CONTRACTOR SHALL CHECK AND VERIFY DIMENSIONS AND ELEVATIONS FOR ALL WORK BEFORE PROCEEDING WITH THE CONSTRUCTION. ALL DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT AND STRUCTURAL ENGINEER PRIOR TO THE START OF ANY WORK.
   j. CONSULT ARCHITECTURAL, CIVIL, MECHANICAL, ELECTRICAL AND PLUMBING DRAWINGS FOR VERIFICATION OF LOCATION AND SIZE OF ALL OPENINGS, SLEEVES, REVEALS, DEPRESSIONS, INSERTS, CONCRETE HOUSEKEEPING PADS, HANDRAILS, GUARDRAILS, PARTITION SUPPORTS, LINTELS, ETC. REQUIRED FOR THE PROJECT. VERIFY REQUIREMENTS OF TRADES AFFECTING THE WORK AND NOTIFY THE ARCHITECT AND STRUCTURAL ENGINEER OF ANY CONFLICTS.
   k. THE FRAMING MEMBERS INDICATED ON THE DOCUMENTS SHALL BE CONSIDERED A MINIMUM PROJECT REQUIREMENT. AT NO ADDITIONAL COST, CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING SUPPLEMENTAL, MISCELLANEOUS AND/OR ADDITIONAL FRAMING INCLUDING JOISTS, HEADERS, RAFTERS, BEAMS, MISCELLANEOUS STEEL, PLATES, ANGLES, CONNECTIONS TO PRIMARY STRUCTURE, ETC. REQUIRED FOR COMPLETED CONSTRUCTION AND RESULTING FROM CONTRACTOR'S COORDINATION OF ALL PROJECT TRADES. ENGINEER IS NOT RESPONSIBLE FOR DESIGN OR MATERIALS FOR SECONDARY OR SUPPLEMENTAL ARCHITECTURAL OR OTHER DISCIPLINE COMPONENTS OR ASSEMBLIES.
   l. WORK NOT INCLUDED ON THE DRAWINGS BUT IMPLIED TO BE SIMILAR TO THAT SHOWN AT CORRESPONDING PLACES ELSEWHERE ON THE DRAWINGS SHALL BE REPEATED.
   m. ALL COSTS OF INVESTIGATION AND/OR REDESIGN, DUE TO THE CONTRACTOR'S MIS-LOCATION OF STRUCTURAL ELEMENTS OR OTHER LACK OF CONFORMANCE WITH THE PROJECT DOCUMENTS, SHALL BE AT THE CONTRACTOR'S EXPENSE.
   n. SEE ARCHITECTURAL DRAWINGS AND SPECIFICATIONS FOR DETAILED INFORMATION REGARDING FINISHES, DAMPPROOFING, WATERPROOFING, UL ASSEMBLY DESIGNATIONS AND FIREPROOFING REQUIREMENTS, ETC.
   o. SEE ARCHITECTURAL DRAWINGS FOR LOCATIONS OF MASONRY AND DRYWALL NON-LOAD-BEARING PARTITIONS, PROVIDE SLIP CONNECTIONS THAT ALLOW VERTICAL MOVEMENT AT THE HEADS OF ALL SUCH PARTITION. UNLESS SHOWN ON THE DRAWINGS, THE CONNECTIONS SHALL BE DESIGNED TO SUPPORT THE TOP OF THE WALLS LATERALLY FOR THE CODE REQUIRED LATERAL LOAD. PROVIDE COMPRESSIBLE FIRESAFING AT THE TOP OF THE WALL AS REQUIRED BY THE ARCHITECTURAL DRAWINGS.
   p. ALL MECHANICAL BOLTS AND ADHESIVE ANCHORS SHALL BE SET IN FULLY CURED CONCRETE OR 100% GROUT FILLED MASONRY.
   q. CUTTING, PATCHING, DEMOLITION AND REMOVAL WORK SHALL BE PERFORMED WITH METHODS LEAST LIKELY TO DAMAGE ADJACENT ADJOINING CONDITIONS. DAMAGE SHALL BE REPAIRED TO THE SATISFACTION OF THE ARCHITECT AND AT THE EXPENSE OF THE CONTRACTOR.
   r. STRUCTURAL COMPONENTS ARE NOT DESIGNED FOR VIBRATORY EQUIPMENT. PLACE VIBRATORY EQUIPMENT ON VIBRATION ISOLATORS APPROPRIATE FOR EQUIPMENT AND USE OF SPACE. VIBRATION ISOLATION HAS NOT BEEN PROVIDED BY THE STRUCTURAL ENGINEER.
   s. CONSTRUCTION IS TO BE IN SUCH A MANNER THAT NO CRANE LOADS OR ANY OTHER UNAPPROVED CONSTRUCTION LOADS ARE PLACED ON SLAB-ON-GROUND OR ELEVATED STRUCTURE DURING CONSTRUCTION.
2. SHOP DRAWINGS
   a. SHOP DRAWINGS FOR ALL STRUCTURAL ELEMENTS SHOWN ON THE CONTRACT DOCUMENTS, INCLUDING ALL CONCRETE AND GROUT MIX DESIGNS AND ADMIXTURES, MUST BE SUBMITTED BY THE GENERAL CONTRACTOR AND REVIEWED BY THE STRUCTURAL ENGINEER. SHOP DRAWINGS SHALL BEAR THE CONTRACTOR'S APPROVAL STAMP CERTIFYING HE HAS VERIFIED ALL CONSTRUCTION CRITERIA INCLUDING FIELD MEASUREMENTS, MATERIAL AND SIMILAR DATA AND HAS CHECKED THE SUBMITTAL FOR COMPLETENESS, COORDINATION AND COMPLIANCE WITH THE CONTRACT DOCUMENTS.
   b. REVIEW IS ONLY FOR GENERAL COMPATIBILITY WITH THE DESIGN CONCEPT OF THE COMPLETED PROJECT AS A FUNCTIONING WHOLE AS INDICATED BY THE CONTRACT DOCUMENTS, AND FOR GENERAL CONFORMANCE WITH REQUIREMENTS OF THE CONTRACT DOCUMENTS. ANY REVIEW OR COMMENTS DO NOT MODIFY THE CONTRACTOR'S INDEPENDENT DUTY TO STRICTLY COMPLY WITH THE CONTRACT DOCUMENTS. PROVIDENCE ASSUMES NO RESPONSIBILITY FOR DIMENSIONS OR QUANTITIES. PROVIDENCE'S REVIEW SHALL NOT CONSTITUTE APPROVAL OF THE MEANS, METHODS, TECHNIQUES, SEQUENCES, OPERATIONS OF CONSTRUCTION OR SAFETY PRECAUTIONS OR PROGRAMS INCIDENTAL THERETO, WHICH ARE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. CONTRACTOR REMAINS RESPONSIBLE FOR DETAIL AND ACCURACY, FOR PERFORMING ALL WORK IN A SAFE AND SATISFACTORY MANNER, AND COORDINATING THE WORK OF ALL TRADES.
   c. UNAUTHORIZED REPRODUCTION OF ANY PORTION OF THE STRUCTURAL DRAWINGS FOR RESUBMITTAL AS SHOP DRAWINGS IS PROHIBITED. SHOP DRAWINGS PRODUCED IN SUCH A MANNER MAY BE REJECTED AND RETURNED.
   d. IF THE CONTRACTOR OR OWNER FAILS TO OBTAIN THE STRUCTURAL ENGINEER'S REVIEW OF THE SHOP DRAWINGS, THE STRUCTURAL ENGINEER WILL NOT BE RESPONSIBLE FOR THE STRUCTURAL CERTIFICATION AND DESIGN OF THE PROJECT. SHOP DRAWINGS ARE REVIEWED BY THE STRUCTURAL ENGINEER AS A CONVENIENCE TO THE GENERAL CONTRACTOR AND ARE NOT A CONTRACT DOCUMENT.
   e. CONTRACTOR SHALL FURNISH DIMENSIONED SHOP DRAWINGS AT ALL LEVELS LOCATING FLOOR AND ROOF EDGES AND LOCATING ALL SLEEVES AND OPENINGS REQUIRED BY ALL TRADES FOR REVIEW BY THE ARCHITECT AND STRUCTURAL ENGINEER.
   f. AT THE TIME OF SHOP DRAWING SUBMISSION, THE GENERAL CONTRACTOR SHALL INFORM THE STRUCTURAL ENGINEER, IN WRITING, OF ANY DEVIATIONS OR OMISSIONS FROM THE CONTRACT DOCUMENTS.
   g. AFTER REVIEW OF SUBMITTAL, PROVIDENCE WILL INDICATE THE APPROPRIATE ACTION ON SUBMITTAL WITH AN ACTION STAMP TO INDICATE ONE OF THE FOLLOWING:
      1) REVIEWED, NO EXCEPTIONS - WORK MAY PROCEED
      2) REVIEWED, EXCEPTIONS NOTED - WORK MAY PROCEED BASED ON CORRECTIONS INDICATED
      3) REVIEWED, EXCEPTIONS NOTED, RESUBMIT FILE COPY - WORK MAY PROCEED BASED ON CORRECTIONS INDICATED
      4) REJECTED, REVISE AND RESUBMIT - WORK MAY NOT PROCEED
      5) INFORMATION ONLY - INFORMATION ONLY SUBMITTALS INCLUDE, BUT ARE NOT LIMITED TO QUALITY CONTROL PROCEDURES, MATERIAL CERTIFICATES, MANUFACTURER DATA, INSPECTION REPORTS, AND CLOSEOUT DOCUMENTS.
   h. PROVIDENCE IS NOT RESPONSIBLE FOR RESUBMITTALS NOR TRACKING PROGRESS OF RESUBMITTALS.

D. DELEGATED DESIGN SUBMITTALS

1. STRUCTURAL SYSTEMS DESIGNATED TO BE DELEGATED DESIGNS SHALL BE PERFORMED BY THE CONTRACTOR'S SPECIALTY STRUCTURAL ENGINEER (SSE) WHO IS LICENSED IN THE PROJECT LOCATION. THE SPECIALTY STRUCTURAL ENGINEER IS RESPONSIBLE FOR THE DELEGATED PORTIONS OF THE WORK.
2. AS THE STRUCTURAL ENGINEER OF RECORD (SEOR) FOR THE REMAINDER OF THE WORK OF THIS PROJECT (PORTIONS NOT DELEGATED), PROVIDENCE WILL PROVIDE DESIGN CRITERIA AND DESIGN INTENT FOR THE SPECIALTY STRUCTURAL ENGINEER'S USE IN PREPARING THE DELEGATED DESIGN. IF THE SPECIALTY STRUCTURAL ENGINEER DETERMINES THERE IS INSUFFICIENT DESIGN INFORMATION OR PROJECT LIMITATIONS, A TIMELY REQUEST FOR INFORMATION SHALL BE SUBMITTED TO THE ARCHITECT AND STRUCTURAL ENGINEER FOR RESOLUTION.
3. LOADS IMPOSED BY THE DELEGATED DESIGN ASSEMBLIES ON THE REMAINDER OF THE WORK SHALL BE CLEARLY PROVIDED BY THE SSE FOR REVIEW BY THE STRUCTURAL ENGINEER OF RECORD (PROVIDENCE).
4. THE CONTRACTOR SHALL SUBMIT DELEGATED DESIGN DRAWINGS AND CALCULATIONS SIGNED AND SEALED BY THE SPECIALTY STRUCTURAL ENGINEER LICENSED IN THE PROJECT'S JURISDICTION.
   a. DELEGATED DESIGN SUBMITTALS SHALL INDICATE THAT PRODUCTS AND SYSTEMS COMPLY WITH PERFORMANCE AND DESIGN CRITERIA IN THE CONTRACT DOCUMENTS AND RELEVANT CODES. INCLUDE LIST OF LOADS, CODES AND OTHER RELEVANT FACTORS USED IN PERFORMING THE DELEGATED DESIGN.
   b. CONTRACTOR IS SOLELY RESPONSIBLE FOR PROVIDING MOST CURRENT CONTRACT DOCUMENTATION INCLUDING REVISIONS, ADDENDA, RFI RESPONSES, ETC. TO THE SPECIALTY STRUCTURAL ENGINEER(S). SPECIALTY STRUCTURAL ENGINEER(S) SHALL PROVIDE A LIST OF RELEVANT DOCUMENTS AND CORRESPONDING DATES OF ISSUANCE AS PART OF THEIR SUBMITTAL.
   c. THE SUBMITTED DRAWINGS AND CALCULATIONS SHALL CLEARLY SHOW THE LOAD REACTIONS AS APPLIED TO THE BUILDING STRUCTURE.
   d. REVIEW BY THE STRUCTURAL ENGINEER OF RECORD (PROVIDENCE) SHALL BE FOR GENERAL CONFORMANCE WITH THE PROJECT PARAMETERS INDICATED ON THE CONTRACT DOCUMENTS. THE STRUCTURAL ENGINEER OF RECORD (PROVIDENCE) WILL CONFIRM THE DELEGATED DESIGN PARAMETERS (INPUT) CONFORM WITH THE SPECIFIED DESIGN CRITERIA AND DESIGN INTENT; HOWEVER, THE SPECIALTY STRUCTURAL ENGINEER IS SOLELY RESPONSIBLE FOR THEIR WORK.
5. LIST OF DELEGATED DESIGN ASSEMBLIES INCLUDED IN CONTRACT:
   a. STUD WALL AND CURTAIN WALL SYSTEMS AND RELATED CONNECTIONS.
      1) DESIGNS SHALL ACCOUNT FOR ALL VERTICAL AND LATERAL LOADS REQUIRED BY APPLICABLE BUILDING CODES.
      2) COLD-FORMED MEMBER TYPE, SIZE, GAGE, AND SPACING INDICATED ON THE CONTRACT DOCUMENTS ARE THE MINIMUM ACCEPTABLE SIZES FOR THE WORK. TIMELY SUBSTITUTION REQUESTS MUST BE SUBMITTED FOR CONSIDERATION PRIOR TO DELEGATED DESIGNER'S COMMENCEMENT OF WORK.
      3) DEFLECTION CRITERIA FOR BACKUP STUD SYSTEMS AND CURTAIN WALLS WITH APPLICABLE DESIGN VERTICAL AND LATERAL LOADS:
         a) NON-MASONRY/NON-BRICK BACKUP - MAXIMUM OF 1/360 OF SPAN IN INCHES.
         b) BRICK AND NON-REINFORCED MASONRY BACKUP - MAXIMUM OF 1/600 OF SPAN IN INCHES, OR 3/8", WHICHEVER IS LESS.
      4) SUBMISSION SHALL CLEARLY SHOW LOAD REACTIONS AND LOCATIONS APPLIED TO THE BUILDING STRUCTURE.
   b. METAL STAIRS, METAL GUARDS, AND METAL RAILINGS
      1) DESIGNS SHALL ACCOUNT FOR ALL VERTICAL AND LATERAL LOADS REQUIRED BY THE SPECIFICATIONS AND/OR APPLICABLE BUILDING CODES.
      2) DEFLECTION CRITERIA FOR STAIR TREADS, PLATFORMS AND FRAMING - MAXIMUM OF 1/360 OF SPAN IN INCHES.
      3) DESIGN SHALL ACCOUNT FOR THERMAL MOVEMENT FROM AMBIENT AND SURFACE TEMPERATURE DIFFERENTIALS.
      4) DESIGNS SHALL BE COMPLETED TO PROVIDE SATISFACTORY (IMPERCEPTIBLE) SWAY AND/OR VIBRATION CHARACTERISTICS.
      5) WHERE HEADERS OR OTHER TYPES OF STRUCTURAL MEMBERS HAVE BEEN DESIGNATED BY THE STRUCTURAL ENGINEER OF RECORD TO SUPPORT THE STAIRS, CONNECTIONS FROM STAIRS SHALL BE DESIGNED TO AVOID IMPOSING ECCENTRIC AND TORSIONAL FORCES ON SUCH MEMBERS.
      6) THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING, FURNISHING AND INSTALLING EMBEDS AND HARDWARE REQUIRED BY THE STAIR DESIGN.
   c. STRUCTURAL STEEL CONNECTIONS
      1) DESIGN THE FOLLOWING CONNECTIONS FOR THE REACTIONS SHOWN ON THE CONTRACT DRAWINGS IN ACCORDANCE WITH THE DESIGN BASIS INDICATED IN THE STRUCTURAL STEEL NOTES AND THE MINIMUM CONNECTION REQUIREMENTS TABLE.

MINIMUM CONNECTION REQUIREMENTS

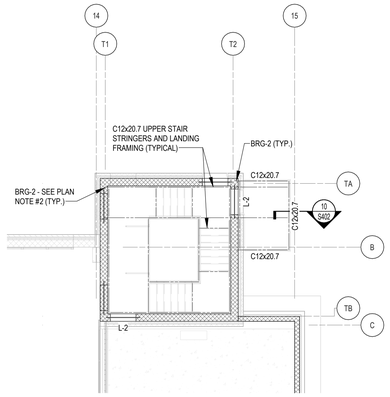
NOMINAL DEPTH OF BEAM OR GIRDER	'L' NOTE 3	MINIMUM NUMBER OF ROWS OF BOLTS	MINIMUM VERTICAL REACTION (R), KIPS (ASD LOADS)	MINIMUM AXIAL REACTION (A) KIPS (ASD), NOTE 1
				ALL BEAM END CONNECTIONS
8, 10	6"	2	5	A + R
18, 21	12"	4	20	A + R

NOTES:
1. WHERE MINIMUM TABULATED AXIAL FORCE (A) IS USED, IT NEED NOT BE CONSIDERED TO ACT SIMULTANEOUSLY WITH THE VERTICAL REACTION (R). WHERE AXIAL FORCES ARE TAKEN FROM THE DRAWINGS, THESE SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH VERTICAL REACTIONS (EITHER MINIMUM TABULATED OR THOSE SPECIFICALLY SHOWN IN THE DRAWINGS).
2. REFER TO STRUCTURAL STEEL AND DELEGATED DESIGN SUBMITTAL GENERAL STRUCTURAL NOTE SECTIONS FOR ADDITIONAL INFORMATION.
3. 'L' INDICATES THE NOMINAL CONNECTION PLATE ANGLE LENGTH. SEE STRUCTURAL DETAILS FOR ADDITIONAL INFORMATION AND DETAIL IN ACCORDANCE WITH AISC SPECIFICATIONS.

   d. STEEL JOISTS
      1) DESIGNS SHALL ACCOUNT FOR ALL VERTICAL AND LATERAL LOADS REQUIRED BY APPLICABLE BUILDING CODES INCLUDING: SPECIAL LOAD DIAGRAMS DEPICTED ON THE CONTRACT DOCUMENTS; NET WIND UPLIFT SHOWN IN THE DESIGN LOADS SECTION; THE WEIGHT OF SUPPORTED EQUIPMENT, PIPING AND CONDUIT; DEFLECTION CRITERIA INDICATED ON THE CONTRACT DOCUMENTS; AND ALL CODE-REQUIRED LOAD COMBINATIONS.
      2) PRIOR TO FABRICATION, SUBMIT SHOP DRAWINGS WITH A COVER LETTER SEALED BY A STRUCTURAL ENGINEER LICENSED IN THE PROJECT LOCATION STATING THE JOISTS AND ASSOCIATED DETAILS HAVE BEEN DEVELOPED USING THE PERFORMANCE CRITERIA INDICATED ON THE STRUCTURAL CONTRACT DOCUMENTS.
      3) SUBMIT SHOP DRAWINGS AND CALCULATIONS AT THE SAME TIME FOR REVIEW BY STRUCTURAL ENGINEER OF RECORD.
         a) SHOP DRAWINGS SHALL INCLUDE JOIST LAYOUT PLANS, PIECE MARKS, SECTIONS, DETAILS AND JOIST DETAIL SHEETS.
         b) SUBMIT DESIGN CALCULATIONS PREPARED AND SEALED BY A SPECIALTY ENGINEER WHO IS LICENSED IN THE PROJECT LOCATION FOR THE FOLLOWING CONDITIONS: SPECIAL LOADINGS, ROLLOVER LOADINGS AT SEATS. CALCULATIONS SHALL BE REFERENCED TO THE JOIST LAYOUT PLANS AND JOIST DETAIL SHEETS.
   e. STOREFRONT GLAZING ASSEMBLIES
   f. PRE-ENGINEERED METAL BUILDING FRAMING
      1) DESIGNS SHALL ACCOUNT FOR ALL VERTICAL AND LATERAL LOADS REQUIRED BY APPLICABLE BUILDING CODES INCLUDING: SPECIAL LOAD DIAGRAMS DEPICTED ON THE CONTRACT DOCUMENTS; THE WEIGHT OF SUPPORTED EQUIPMENT, PIPING AND CONDUIT; DEFLECTION CRITERIA INDICATED ON THE CONTRACT DOCUMENTS; AND ALL CODE-REQUIRED LOAD COMBINATIONS.
      2) SUBMITTED SHOP DRAWINGS AND ENGINEERING CALCULATIONS SHALL CLEARLY INDICATE COMPLETE RATIONAL LOAD PATH, MEMBER LOCATIONS, DIMENSIONS, STRUCTURAL ELEVATIONS, CROSS SECTIONS, CONNECTION DETAILS, ETC.
      3) SUBMISSION SHALL INCLUDE AN ANCHOR ROD SETTING PLAN AND FRAME REACTION DIAGRAMS.
   g. SHEETING/SHORING/TEMPORARY BRACING.

E. FOUNDATION

1. DESIGN DATA
   a. FOUNDATIONS HAVE BEEN DESIGNED IN ACCORDANCE WITH THE GEOTECHNICAL REPORT PREPARED BY DAVID BLACKMORE & ASSOCIATES, INC., DATED 01/27/2026. REPORT PROJECT NO. 5779G1R1.
   b. ALL FOUNDATIONS HAVE BEEN DESIGNED FOR AN ALLOWABLE NET BEARING PRESSURE OF 3,000 PSF. IT SHALL BE THE OWNER'S RESPONSIBILITY TO SECURE AND PAY FOR THE SERVICES OF A GEOTECHNICAL ENGINEER FOR FIELD VERIFICATION OF THE SOIL BEARING PRESSURES. BEARING CAPACITY OF THE SOIL SHALL BE INSPECTED AND APPROVED BY THE GEOTECHNICAL ENGINEER IMMEDIATELY PRIOR TO CONCRETE PLACEMENT. SHOULD THE SOIL BEARING PRESSURE BE FOUND TO BE LESS THAN 3,000 PSF, THE OWNER SHALL IMMEDIATELY NOTIFY THE ARCHITECT AND STRUCTURAL ENGINEER.
   c. ALL EXTERIOR FOUNDATIONS SHALL BEAR A MINIMUM OF 3'-0" BELOW FINISHED GRADE IN CASE OF CONFLICT, NOTIFY THE STRUCTURAL ENGINEER IN ADVANCE OF ANY CONSTRUCTION TO ALLOW FOR ADJUSTMENT. FOOTINGS SHALL BEAR ON APPROVED UNDISTURBED MATERIAL OR STRUCTURAL FILL.
2. GENERAL
   a. SEE THE PROJECT SPECIFICATIONS AND GEOTECHNICAL ENGINEERING REPORT FOR EXCAVATION AND SUBGRADE PREPARATION REQUIREMENTS, INCLUDING COMPACTION PROCEDURES. REQUIREMENTS CONTAINED IN THE GEOTECHNICAL ENGINEERING REPORT ARE PART OF THIS WORK.
   b. ALL EXCAVATION, BACKFILLING AND STRUCTURAL FILL PLACEMENT OPERATIONS BENEATH THE BUILDING SLAB AND FOUNDATIONS, AND ALL COMPACTION TESTS AND INSPECTIONS SHALL BE DONE UNDER THE DIRECTION AND SUPERVISION OF A LICENSED PROFESSIONAL GEOTECHNICAL ENGINEER. ALL FILL MATERIAL, COMPACTION EQUIPMENT AND PROCEDURES SHALL BE APPROVED BY THE GEOTECHNICAL ENGINEER PRIOR TO PERFORMING ANY EARTHWORK OPERATIONS.
   c. CONCRETE FOR FOUNDATIONS SHALL BE PLACED ON THE SAME DAY SUBGRADE APPROVAL IS GIVEN BY THE GEOTECHNICAL ENGINEER. SHOULD THE SOIL BEARING PRESSURE BE FOUND TO BE LESS THAN THE ALLOWABLE BEARING PRESSURES LISTED ABOVE, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE STRUCTURAL ENGINEER PRIOR TO PROCEEDING WITH THE WORK.
   d. THE CONTRACTOR SHALL VERIFY ALL EXISTING FIELD CONDITIONS THAT MAY AFFECT THE INSTALLATION OF THE FOUNDATION SYSTEM AS SHOWN PRIOR TO STARTING WORK.
   e. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING AND PROTECTING ALL EXISTING UTILITIES, EXISTING STRUCTURES, ETC., WHETHER INDICATED OR NOT, WHICH MAY BE AFFECTED BY THE CONSTRUCTION PROCESS. SHOULD ANY DAMAGE TO SUCH UTILITIES OCCUR, THE CONTRACTOR SHALL BE REQUIRED TO REPAIR SUCH DAMAGE AT HIS OWN EXPENSE AND TO THE SATISFACTION OF THE OWNER.
   f. UTILITY LINES SHALL NOT BE PLACED THROUGH OR BELOW FOUNDATIONS WITHOUT THE STRUCTURAL ENGINEER'S APPROVAL. STEP FOUNDATIONS UNDER UTILITIES AS REQUIRED WHERE UTILITIES OCCUR.
   g. THE SLOPE BETWEEN THE LOWER EDGES OF ADJACENT FOUNDATIONS SHALL NOT EXCEED 45 DEGREES WITH THE HORIZONTAL UNLESS INDICATED OTHERWISE ON THE PLANS, MAINTAIN A 1:1 SLOPE FROM BOTTOM EDGE OF ANY EXCAVATION.
   h. FOLLOWING REQUIRED STRIPPING OPERATIONS, ANY PROOF ROLLING SHALL BE AS DIRECTED BY A QUALIFIED GEOTECHNICAL ENGINEER. THE PURPOSE FOR PROOF ROLLING WILL BE TO LOCATE ANY ISOLATED AREAS OF SOFT OR LOOSE SOILS REQUIRING IMPROVEMENT OR REPLACEMENT. SOFT AREAS SHALL BE UNDERCUT AND REPLACED BY PROPERLY COMPACTED MATERIALS AS DIRECTED BY THE GEOTECHNICAL ENGINEER.
   i. ALL SHORING, SHEETING AND DEWATERING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR SHALL ENGAGE AN ENGINEER LICENSED IN THE PROJECT'S JURISDICTION TO DESIGN ALL SHEETING AND SHORING.
   j. SEE PLUMBING AND CIVIL DRAWINGS FOR UNDER SLAB AND PERIMETER DRAINAGE SYSTEMS (IF ANY).
3. BACKFILL
   a. ALL BACKFILL OPERATIONS SHALL BE PERFORMED IN HORIZONTAL LIFTS USING STRUCTURAL FILL MATERIAL APPROVED BY THE GEOTECHNICAL ENGINEER, AT THE OPTIMUM MOISTURE CONTENT OF



STAIR TOWER UPPER STAIR FRAMING PLAN

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

PLAN NORTH

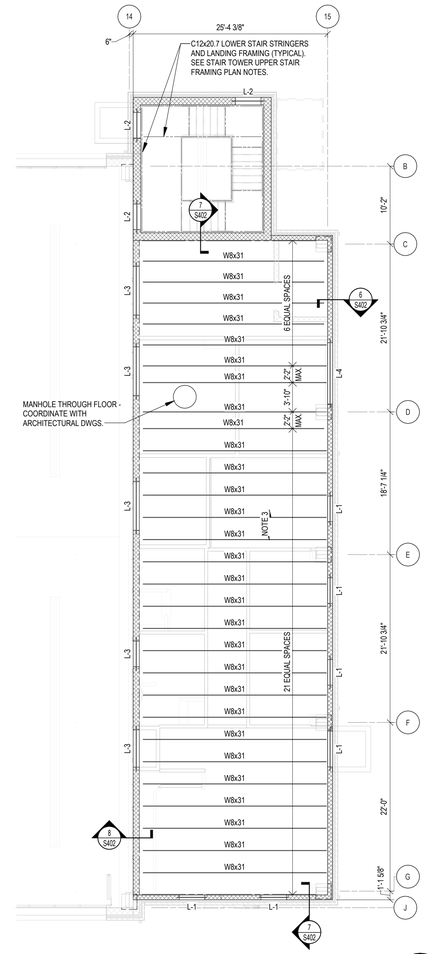
PLAN NOTES

1. BALCONY FRAMING TO BE INTERGRAL WITH STAIR STRINGER. MEMBER SIZES LISTED ARE FOR ESTIMATING PURPOSES ONLY. FINAL SIZES TO BE BY DELEGATED DESIGN ENGINEER.
2. BEARING PLATE OPTION FOR ESTIMATING PURPOSES ONLY. CONNECTION OF STAIR MEMBERS TO CMU TO BE BY DELEGATED DESIGN ENGINEER.
3. BALCONY FRAMING TO BE HOT DIP GALVANIZED AFTER FABRICATION.

LINTEL SCHEDULE

MARK	DESCRIPTION	BEARING (EACH END)	REMARKS
L-1	(2) L3 1/2x3 1/2x5/16	6" MIN.	
L-2	(3) L3 1/2x3 1/2x5/16	6" MIN.	
L-3	W8x18 WITH 3/8" THK. BOTTOM PLATE	8" MIN.	PLATE EXTENDS ACROSS MASONRY OPENING ONLY
L-4	GALV. W8x24 WITH 1/2" THK. BOTTOM PLATE	8" MIN.	PLATE EXTENDS ACROSS MASONRY OPENING ONLY
L-5	GALV. HSS12x10x5/16 (LSH) WITH C10x15.3	8" MIN.	SEE NOTE #1
4 L-5A	ARCHED W16x40 WITH 3/8" x 20"± W. BOTTOM PLATE AND ARCHED CAST STONE LINTEL PER MANUFACTURER DESIGN	8" MIN.	SEE NOTE #1 AND SEE ARCHITECTURAL DWGS. FOR ARCH CURVATURE AND CAST STONE CONFIGURATION

NOTE:
1. FOR LINTEL CONFIGURATION, SEE DETAIL J / S401
2. BUILD ALL MASONRY TIGHT AROUND LINTEL BEAMS AND ANCHOR WITH MASONRY TIES.



MEZZANINE FRAMING PLAN

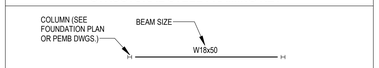
SCALE: 1/8" = 1'-0"

PLAN NORTH

PLAN NOTES

1. TOP OF SLAB ELEVATION = (+10'-8") ABOVE REFERENCE ELEVATION (0'-0") UNLESS NOTED. CONTRACTOR TO FIELD VERIFY. COORDINATE WITH ARCHITECTURAL DWGS.
2. TOP OF STEEL (BOTTOM OF METAL DECK) ELEVATION IS (-0'-4") BELOW TOP OF FLOOR SLAB UNLESS NOTED (x'-x"). THIS IS THE REFERENCE ELEVATION FOR THIS PLAN.
3. STRUCTURAL SLAB TO BE 2 1/2" NORMAL WEIGHT CONCRETE OVER 1 1/2" DEEP x 22 GAGE GALVANIZED FORMDECK (NON-COMPOSITE DECK), TOTAL THICKNESS = 4", REINFORCED WITH 6x6-W1.4 x W1.4 WWF. SEE GENERAL STRUCTURAL NOTES AND DETAIL D / S401 FOR DECK ATTACHMENT REQUIREMENTS.
4. SEE S001 AND S002 FOR GENERAL STRUCTURAL NOTES.
5. COORDINATE SIZE AND LOCATION OF ALL OPENINGS AND SLEEVES WITH ARCHITECTURAL, MECHANICAL, ELECTRICAL AND PLUMBING DRAWINGS. SEE DETAIL A / S401
6. L-x - INDICATES LINTEL BELOW REFERENCE ELEVATION OF PLAN. SEE LINTEL SCHEDULE ON THIS SHEET AND MASONRY SECTION OF GENERAL STRUCTURAL NOTES.
7. BRG-x - INDICATES BEARING PLATE. SEE DETAIL E / S401. ALL BEARING PLATES TO BE BRG-1 (U.N.O.).

STRUCTURAL STEEL FRAMING KEY



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MEZZANINE FRAMING PLAN

SHEET

S201

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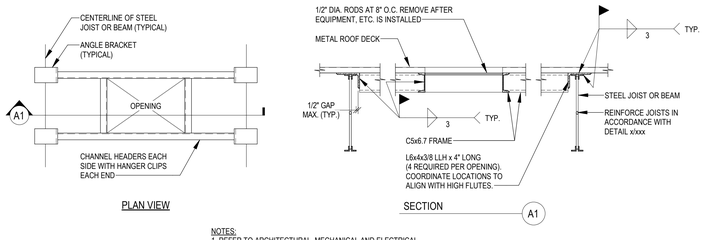
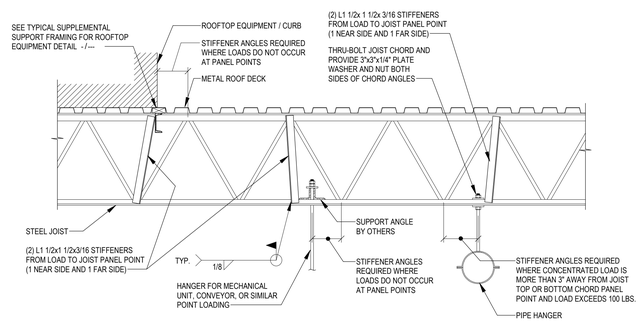
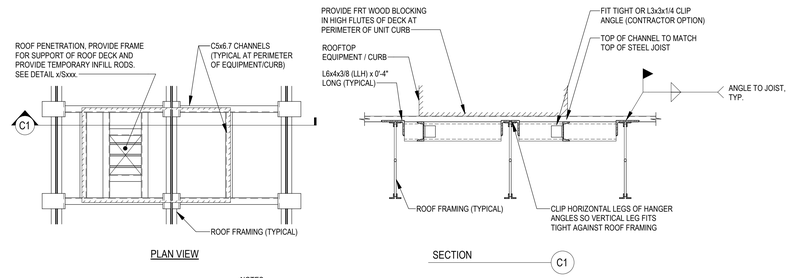


NOTES:
1. REFER TO ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS FOR EXACT NUMBER, SIZE AND LOCATION. PROVIDE FRAMES FOR ALL OPENINGS GREATER THAN 10" DIAMETER.

A TYPICAL ROOF OPENING
S401 NO SCALE

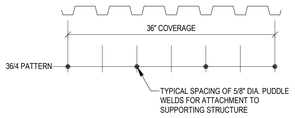


B TYPICAL JOIST REINFORCING
S401 NO SCALE



NOTES:
1. EQUIPMENT CONNECTIONS TO SUPPORTING STRUCTURE SHALL BE PROVIDED BY THE CONTRACTOR AND IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.

C TYPICAL SUPPLEMENTAL SUPPORT FRAMING FOR ROOFTOP EQUIPMENT
S401 NO SCALE



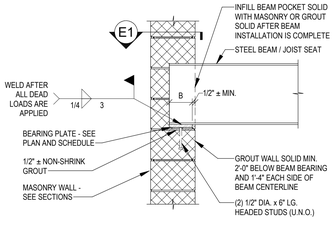
SIDELAP NOTES:

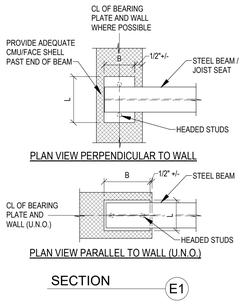
36/4 PATTERN	FASTEN SIDELAPS TOGETHER WITH (1) FASTENER BETWEEN EACH SUPPORT USING #10 SHEET METAL SCREWS

D TYPICAL DECK FASTENING
S401 NO SCALE

BEAM BEARING PLATE SCHEDULE

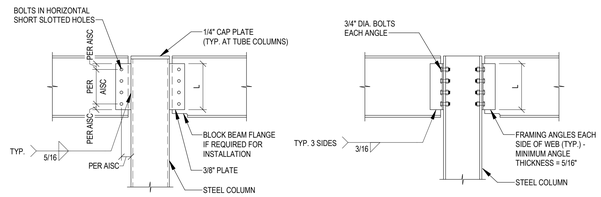
MARK	SIZE (BxL)	THICKNESS	REMARKS
BRG-1	6"x10"	1/2"	TYPICAL AT BEAMS
BRG-2	6"x8"	3/8"	TYPICAL AT JOISTS





E TYPICAL BEARING PLATE DETAIL
S401 NO SCALE

BEAM SIZE	'L'	NUMBER OF BOLTS
W6	5"	2
W8	6"	2
W21	15"	5



F TYPICAL BEAM CONNECTIONS
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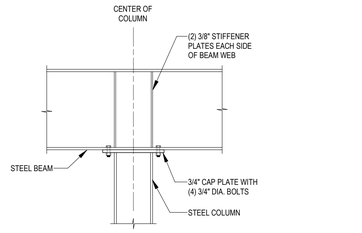
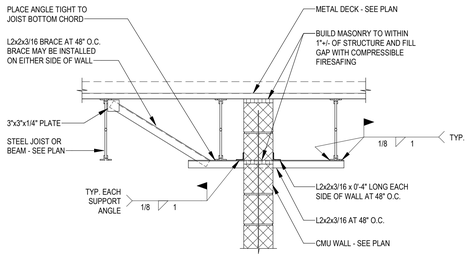
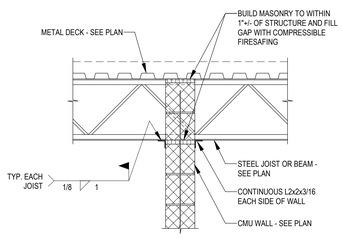
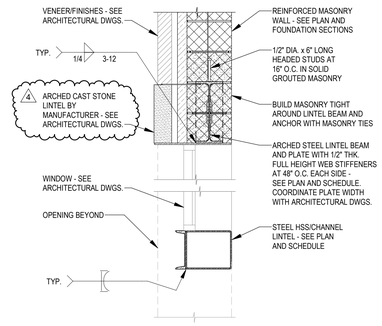


G TYPICAL BEAM OVER COLUMN CONNECTION
S401 NO SCALE





H TYPICAL MASONRY WALL BRACING
S401 NO SCALE



J TYPICAL APPARATUS BAY FOLDING DOOR LINTEL
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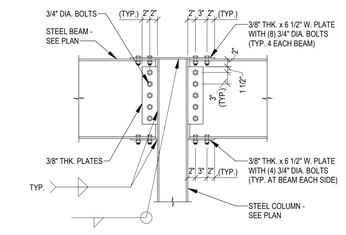

K TYPICAL BEAM TO COLUMN MOMENT CONNECTION
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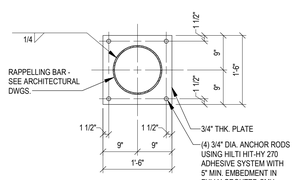
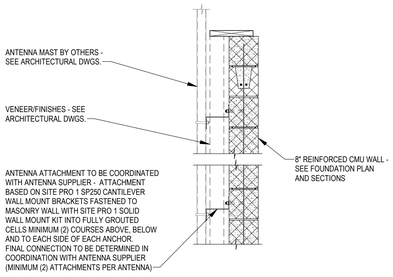


L TOWER RAPPELLING BAR ATTACHMENT
S401 NO SCALE



M ANTENNA BRACKET ATTACHMENT
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STRUCTURAL DETAILS

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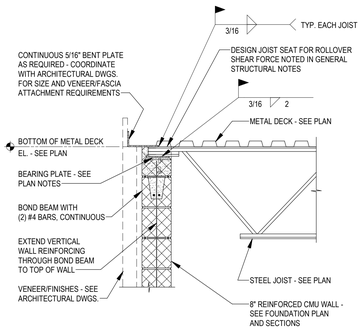

1 S402 SECTION
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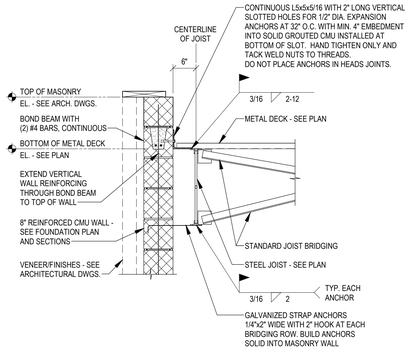

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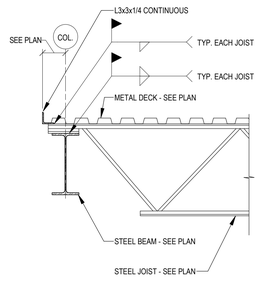

3 S402 SECTION
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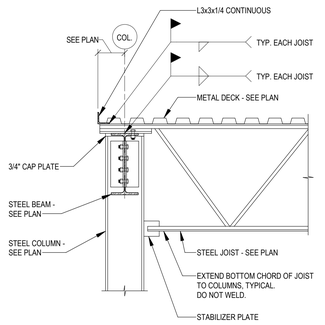

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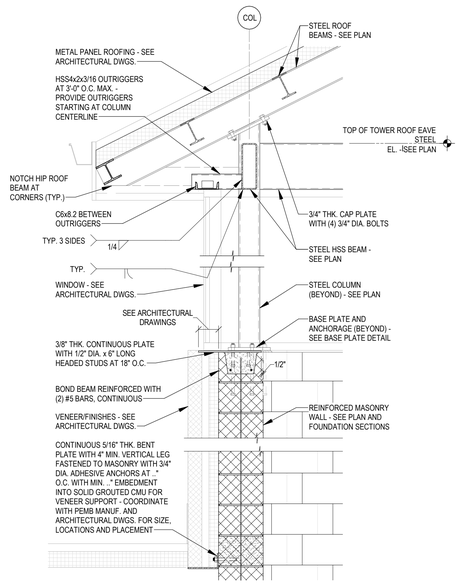

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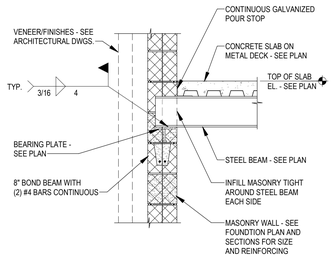

6 S402 SECTION
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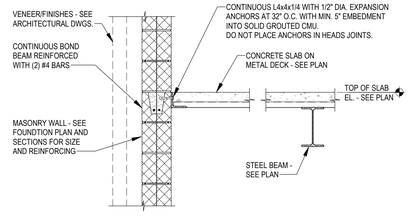

7 S402 SECTION
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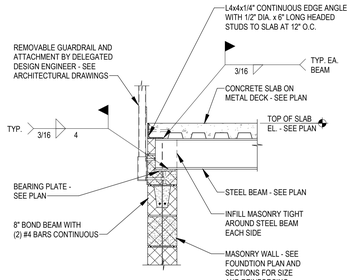

8 S402 SECTION
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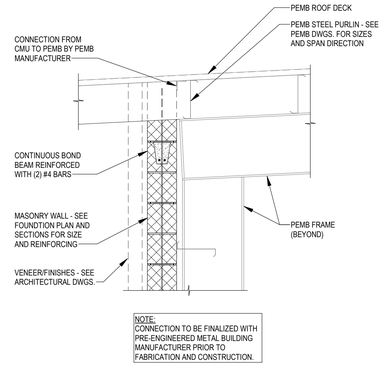

9 S402 SECTION
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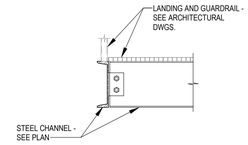
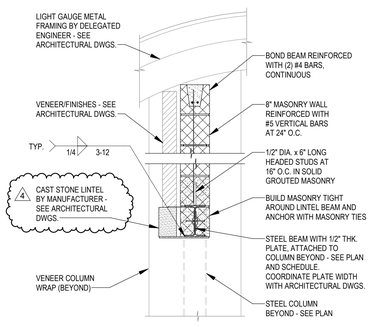


10 S402 SECTION
SCALE: 3/4" = 1'-0"



11 S402 SECTION
SCALE: 3/4" = 1'-0"

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PEC Job Number: 251008
Certificate Number: 3869

SEAL:

EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING, PA 19606

PROJECT NUMBER: 25-049

SUBMISSION
BID SET

ORIGINAL ISSUE
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
4	11/05/26

LAST PROJECT REVISION: No 4 | 11/05/26

STRUCTURAL SECTIONS

SHEET
S402

11/6/2026 8:57:01 AM

General Plan Symbols

- Plan Revision Number
- Detail Number on Sheet / Sheet Number Where Detail is Placed
- Keynote Symbol
- Continuation Symbol
- Point Where New Connects To Existing
- Room Name / Number (Room 1)
- Area Being Demolished
- Area Not In Contract

Abbreviations

Ø	ROUND	LVR	LOUVER
ABV	ABOVE	LWT	LEAVING WATER TEMPERATURE
AC	AIR CONDITIONING	M/A	MIXED AIR
AD	AREA DRAIN	MAX	MAXIMUM
ADD	ADDENDUM	MBH	ONE THOUSAND BTU PER HOUR
AFF	ABOVE FINISHED FLOOR	MCF	ONE THOUSAND CUBIC FEET
AFUE	ANNUAL FUEL UTILIZATION EFFICIENCY	MD	MOTORIZED DAMPER
ALT	ALTERNATE	MECH	MECHANICAL
AP	ACCESS PANEL	MFR	MANUFACTURER
ARCH	ARCHITECT/ARCHITECTURAL	MIN	MINIMUM
BFF	BELOW FINISHED FLOOR	MISC	MISCELLANEOUS
BLW	BELOW	MTR	MOTOR
BOR/FV	BOTTOM OF REFLECTOR/FAN/VACUUM	MU/A	MAKE-UP/AIR
BTU	BRITISH THERMAL UNITS	NC	NOISE CRITERIA
BTUH	BRITISH THERMAL UNITS PER HOUR	NC	NORMALLY CLOSED
CAP	CAPACITY	NIC	NOT IN CONTRACT
CB	CATCH BASIN	NO	NUMBER
CFM	CUBIC FEET PER MINUTE	NO	NORMALLY OPEN
CLG	CEILING	NTS	NOT TO SCALE
CO	CLEAN OUT	O	OXYGEN
CW	COLD WATER	O/A	OUTSIDE AIR
D	DEGREE	ORD	OVERFLOW ROOF DRAIN
DB	DRY BULB	PD	PRESSURE DROP
DIA	DIAMETER	PIV	POST INDICATOR VALVE
DN	DOWN	PLBG	PLUMBING
DW	DISTILLED WATER	PRESS	PRESSURE
EA	EACH	PRV	PRESSURE REDUCING VALVE
EAT	ENTERING AIR TEMPERATURE	PSI	POUNDS PER SQUARE INCH
ELEC	ELECTRICAL	PSIG	POUNDS PER SQUARE INCH GAUGE
EQUIP	EQUIPMENT	PWR	POWER
EWC	ELECTRIC WATER COOLER	R	DUCT RISER
EWT	ENTERING WATER TEMPERATURE	R/A	RETURN AIR
E/A	EXHAUST AIR	RCP	RADIANT CEILING PANEL
EXIST	EXISTING	RD	ROOF DRAIN
F	DEGREES FAHRENHEIT	REC	RECESSED
FCO	FLOOR CLEAN OUT	RED	REDUCER
FD	FLOOR DRAIN	RH	RELATIVE HUMIDITY
FDC	FIRE DEPARTMENT CONNECTION	RL/A	RELIEF AIR
FL	FLOOR	RM	ROOM
FO	FUEL OIL	RPM	REVOLUTIONS PER MINUTE
FOV	FUEL OIL VENT	RW	RAIN WATER
FOR	FUEL OIL RETURN	SF	SQUARE FOOT
FOS	FUEL OIL SUPPLY	S/A	SUPPLY AIR
FPM	FEET PER MINUTE	SAN	SANITARY
FS	FLOOR SINK	SF	SQUARE FOOT
FT	FOOT/FEET	SD	SMOKE DAMPER
FTR	FIN TUBE RADIATION	SM	SURFACE MOUNT
GAL	GALLON	SP	STANDPIPE
GF	GAS-FIRED	SP	STATIC PRESSURE
GC	GENERAL CONTRACTOR	STM	STEAM
GPM	GALLONS PER MINUTE	T	THERMOSTAT
GW	GREASE WASTE	TD	TEMPERATURE DROP
HB	HOSE BIB	TDR	TRENCH DRAIN
HP	HORSE POWER	TEMP	TEMPERATURE
HTG	HEATING	TYP	TYPICAL
HTR	HEATER	UG	UNDERGROUND
HW	HOT WATER	VAC	VACUUM
HYD	HYDRANT	V	VENT
ID	INDIRECT	VAV	VARIABLE AIR VOLUME
IN	INCH	VENT	VENTILATION
INV	INVERT	VTR	VENT THROUGH ROOF
LB	POUND	W	WASTE
LB/HR	POUNDS PER HOUR	WB	WET BULB
LAT	LEAVING AIR TEMPERATURE	WCO	WALL CLEAN OUT
LP	LOW PRESSURE	WH	WALL HYDRANT
LPG	LIQUEFIED PETROLEUM GAS		

Equipment Abbreviations

AC	AIR CONDITIONING UNIT	ET	EXPANSION TANK
ACCU	AIR COOLING CONDENSING UNIT	EWH	ELECTRIC WATER HEATER
AHU	AIR HANDLING UNIT	FCU	FAN COIL UNIT
AS	AIR SEPARATOR	FP	FIRE PUMP
B	BOILER	GI	GREASE INTERCEPTOR
CH	CHILLER	GRV	GRAVITY ROOF VENTILATOR
CT	COOLING TOWER	HWP	HEATING WATER PUMP
CUH	CABINET UNIT HEATER	HRU	HEAT RECOVERY UNIT
CHWP	CHILLED WATER PUMP	PRV	POWER ROOF VENTILATOR
DBP	DOMESTIC WATER BOOSTER PUMP	RE	RETURN/EXHAUST FAN
DC	DUCT MOUNTED COIL	RTU	ROOFTOP UNIT
DCP	DOMESTIC WATER CIRCULATING PUMP	SP	SUMP PUMP
EF	EXHAUST FAN	UH	UNIT HEATER
EDC	ELECTRIC DUCT COIL	VFD	VARIABLE FREQUENCY DRIVE
		WH	WATER HEATER

* NOTE *

ALL OF GENERAL NOTES ON THIS SHEET ARE TO BE APPLIED TO ALL OTHER DRAWINGS IN THIS SET. THE SYMBOLS AND ABBREVIATIONS SHOWN ON THIS SHEET MAY OR MAY NOT BE USED IN THIS SET OF DRAWINGS.

HVAC Symbols

- 24"x12" — Sq. Duct Size (Width x Height)
- 24"/12" — Oval Duct Size (Width / Height)
- 18"Ø — Round Duct Size (Diameter)
- (E) — Existing Duct To Remain
- Duct To Be Demolished
- S/A — Supply Air
- V/A — Ventilation Air
- O/A — Outdoor Air
- R/A — Return Air
- T/A — Transfer Air
- L/A — Building Relief Air
- E/A — General Exhaust Air
- KED — Kitchen Exhaust Duct
- LH — Laboratory Hood
- ETS — Env. Tobacco Smoke
- FLUE — Flue Gas Vent
- C/A — Combustion Air
- Rect. Supply Duct Rise / Drop
- Round Supply Duct Rise / Drop
- Rect. Return Duct Rise / Drop
- Round Return Duct Rise / Drop
- Rect. Exhaust Duct Rise / Drop
- Round Exhaust Duct Rise / Drop

Grille, Register, Diffusers

Square Ceiling Diffuser: CD3 | 500 — Type (See Schedule); Airflow; 10"Ø/24x24 — Neck Size / Module Size; 29 /HS/9/17 — Catalog Throw Performance; Throw Pattern; Max NC Rating

Round Ceiling Diffuser: CD11 | 100 — Airflow; 6"Ø — Neck Size; TYP. X 4 — Type Count for Space

Sidewall Supply Grille: SG1 | 500 — Airflow; 18"x10" — Nominal Duct Size; AFF-9'-0" — Mounting Elevation (Centerline)

Linear Diffuser: LD8 | 200 — Airflow; 8"Ø/2s/4'-0"L — Neck Size/ Slot(s)/ Active Length

Sidewall Return Grille: RG1 | 800 — Airflow; 16"x16" — Nominal Duct Size; AFF-9'-0" — Mounting Elevation (Centerline)

Ceiling Return: RG2 | 500 — Airflow; 12"x12"/24x24 — Neck Size / Module Size; 25 — Max NC Rating

Mechanical Equipment

- RTU-1 — Unit Identity
- 10.0 ton — Nominal Cooling Capacity
- RTU-1 — Unit Identity
- 180000 Btu/h — Heating Capacity
- 180 CFH — Gas Supply Input Rate
- ET-1 — Unit Identity
- 379 lb — Operating Weight
- EF-XX — Unit Identity
- 500 CFM — Design Airflow Rate
- VAV 1-2 — Unit Identity
- 3.7 GPM — Design Water Flow
- AC-1 — Unit Identity
- AFF-7'-0" — Bottom of Equipment Height
- (E)AHU-2 — Existing to Remain Equipment
- (R)AHU-3 — Existing Relocated Equipment
- Equipment By Others (Refer To Other Disciplines)

Damper Types

- (B) Manual Damper
- (M) Motorized Damper
- (D) Backdraft Damper
- (Z) Smoke Damper
- Fire Damper
- (Z) Comb. Fire/ Smoke Damper

Mechanical Piping Symbols

- 2" — Nominal Pipe Size
- Above Ground Piping
- Below Ground Piping
- 1/8" / 12" SLOPE — Pipe Slope (When Applicable)
- (E) — Existing Pipe To Remain
- Pipe To Be Demolished
- CHWR — Chilled-Water Return
- CHWS — Chilled-Water Supply
- CD — Condensate Drain
- CWR — Condenser-Water Return
- CWS — Condenser-Water Supply
- GWR — Geothermal-Water Return
- GWS — Geothermal-Water Supply
- HWR — Hot-Water Return
- HWS — Hot-Water Supply
- NG — Natural Gas
- LP — Liquid Propane
- RL — Refrigerant Liquid
- RS — Refrigerant Gas
- RD — Refrigerant Discharge
- STM — Steam Supply
- CDR — Steam Condensate Return
- Pipe Rise / Drop

Valve Types

- 2" SHUTOFF — Ball Valve
- 2" BAL — Balancing Valve
- 2" BFV — Butterfly Valve
- 2" CHECK — Check Valve
- 2" CHECK — Alternate Check Valve
- 3" CIRC — Circuit Setter
- 2" GATE — Gate Valve
- 2" GLOBE — Globe Valve
- 2" LOCK — Locked Shield Valve
- 2" PRV — Pressure Reducing Valve
- 2" QUICK — Quick Opening Valve
- 2" STRAIN — Fluid Strainer
- (M) 2" M-CNTRL — Elec. Control Valve
- (M) 4" 3-WAY CNTRL — 3-Way Elec. Valve
- (S) 1" GAS-CNTRL — Emergency Gas Shutoff
- 1" PLUG — Plug Valve
- 1" GAS COCK — Gas Shutoff Cock
- 1" REG — Gas Regulator

Mechanical Devices

- AHU-1 — Unit Identity
- (TS) Temperature Sensor
- (TH) Temp/ Humidity Sensor
- (TC) Temp/ CO2 Sensor
- (T) Thermostat
- (H) Humidistat
- (HS) Humidity Sensor
- CO2 Carbon Dioxide Detector
- CO Carbon Monoxide Detector
- H2 Hydrogen Gas Detector
- HZG Hazardous Gas Detector
- NO2 Nitrogen Dioxide Detector
- O2 Oxygen Gas Detector

Project Requirements

A. COORDINATE INSTALLATION OF PIPING, DUCTWORK, CONDUIT, LIGHTS, CABLE TRAY, STRUCTURE, AND EQUIPMENT TO PREVENT CONFLICTS.

B. FINAL PRODUCT SHALL BE A COMPLETE AND FUNCTIONING SYSTEM, AND SHALL CONFORM TO ALL REQUIREMENTS OF APPLICABLE FEDERAL, STATE, AND LOCAL CODES, INCLUDING BUT NOT LIMITED TO THE INTERNATIONAL BUILDING CODE AND INTERNATIONAL MECHANICAL CODE.

C. LOCATE EQUIPMENT REQUIRING ACCESS 2'-0" MAXIMUM ABOVE CEILING.

D. ALL ROOF MOUNTED EQUIPMENT SHALL BE A MINIMUM 10'-0" FROM EDGE OF ROOF.

E. LOCATE DUCTWORK, PIPING AND MECHANICAL EQUIPMENT AWAY FROM THE SPACE ABOVE ELECTRICAL PANELS, TRANSFORMERS AND OTHER ELECTRICAL EQUIPMENT.

F. PENETRATIONS OF RATED ASSEMBLIES SHALL BE FIRE STOPPED. FIRE STOPPING SHALL BE AN APPROVED MATERIAL AS PRESCRIBED IN CSFM STANDARD 43-1 AND SHALL BE U.L. LISTED.

G. PROVIDE SLEEVES AND/OR OPENINGS TO RUN PIPES AND DUCTS THROUGH FOUNDATIONS, FLOORS, WALLS, AND ROOF.

H. MAINTAIN CLEAR ACCESS TO SERVICE EQUIPMENT AND OTHER ACCESSORIES REQUIRING SERVICE, VISUAL INSPECTION OR HAND OPERATION. WHERE INDICATED OR REQUIRED, PROVIDE ACCESS PANELS OF THE TYPE SELECTED TO SUIT MATERIALS IN WHICH INSTALLED.

I. ADJUST PIPING AND DUCTWORK SIZES TO PROPERLY CONNECT TO MECHANICAL EQUIPMENT.

J. REFER TO HVAC SERIES DRAWINGS FOR GAS AND A.C. CONDENSATE DRAIN PIPING.

K. PIPE SIZES SHOWN SHALL BE CONTINUED IN THE DIRECTION OF FLOW UNTIL ANOTHER SIZE IS SHOWN.

L. FOR DETAILS, EQUIPMENT CONNECTIONS, AND PIPE SIZES NOT SHOWN ON THE SEGMENTS, REFER TO DETAILS, SCHEDULES, AND SPECIFICATIONS.

M. INSTALL ALL EQUIPMENT IN ACCORDANCE WITH THE RESPECTIVE MANUFACTURER'S WRITTEN INSTALLATION INSTRUCTIONS, AT A LEVEL OF QUALITY AND WORKMANSHIP CONSISTENT WITH THE SPECIFICATIONS.

N. LOCATIONS OF PIPING, DUCTWORK AND EQUIPMENT AS INDICATED ON THE DRAWING, ARE APPROXIMATE AND SUBJECT TO MINOR ADJUSTMENTS IN THE FIELD. WORK SHALL BE COORDINATED WITH ALL OTHER TRADES TO AVOID INTERFERENCE IN THE FIELD.

O. INSTALL EXPOSED PIPING AND DUCTWORK AS HIGH AS PRACTICAL IN ROOMS WITHOUT CEILINGS.

P. THE CONTRACTOR'S WORK SCHEDULE SHALL BE SUBMITTED TO AND APPROVED BY THE OWNER.

Q. PRIOR TO STARTING WORK, SUBMIT SHOP DRAWINGS FOR ALL MECHANICAL EQUIPMENT, PLUMBING FIXTURES, AND DIFFUSERS.

R. CONTRACTOR SHALL OBTAIN AND PAY FOR ALL NECESSARY PERMITS AND SHALL ARRANGE FOR ALL INSPECTIONS AS REQUIRED.

S. PROVIDE ONE YEAR WARRANTY FOR ALL WORKMANSHIP AND MATERIALS AFTER THE DATE OF FINAL ACCEPTANCE.

HVAC General Notes

A. SUPPLY AND RETURN PIPING TO COILS ARE THE SAME SIZE.

B. CONTRACTOR SHALL LOCATE THERMOSTATS AND TEMPERATURE SENSORS AT 5'-0" AFF, A MINIMUM OF 8" FROM LIGHT SWITCH.

C. REFER TO HVAC DRAWINGS FOR THERMOSTAT AND TEMPERATURE SENSOR LOCATIONS.

D. CONDENSATE DRAINS SHALL BE SUPPLIED FOR ALL COOLING EQUIPMENT. CONTRACTOR SHALL ENSURE PROPER INSTALLATION AND DRAINAGE AS REQUIRED BY FEDERAL, STATE, AND LOCAL CODES. CONDENSATE PIPING SHALL BE TYPE "L" COPPER.

E. ALL SUPPLY, RETURN, AND EXHAUST DUCTWORK SHALL BE RATED FOR PRESSURE CLASS OF 2" W.G. UNLESS NOTED OTHERWISE.

F. COORDINATE THE EXACT LOCATION OF ALL CEILING DIFFUSERS, REGISTERS, AND GRILLES WITH NEW AND EXISTING LIGHTING.

G. PROVIDE A 4" HOUSEKEEPING PAD FOR EACH PIECE OF MECHANICAL EQUIPMENT. COORDINATE SIZES WITH MECHANICAL EQUIPMENT SELECTED.

H. THIS CONTRACTOR SHALL BE REQUIRED TO REPLACE FILTERS ON HVAC EQUIPMENT AFTER ALL DUST PRODUCING CONSTRUCTION HAS BEEN COMPLETED AND PRIOR TO THE FINAL PUNCH.

I. PROVIDE DIFFUSERS AND REGISTERS WITH 4-WAY BLOW PATTERN UNLESS OTHERWISE NOTED.

J. IN HIGH-HUMIDITY AREAS, INCLUDING SHOWER ROOMS, ALL DUCTWORK SHALL BE CONSTRUCTED OF ALUMINUM.

K. INSTALL, SUPPORT, AND BRACE ALL HVAC DUCTWORK AND ACCESSORIES PER "HVAC DUCT CONSTRUCTION STANDARDS" BY SMACNA, ANSI/SMACNA 006-2006 AND "SEISMIC RESTRAINT MANUAL GUIDELINES FOR MECHANICAL SYSTEMS" BY SMACNA, ANSI/SMACNA 001-2008.

L. A COPY OF "HVAC DUCT CONSTRUCTION STANDARDS" BY SMACNA, ANSI/SMACNA 006-2006 SHALL BE PROVIDED BY THE CONTRACTOR AND KEPT ON THE JOB SITE AT ALL TIMES.

4

HVAC SHEET INDEX

M000	HVAC TITLE SHEET
M001	FIRST FLOOR - HVAC ZONE PLAN
M101	FIRST FLOOR - HVAC PLAN
M102	MEZZANINE - HVAC PLAN
M103	ROOF - HVAC PLAN
M111	FIRST FLOOR - MECHANICAL PIPING PLAN
M112	MEZZANINE - MECHANICAL PIPING PLAN
M201	FIRST FLOOR - MECHANICAL RCP
M601	MECHANICAL SCHEDULES
M602	MECHANICAL SCHEDULES
M603	MECHANICAL SCHEDULES
M604	MECHANICAL DETAILS
M701	SEQUENCE & CONTROLS DIAGRAMS
M702	SEQUENCE & CONTROLS DIAGRAMS
M703	SEQUENCE & CONTROLS DIAGRAMS

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EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING PA 19606

PROJECT NUMBER: 25-049

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HVAC TITLE SHEET

SHEET NUMBER:
M000

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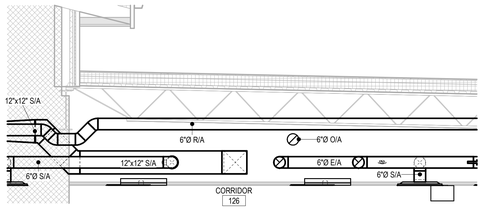
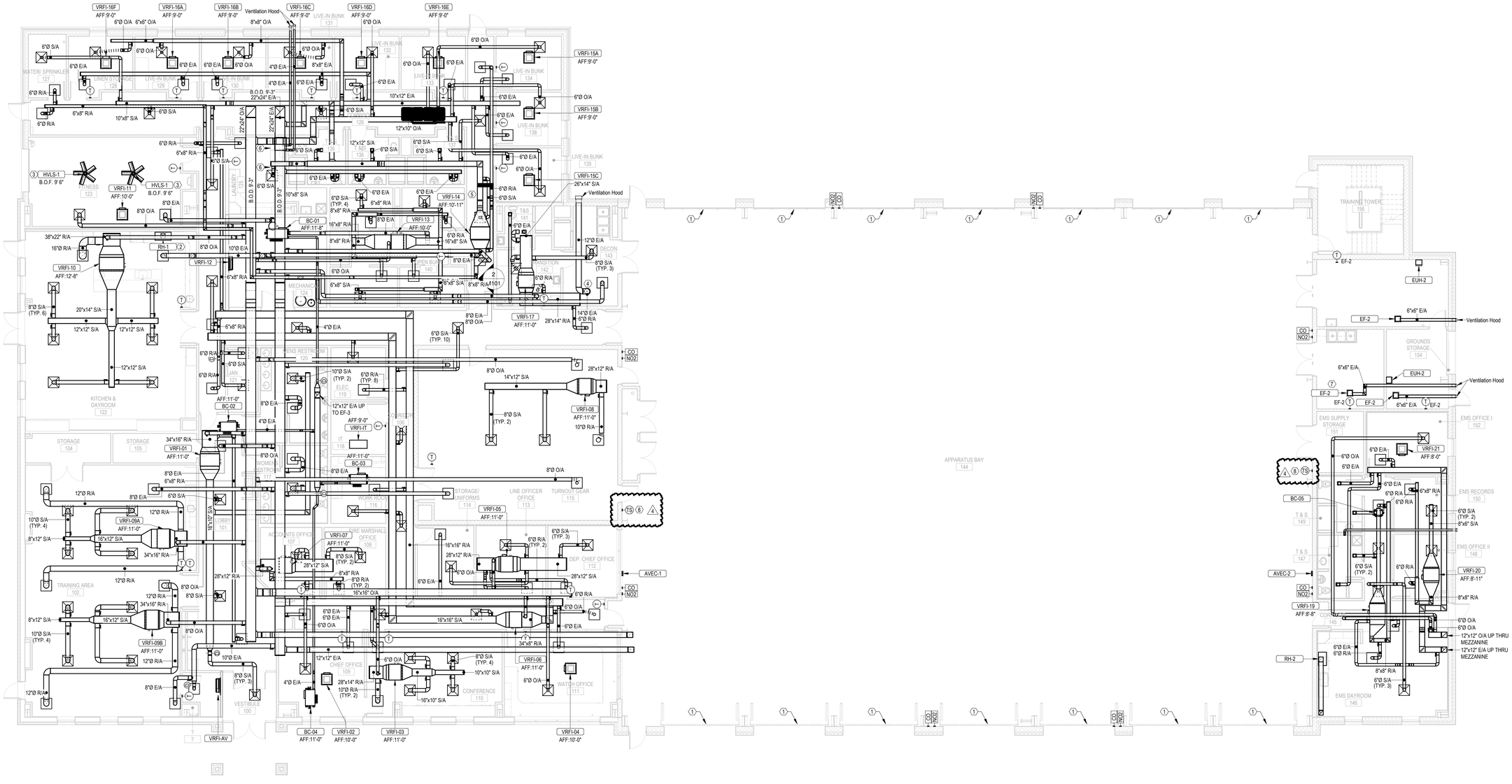


2 / M101 DUCT SECTION VIEW
3/8" = 1'-0"

NOTE:
- CONTRACTOR TO INSTALL DUCT AND PIPING IN A WAY TO MAINTAIN CLEARANCE WITH DEEP JOIST.

KEYNOTES

1. APP BAY DOOR TO BE INSTALLED WITH TAKEX MODEL PB-30TK AND SHALL BE CONNECTED TO THE AIRVAC SYSTEM. CONTRACTOR TO COORDINATE W/AIRVAC VENDOR FOR WIRING AND CONNECTIONS.
2. RH-1 TO BE EXHAUSTED UP TO ROOF WITH 6"Ø DUCT CONNECTED TO INLINE BLOWER.
3. MECHANICAL CONTRACTOR TO COORDINATE EXACT FAN LOCATION WITH ELECTRICAL CONTRACTOR.
4. MC TO PROVIDE A 12" FAMCO WVEBP HOODED WALL VENT WITH SPRING LOADED DAMPER, GASKET, AND SCREEN AT THE EXTERIOR WALL. CONNECT 12"Ø EXHAUST DUCT TO PPE DRYING CABINET. TRANSITION TO 14"Ø AT CABINET CONNECTION.
5. REFER TO SECTION 2/M101.
6. DRYER LOCATION SHOWN FOR REFERENCE.
7. COORDINATE LOCATION OF EF OVER COMPRESSOR IN FIELD.
4. RADIANT CORRIDOR TEMPERATURE SENSOR WITH GUARD, WALL-MOUNTED AT 5'-6" AFF. WIRE TO BAS CONTROLLER DDC-AB. REFER TO BAS SEQUENCE ON M703.



1 / M101 FIRST FLOOR - HVAC PLAN
1/8" = 1'-0"

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2	10/22/26
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FIRST FLOOR - HVAC PLAN

SHEET NUMBER:
M101

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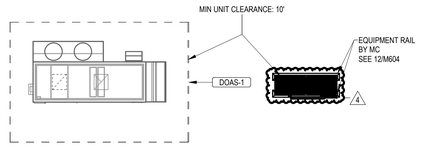
KEYNOTES

1 EXHAUST FAN TO SERVE REFRIGERANT BRANCH CONTROLLER ENCLOSURE: BC-1 THRU BC-4 LOCATED ON FIRST FLOOR IN THE EVENT OF A REFRIGERANT LEAK TO PREVENT ODOR FROM ESCAPING INTO OCCUPIED SPACES.

2 VRFO TO BE HUNG FROM TOWER WALL WITH QWIK-SLING WALL BRACKETS.



1 M103 ROOF - HVAC PLAN
1/8" = 1'-0"

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ROOF - HVAC PLAN

SHEET NUMBER:
M103

11/5/2026 12:53:14 PM

Product Data - Horizon™ - Outdoor Air Unit (Revision 6)

Size	Qty	Description	Model Number
D015	1	Horizon™ - Outdoor Air Unit (Revision 6)	OADG015E3-DAB5GAE00-J1AGG3AE0-21A20C01B-A00C00A00-A01A00000-00AL00000

Tag(s): DOAS-1

Unit Voltage: 460-3-60
Curb Selection: Standard Knockdown Curb - Energy Recovery Wheel Cabinet
Warranty: 1-Year Parts Only (manufacturer warranty)
Warranty: 5-Year Digital/Variable Speed/Standard Scroll Compressor / 25-Year Heat Exchanger
Controller Hardware Template: UC600 - Horizon v12.1 / Thrive v2.3
Airflow Configuration: Horizontal Discharge/Vertical Return
Indoor Coil Type: DX 6-Row
Reheat: Fin & Tube Modulating HGRH
Compressor: Digital Scroll-1st Circuit Only
Outdoor Coil Type: ASHP Fin & Tube
Capacity Control: R-454B - Low GWP Refrigerant & No RCC Valve
Heat Type - Primary: Indirect Fired NG (IF) - Standard Efficiency (80%)
Heat Capacity - Primary: 150 MBH, (10:1 Turndown)
Supply Fan Motor Type: Direct Drive w/VFD
Exhaust Fan Motor Type: Direct Drive w/Shaft Grounding Ring w/VFD
Unit Controls: Discharge Air Control
Building Interface: BACnet
Filter Options: MERV-8,30%
Energy Recovery: ERV-Composite Construction with Frost Protection w/ VFD
Energy Recovery Wheel Size: ERC-4136C
Damper Options: 100% OA 2-Position Damper
Exhaust Dampers: Isolation Dampers
Electrical Options: Non-Fused Disconnect *Circuit Breaker*
Condenser Fan Options: Active (VFD) Head Pressure Low Ambient Control
Hailguards: Hailguards
Installation: Outdoor
Controls Display: TD7 Factory Installed
Cooling Controls: Relatel
Supply Discharge Air Sensor (FLD)
2 inch Double Wall Construction
Stainless Steel Drip Pan
Blower HP - 5
Blower RPM - 1878
Supply Fan - ANPA 18
Exhaust RPM - 2203
Exhaust HP - 3
Exhaust Fan - ANPA 16
Unit Amps - FLA: 41.2 Amps
Min Circuit Ampacity - MCA: 44.4 Amps
Maximum Overcurrent Protection - MOCP: 50 Amps

TRANE

Project Name: **Exeter Township Fire Department** Tag: **DOAS-1**

Comments:

Unit Information

Model:	**Horizon™ (OAD/N Rev6 - OADG/DANG)**	Unit Length:	**183** in	Weight Operating:	**4067** lb*
Size:	**D015**	Unit Width:	**95** in	***Note: Weight does not include CURB weight. See CURB submittal for actual**	
Quantity:	**1**	Unit Height:	**88** in	**Refrigerant Charge - R-454B**	
Supply Airflow:	**4,000** CFM	Elevation:	**0** ft	Circuit 1:	**39.6** lbs
Outside Airflow:	**4,000** CFM	Ambient Air DB:	**95** F		
Minimum Airflow:	**1722** CFM				

Cooling Performance

Gross Total Capacity:	**186.7** MBh	Evaporator Face Area:	**13.89** sq ft
Gross Sensible Capacity:	**120.1** MBh	Evaporator Rows / FPI:	**6 / 14**
Net Total Capacity:	**179.1** MBh	Condenser Face Area:	**28.67** sq ft
Net Sensible Capacity:	**112.5** MBh	Condenser Rows / FPI:	**3 / 12**
Entering Air DB / WB (Coil):	**82.9 / 69.8** F	Air Velocity:	**287** fpm
Leaving Air DB / WB (Coil):	**54.8 / 54.8** F	Coil Air PD:	**0.20** in H2O
Leaving Air DB / WB (Reheat):	**81.6 / 64.7** F	EER:	**16.9**
Leaving Air DB / WB (Unit):	**83.7 / 65.4** F	Watts:	**18421**
Leaving DP:	**54.8** F	MRE:	**7.37** lb/kWh
MRC:	**135.84** lb/h	**AHRI Certified ISMRE2**	**6.4**
		AHRI Certified ISMRE2-70	**6.4**
		ISCOP2 @ AHRI	**4.7**
		Rated in accordance with AHRI standard 920	

Heating Performance

Heat Type:	**Heat Pump**	COP:	**2.9**
Capacity:	**104.8** MBh	Entering Air DB:	**44.5** F
Ambient Air DB:	**0** F	Leaving Air DB:	**66.7** F

Heating Performance

Heat Type:	**Gas Furnace**	Entering Air DB:	**44.5** F
Input Capacity	**150** MBh	Leaving Air DB:	**72.1** F
Output Capacity:	**120** MBh	Coil Air PD:	**0.69** in H2O

Energy Recovery Wheel ERC-4136C

*** TAB Outside airflow through OA Intake to this value*

Summer Conditions

Ventilation Supply		Outside	
Airflow:	**4,000** CFM	Airflow:	**4,279** CFM**
DB:	**82.9** F	DB:	**95.0** F
WB:	**69.8** F	WB:	**78.0** F
PD:	**1.06** in H20		
Return		**Exhaust**	
Airflow:	**4,000** CFM	Airflow:	**4,279** CFM
DB:	**75.0** F	DB:	**87.0** F
WB:	**63.0** F	WB:	**72.4** F
ESP:	**1.00** in H20	ERV PD:	**1.04** in H20

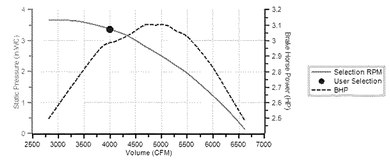
Winter Conditions

Ventilation Supply		Outside	
Airflow:	**4,000** CFM	Airflow:	**4,279** CFM**
DB:	**44.5** F	DB:	**10.0** F
WB:	**40.4** F	WB:	**8.0** F
PD:	**1.06** in H20		
Return		**Exhaust**	
Airflow:	**4,000** CFM	Airflow:	**4,279** CFM
DB:	**70.0** F	DB:	**33.3** F
WB:	**58.0** F	WB:	**32.4** F
ESP:	**1.00** in H20	ERV PD:	**1.04** in H20

Frost likely to occur. Results are considered to be estimates.

Total Capacity:	**133.13**	MBH	Eff: **58.0%**	Total Capacity:	**234.64** MBH Eff: **59.0%**
Sensible Capacity:	**51.61**	MBH	Eff: **60.0%**	Sensible Capacity:	**159.17** MBH Eff: **61.0%**
Latent Capacity:	**81.52**	MBH	Eff: **56.0%**	Latent Capacity:	**75.46** MBH Eff: **56.0%**
Enthalpy Recovery Ratio:	**58.2%**			Enthalpy Recovery Ratio:	**56.0%**
Sensible Recovery Ratio:	**99.8%**			Sensible Recovery Ratio:	**66.8%**

Supply Fan ANPA 18



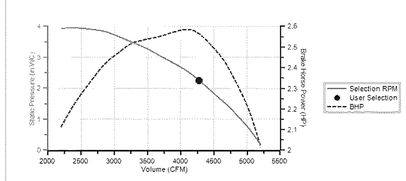
Supply Pressure Drop Summary

External Static Pressure:	**1.00** in H2O
Cabinet:	**0.01** in H2O
Cooling Coil:	**0.2** in H2O
Base Filter:	**0.01** in H2O
Filter:	**0.11** in H2O
Primary Heat:	**0.69** in H2O
HGRH:	**0.03** in H2O
ERV OA:	**1.06** in H2O
Outdoor:	**0.06** in H2O
Airflow Configuration:	**0.19** in H2O
Total Static Pressure:	**3.36** in H2O

Supply Fan Conditions

Fan Motor BHP:	**2.98** BHP
Operating RPM:	**1878** RPM
Minimum RPM:	**808** RPM

Exhaust Fan ANPA 16



Exhaust Pressure Drop Summary

Return External Static Pressure:	**1** in H2O
ERV Return Filter PD:	**0.2** in H2O
ERV Wheel PD:	**1.04** in H2O
Total Exhaust Static Pressure	**2.24** in H2O

Exhaust Fan Conditions

Fan Motor BHP:	**2.56** BHP
Operating RPM:	**2203** RPM

Standard Radiated Sound Power Level (dBA)

63	125	250	500	1000	2000	4000	8000	Total dBA
50	**60.1**	**67.7**	**72.7**	**72.9**	**72.4**	**73.9**	**69.2**	**79.8**

Sound power levels are listed for informational purposes only and are not guaranteed.

Unit Electrical Data

Unit Voltage-Ph-Hz:	**460-3-60**	Min Circuit Ampacity - MCA:	**44.4** Amps
Unit Amps - FLA:	**41.2** Amps	Maximum Overcurrent Protection - MOCP:	**50.0** Amps

Electrical Summary

Component	Fan Service	Qty	HP (ea.)	FLA (ea.)	RLA (ea.)	LRA (ea.)
ERV/HRV		**1**	**0.17**	**0.44**		
	Exhaust	**1**	**3**	**4.2**		
Scroll		**1**			**11.5**	**103**
Digital Scroll		**1**			**12.8**	**100**
	Supply	**1**	**5**	**6.6**		
	Condenser	**2**	**1**	**2.1**		
Controls		**1**		**1.48**		
Gas Heater		**1**		**3.13**		

Notes

- Unit Electrical amps include the greater of compressor or electrical heat amps.
- Unit's electrical as shown above are for single point power.

Exhaust Fan Schedule

Identity	Manufacturer	Model	QTY.	Installation Type	Design Airflow Rate	Fan Design ESP	Fan Design bhp	Fan Design RPM	Electrical Voltage	Electrical Phase	Motor Power	Weight	Notes
EF-1	GREENHECK	CUE-240-VG	1	Sidewall	9,298 CFM	0.20 in-wg	2.89 hp	605	460 V	3	5 HP	380 lb	TO BE MOUNTED ON CURB MODEL: GPF-34-G12. CONTRACTOR SHALL COORDINATE ALL WORK IN FIELD WITH OTHER DISCIPLINES AS REQUIRED.
EF-2	GREENHECK	SP-B70	4	Above Ceiling	620 CFM	0.10 in-wg	0.04 hp	1725	115 V	1	.10	11 lb	FAN TO BE PROVIDED WITH TEMP AND RELATIVE HUMIDISTAT CONTROLS.
EF-3	GREENHECK	G-097-VG	1	Roof	150 CFM	0.73 in-wg	0.07 hp	1429	115 V	1	-	54 lb	TO BE MOUNTED ON CURB MODEL: GPFP-19-G12. CONTRACTOR TO CONFIRM ROOF PITCH PRIOR TO ORDERING AND SHALL COORDINATE ALL WORK IN FIELD WITH OTHER DISCIPLINES AS REQUIRED.
EF-4	GREENHECK	SE1-12-426-D	1	Sidewall	500 CFM	0.10 in-wg	-	1300	115 V	1	-	85 lb	TO BE MOUNTED DIRECTLY TO WALL SURFACE IN HOSE TOWER. FAN TO BE PROVIDED WITH TEMP AND RELATIVE HUMIDISTAT CONTROLS.
KEF-1	GREENHECK	CUE-090-E	1	Roof	250 CFM	0.40 in-wg	0.10 hp	1256	115 V	1	.10	45 lb	TO BE MOUNTED ON CURB MODEL: GPFP-19-G12. CONTRACTOR TO CONFIRM ROOF PITCH PRIOR TO ORDERING AND SHALL COORDINATE ALL WORK IN FIELD WITH OTHER DISCIPLINES AS REQUIRED.
KEF-2	GREENHECK	CUE-090-E	1	Roof	250 CFM	0.40 in-wg	0.10 hp	1256	115 V	1	.10	45 lb	TO BE MOUNTED ON CURB MODEL: GPFP-19-G12. CONTRACTOR TO CONFIRM ROOF PITCH PRIOR TO ORDERING AND SHALL COORDINATE ALL WORK IN FIELD WITH OTHER DISCIPLINES AS REQUIRED.

NOTE:
EF-1 TO BE CONNECTED TO APPARATUS BAY GARAGE DOOR AND THE CO/NO2 SYSTEM.
EF-3 TO SERVE REFRIGERANT BRANCH CONTROLLER ENCLOSURE: BC-1 THRU BC-4 LOCATED ON FIRST FLOOR IN THE EVENT OF A REFRIGERANT LEAK TO PREVENT ODOR FROM ESCAPING INTO OCCUPIED SPACES.

GREENHECK HVLS SCHEDULE

Identity Mark	Manufacturer	Model	Description	Count	# of Blades	Fan Diameter	Fan RPM	Electrical Volt.	Hz	Phase	FLA	Notes
HVLS-1	Greenheck	DC-5-4-MV	High Volume, Low Speed Ceiling Fan	2	5	52'	85	120 V	60 Hz	1	2 A	1, 2
HVLS-2	Greenheck	DS-3-10-90LV	High Volume, Low Speed Ceiling Fan	4	3	120"	105	208 V	60 Hz	1	7 A	1, 3

NOTE:
1. MC TO CONFIRM COLOR OF FOILS WITH CUSTOMER BEFORE ORDERING.
2. MC TO PROVIDE FANS WITH 12" DOWN ROD SUSPENDED FROM UNISTRUT BRIDGING BOTTOM CHORDS OF BAR JOISTS.
3. MC TO PROVIDE FANS WITH 2'-0" DOWN ROD SUSPENDED FROM UNISTRUT BRIDGING BOTTOM CHORDS OF BAR JOISTS.
4. PROVIDE WITH HVLS ADVANCED TOUCHSCREEN WITH BACNET CONTROLLER (1 FOR ALL FANS)

AIRVAC FILTER SCHEDULE

Identity Type Mark	Manufacturer	Model	Count	Power Supply (Ph, V, Hz)	Type Coomments
AVF-1	AIRVAC 911	AIR VACUUM CORPORATION	8	120/60/1	VERTICULAR AIR FLOW DESIGN, CEILING HUNG, RE-CIRCULATING AIR FILTRATION SYSTEM W/ PREFILTERS & AIRVAC 911 4 STAGE FILTER PACK, NEMA 5-20P PLUG
AVF-2	AIRVAC 911	AIR VACUUM CORPORATION	6	120/60/1	VERTICULAR AIR FLOW DESIGN, CEILING HUNG, RE-CIRCULATING AIR FILTRATION SYSTEM W/ PREFILTERS & AIRVAC 911 4 STAGE FILTER PACK, NEMA 5-20P PLUG

Electric Unit Heater Schedule

Identity	Manufacturer	Model	Product Type	Electric Heat Rating	Electrical Voltage	Electrical Phase	Product Weight	Notes
EUH-1	Marley Engineered Products	QWD07832	Washdown Electric Unit Heater	25590.0 Btu/h	208 V	3	25 lb	7500W Washdown electric unit heater w/ wall mounting bracket and inegral T-stat.
EUH-2	Marley Engineered Products	MUH	Unit Heater	17000.0 Btu/h	208 V	3	27 lb	Electric unit heater w/ wall mounting bracket and inegral T-stat.

Vacuum Pump Schedule

Type ID	Qty	Manufacturer	Model	HP	RPM	INTAKE DUCT DIA. (INCH)	EXHAUST DUCT DIA.	ELECTRICAL Voltage	ELECTRICAL Phase	ELECTRICAL A	Product Weight	Notes
VP-1	2	CO-RAY-VAC	CRV-EP-201	.75	3450	4"	4"	115 V	1	6.6	112 lb	1,2

1) PROVIDE 120V, 20 AMP CORAYVAC HEATING CONTROL PANEL, MANUFACTURER MODEL #0277002, CONTROLLING VACUUM PUMPS VP-1 AND VP-2 AND HEATING ZONES 1 AND 2. EACH ZONE SHALL OPERATE ONLY ITS OWN VACUUM PUMP.
2) DO NOT PROVIDE MANUFACTURER THERMOSTATS. ZONE CONTROL IS BY THE BAS: CONNECT BAS DRY-CONTACT ZONE CALLS TO THE PANEL'S 24V THERMOSTAT TERMINALS FOR ZONES 1 AND 2. SEE BAS SEQUENCE AND POINTS LIST.
3) PROVIDE DRY CONTACTS FOR VACUUM PUMP STATUS (EACH PUMP) AND PANEL FAULT FOR BAS MONITORING.

Grilles, Registers & Diffusers Schedule

ID Type	Description	Manufacturer	Model	Qty	Type	Material	Finish	Border Application	Face or Module Size	Notes
CD1	Ceiling Diffuser	Titus	PAS-AA	71	Perforated Face	Steel	White Enamel	Lay-In Full Face	24x24	
CE1	Ceiling Exhaust	Titus	PAR-AA	26	Perforated Exhaust	Aluminum	White Enamel	Lay-In Full Face	24x24	
CR1	Ceiling Return	Titus	PAR-AA	37	Perforated Return	Aluminum	White Enamel	Lay-In Full Face	24x24	
EG1	Exhaust Grille	Titus	350FL	6	Louvered Exhaust	Aluminum	Mill	Surface Mount	---	
RG1	Return Grille	Titus	T700L	4	Door Louver	Steel	Mill	Surface Mount	---	
SG1	Supply Grille	Titus	300F	6	Louvered Grille	Aluminum	Mill	Surface Mount		

Gas-Fired Heater Burner Schedule

Identity	Qty	Manufacturer	Model	FUEL	INPUT MBH	Electrical Voltage	Electrical Phase	Electrical A	Notes
B-1	4	CO-RAY-VAC	CRV-B4	N.G.	40.0	120 V	1	.30	1,2,3,4,5
B-2	10	CO-RAY-VAC	CRV-B6	N.G.	60.0	120 V	1	.30	1,2,3,4,5

1. INCLUDE COMPLETE SYSTEM. BURNER/PUMP/CONTROL PANEL, MOUNTING HARDWARE, 5 PSI REGULATOR.
2. TUBING SHALL BE HEAT TREATED ALUMINIZED.
3. ALL BURNERS SHALL HAVE COMBUSTION INTAKE FILTERS.
4. BRANCH RUNS ALONG PERIMETER WALLS SHALL HAVE PERIMETER REFLECTORS. ALL OTHER DEFLECTORS SHALL BE ANGLED AT 45°.
5. PROVIDE 120V, 20 AMP SYSTEM CONTROL PANEL, MANUFACTURER MODEL # 0277002 AND MANUFACTURER RECOMMEND 24-VOLT THERMOSTATS.

Range Hood Schedule

Identity	Qty	Manufacturer	Model	CFM	Fan Type	Venting	Electrical Voltage	Electrical Phase	Electrical A	Notes
RH-1	1	DENLAR	D1036	250	IN-LINE DUCT FAN	VERTICAL DUCT	115 V	1	5	
RH-2	1	DENLAR	D1036	250	IN-LINE DUCT FAN	VERTICAL DUCT	115 V	1	5	

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EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
2	10/22/26
4	11/06/26

LAST PROJECT REVISION: No 4 | 11/06/26

MECHANICAL SCHEDULES

SHEET NUMBER:
M601

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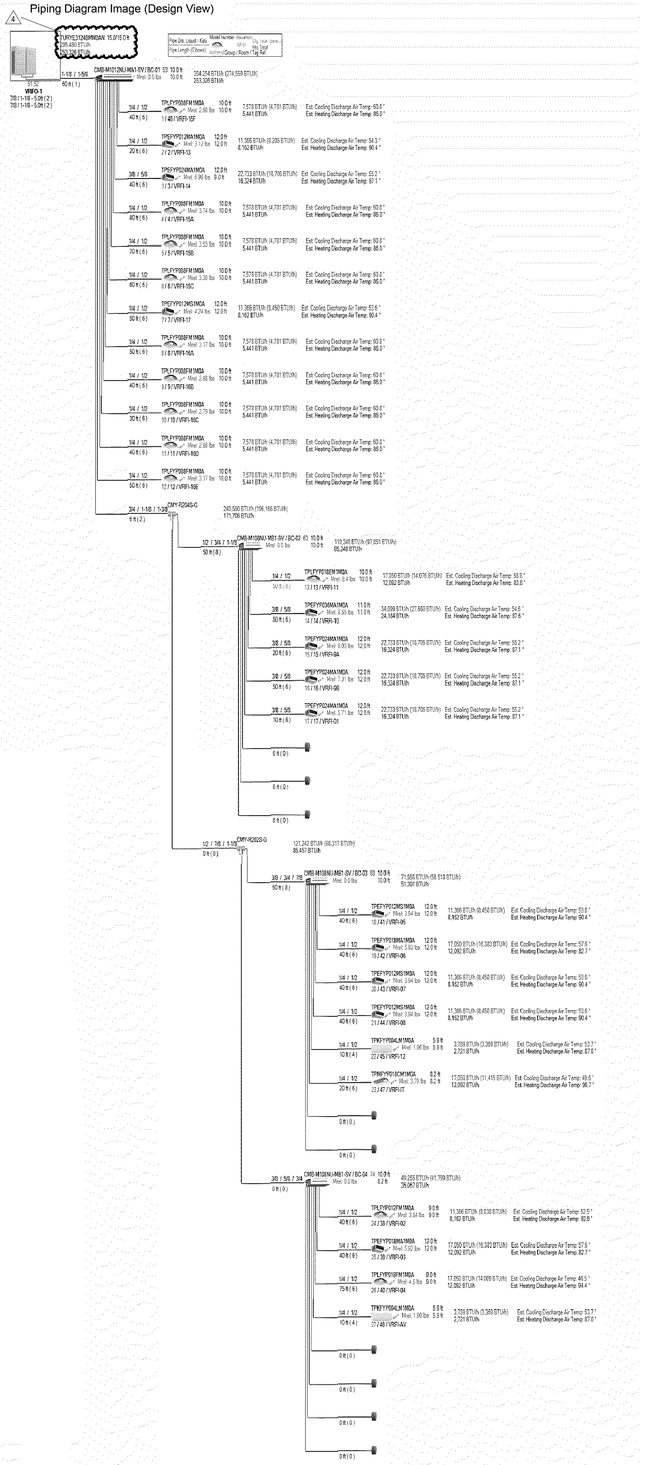
Centralized System - 1 : VRFO-1

Piping Diagram Image (Design View)

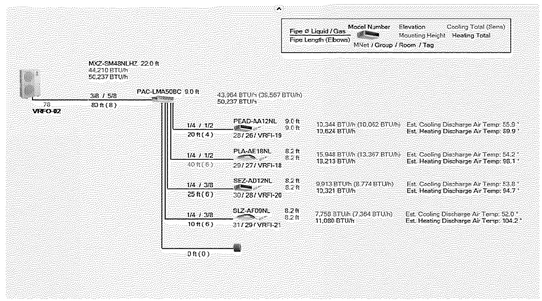


Quantities

Qty	Model	Description	Tag
31	TAC-YT53CRAU-J	Simple MA controller	CTR2-VRFI-13,CTR3-VRFI-14,CTR4-VRFI-15A,CTR5-VRFI-15B,CTR6-VRFI-15C,CTR7-VRFI-17,CTR8-VRFI-16A,CTR9-VRFI-16B,CTR10-VRFI-16C,CTR11-VRFI-16D,CTR12-VRFI-16E,CTR13-VRFI-11,CTR14-VRFI-10,CTR15-VRFI-9A,CTR16-VRFI-9B,CTR17-VRFI-01,CTR1-VRFI-19,CTR2-VRFI-18,CTR3-VRFI-20,CTR4-VRFI-21,CTR24-VRFI-02,CTR25-VRFI-03,CTR26-VRFI-04,CTR18-VRFI-05,CTR19-VRFI-06,CTR20-VRFI-07,CTR21-VRFI-08,CTR22-VRFI-12,CTR1-VRFI-16F,CTR23-VRFI-IT,CTR27-VRFI-AV
1	TURYE2884BMM0AN	R32 R2 Series Outdoor Unit	VRFO-1
1	MXZ-SM48NLHZ	R454B MXZSM Series Outdoor Unit	VRFO-02
1	CMB-M1012NU-MA1-SV	BC Controller Main	BC-01
3	CMB-M108NU-MB1-SV	BC Controller Sub	BC-02,BC-03,BC-04
9	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way) Indoor Unit	VRFI-16F,VRFI-15A,VRFI-15B,VRFI-15C,VRFI-16A,VRFI-16B,VRFI-16C,VRFI-16D,VRFI-16E
1	TPEFYP012MA1M0A	Ceiling-Concealed (Ducted) Indoor Unit	VRFI-13
3	TPEFYP018MA1M0A	Ceiling-Concealed (Ducted) Indoor Unit	VRFI-14,VRFI-06,VRFI-03
4	TPEFYP012MS1M0A	Ceiling-Concealed (Ducted) Indoor Unit	VRFI-17,VRFI-05,VRFI-07,VRFI-08
1	TPLFYP018EM1M0A	Ceiling-Cassette (Four-Way) Indoor Unit	VRFI-11
1	TPEFYP036MA1M0A	Ceiling-Concealed (Ducted) Indoor Unit	VRFI-10
3	TPEFYP024MA1M0A	Ceiling-Concealed (Ducted) Indoor Unit	VRFI-9A,VRFI-9B,VRFI-01
2	TPKFYP004LM1M0A	Wall -Mounted Indoor Unit	VRFI-12,VRFI-AV
1	TPMFYP018CM1M0A	Ceiling Cassette (One-Way) Indoor Unit	VRFI-IT
1	TPLFYP012FM1M0A	Ceiling-Cassette (Four-Way) Indoor Unit	VRFI-02
1	TPLFYP018FM1M0A	Ceiling-Cassette (Four-Way) Indoor Unit	VRFI-04
1	PEAD-AA12NL	Ceiling-Concealed (Ducted) Indoor Unit	VRFI-19
1	PLA-AE18NL	Ceiling-Cassette (Four-Way) Indoor Unit	VRFI-18
1	SEZ-AD12NL	Ceiling-Concealed (Ducted) Indoor Unit	VRFI-20
1	SLZ-AF09NL	Ceiling-Cassette (Four-Way) Indoor Unit	VRFI-21
1	CMY-R204S-G	Branch Joint	
1	CMY-R202S-G	Branch Joint	
1	TE-C400A	System Remote Controller	CTR1
1	LIC-BACNET-MASTER	Software License	
1	QSSB48M-18	Super Stand w/ 48in rails, 18in Tall	
1	QSSX48M-18	Super Stand Ext w/ 48in Rails, 18in Tall	
34	COMBI	Condensate Pump	BC-01,BC-02,BC-03,VRFI-13,VRFI-14,VRFI-15A,VRFI-15B,VRFI-15C,VRFI-17,VRFI-16A,VRFI-16B,VRFI-16C,VRFI-16D,VRFI-16E,VRFI-11,VRFI-10,VRFI-9A,VRFI-9B,VRFI-01,VRFI-19,VRFI-18,VRFI-20,VRFI-21,VRFI-02,VRFI-03,VRFI-04,VRFI-05,VRFI-06,VRFI-07,VRFI-08,VRFI-12,VRFI-16F,VRFI-IT,VRFI-AV
1	CMY-R304S-G1	Reducer	BC-01
1	CMY-R303S-G1	Reducer	BC-01
3	CMY-R306S-G	Reducer	BC-02,BC-03,BC-04
2	ADP3812	Port Adapter size: 3/8" x 1/2"	
1	QSMS1802M	Stand - 18" High	VRFO-02
11	TLP-18FAU	Decoration Panel	VRFI-15A,VRFI-15B,VRFI-15C,VRFI-16A,VRFI-16B,VRFI-16C,VRFI-16D,VRFI-16E,VRFI-02,VRFI-04,VRFI-16F
1	TLP-41EAEU	Grille with 3D i-see Sensor™	VRFI-11
1	PLP-41EAEU	Grille with 3D i-see Sensor™	VRFI-18
1	SLP-18FAU	Decoration Panel	VRFI-21
1	TLP-449W-U1	Grille	VRFI-IT
1	PAC-LMA50BC	Branch Box	

Centralized System - 1 : VRFO-02

Piping Diagram Image (Design View)



VRF HEAT RECOVERY BRANCH CIRCUIT CONTROLLER

System Tag	Tag Reference	M-NET Address	Model Number	Type (double / Main / Sub)	Number of Ports	Connected Capacity to BC	Voltage / Phase	MCA 208/230	Mrel (lbs)	Notes / Options
VRFO-1	BC-01	53	CMB-M1012NU-MA1-SV	Main	12	374,000.0	208/230V/1-phase	1.1/1.29	0	1
VRFO-1	BC-02	63	CMB-M108NU-MB1-SV	Sub	8	126,000.0	208/230V/1-phase	0.74/0.87	0	1
VRFO-1	BC-03	68	CMB-M108NU-MB1-SV	Sub	8	76,000.0	208/230V/1-phase	0.74/0.87	0	1
VRFO-1	BC-04	74	CMB-M108NU-MB1-SV	Sub	8	52,000.0	208/230V/1-phase	0.74/0.87	0	1

Notes & Options:
1 Include Diamondback Ball Valves BV-Series, 700PSIG working pressure, full port, 410A rated.
2 For sub BC Controller CMB-P-NU-GB1 or -GB, the total connectable indoor unit capacity can be 126,000 BTUs or less. If two sub BC controllers are used, the total indoor unit capacity connected to BOTH sub BC controllers also cannot exceed 126,000 BTUs. For sub BC controller CMB-P1016NU-HB1 the total connectable indoor unit capacity can be 126,000 BTUs or less. However, if two sub controllers are used, and one of them is CMB-1016NU-HB1, the total indoor unit capacity connected to BOTH sub controllers must NOT exceed 168,000 BTUs.
3 Provide Condensate Pump for indoor Units up to 120,000 BTUs 100-240 VAC

MXZ Branch Box

System Tag	Model Number	Connectable number of Indoor unit (Maximum)	Voltage / Phase	Frequency - Hz	Power Input - kW	Running Current - A	External Finish	Unit Dimension			Weight - lb(kg)	Piping Connection				Notes / Options
								Width - in(mm)	Depth - in(mm)	Height - in(mm)		to Outdoor Unit		to Indoor Unit		
												Liquid - in(mm)	Gas - in(mm)	Liquid - in(mm)	Gas - in(mm)	
VRFO-02	PAC-LMA50BC	5	208/230 / 1-phase	60	0.003	0.15	Galvanized Sheets	17-23/32 (450)	11-1/32 (280)	6-11/16 (170)	16 (7.4)	3/8 (9.52)	5/8 (15.88)	1/4 (6.35) x 5 {A, B, C, D, E}	3/8 (9.52) x 4 {A, B, C, E}, 1/2 (12.7) x 1 {E}	1

Notes & Options:
1 The piping connection size differs according to the type and capacity of indoor units. Match the piping connection size for indoor and branch box. If the piping connection size of branch box does not match the piping connection size of indoor units, use optional different-diameter (deformed) joints to the branch box side. (Connected deformed joint directly to the branch box side.)

MITSUBISHI ELECTRIC TRANE HVAC US: CITY MULTI VRF OUTDOOR UNIT SCHEDULE

System Tag	Tag Reference	M-NET Address	Model Number	Module	Nominal Cooling Capacity (BTU/h)	Nominal Heating Capacity (BTU/h)	Cooling Efficiency (IEER) [SEER]	EER2 [SEER2]	Design Cooling Outdoor Temp DB (°F)	Design Heating Outdoor Temp WB (°F)	Altitude (feet)	Corrected Cooling Total Capacity (BTU/h)	Corrected Heating Capacity (BTU/h)	Electrical-Per Module 208/230 or [460V]				Notes / Options
														Voltage / Phase	MCA 208/230 or [460V]	RFS	MOCP	
VRFO-1	VRFO-1	51, 52	TURYE3124BMM0AN	EM168, EM144	312,000	350,000	21.15 / 11.2	N/A	92.0	7.9	266.0	295,479.6	253,326.2	460V / 3-phase 3-wire	31,31	35,35	50, 50	1, 2, 3, 5, 6
VRFO-02	VRFO-02	78	MXZ-SM48NLHZ	P48	48,000	54,000	N/A	11.55	92.0	7.9	266.0	44,209.6	50,237.4	208/230V / 1-phase	51	45	86	1, 2, 3, 5, 6

Notes & Options:
1 Nominal cooling capacities are based on indoor coil EAT of 80/67°F (DB/WB), outdoor of 95°F (DB)
2 Nominal heating capacities are based on indoor coil EAT of 70°F (DB), outdoor of 43°F (WB)
3 Efficiency values for EER, IEER, COP are based on AHRI 1230 test method for mixture of ducted & non-ducted indoor units.
4 Efficiency values for EER2, SEER2, COP are based on AHRI 210/240 test method for mixture of ducted & non-ducted indoor units.
5 For systems with multiple modules, refrigerant pipe dimensions indicate total system combined piping downstream of module twinning.
6 Actual field piping design must be in accordance with the manufacturer's installation manual and all applicable codes.

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EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

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MECHANICAL SCHEDULES

SHEET NUMBER:
M602

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MITSUBISHI ELECTRIC TRANE HVAC US: CITY MULTI VRF INDOOR UNIT SCHEDULE

System Tag	Room Name	Tag Reference	Model	Type	Nominal Cooling Capacity (BTU/h)	Nominal Heating Capacity (BTU/h)	Cooling Design Entering Temp DB/WB (°F) / [Water in temp]	Heating Design Entering Temp DB/WB (°F) / [Water in temp]	Altitude (feet)	Corrected Capacity					Refrig Pipe Dim Liquid/Suction (inch)	Fan Speed Setting	Peak Fan Airflow (cfm) / [Design gpm G(US)/min]	Max Fan ESP Setting 208V/230V (IN WG)	Voltage / Phase	Electrical MCA/MFS	Mrel (lbs)	Notes / Options
										Cooling Diversity Full/Partial (See Note 5, 6)	Cooling Total Capacity (BTU/h)	Cooling Sensible Capacity (BTU/h)	Heating Diversity Full/Partial (See Note 5, 6)	Heating Capacity (BTU/h)								
VRFO-1		VRFI-16F	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way)	8,000	9,000	75.0/63.0	70	266.0	PARTIAL DEMAND	7,577.6	6,062.6	FULL DEMAND	5,441.4	1/4 / 1/2	HIGH	315		208/230V/1-phase	0.36/15	2.98	1, 2, 3, 4, 5
VRFO-1		VRFI-13	TPEFYP012MA1M0A	Ceiling-Concealed (Ducted)	12,000	13,500	75.0/63.0	70	266.0	PARTIAL DEMAND	11,366.5	8,205.5	FULL DEMAND	8,162.1	1/4 / 1/2	HIGH	371	0.6	208/230V/1-phase	1.9/15	3.12	1, 2, 3, 4, 5
VRFO-1		VRFI-14	TPEFYP024MA1M0A	Ceiling-Concealed (Ducted)	24,000	27,000	75.0/63.0	70	266.0	PARTIAL DEMAND	22,732.9	18,705.0	FULL DEMAND	16,324.1	3/8 / 5/8	HIGH	883	0.6	208/230V/1-phase	2.5/15	6.98	1, 2, 3, 4, 5
VRFO-1		VRFI-15A	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way)	8,000	9,000	75.0/63.0	70	266.0	PARTIAL DEMAND	7,577.6	6,062.6	FULL DEMAND	5,441.4	1/4 / 1/2	HIGH	315		208/230V/1-phase	0.36/15	3.74	1, 2, 3, 4, 5
VRFO-1		VRFI-15B	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way)	8,000	9,000	75.0/63.0	70	266.0	PARTIAL DEMAND	7,577.6	6,062.6	FULL DEMAND	5,441.4	1/4 / 1/2	HIGH	315		208/230V/1-phase	0.36/15	3.55	1, 2, 3, 4, 5
VRFO-1		VRFI-15C	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way)	8,000	9,000	75.0/63.0	70	266.0	PARTIAL DEMAND	7,577.6	6,062.6	FULL DEMAND	5,441.4	1/4 / 1/2	HIGH	315		208/230V/1-phase	0.36/15	3.36	1, 2, 3, 4, 5
VRFO-1		VRFI-17	TPEFYP012MS1M0A	Ceiling-Concealed (Ducted)	12,000	13,500	75.0/63.0	70	266.0	PARTIAL DEMAND	11,366.5	8,450.4	FULL DEMAND	8,162.1	1/4 / 1/2	HIGH	370	0.2	208/230V/1-phase	1.17/15	4.24	1, 2, 3, 4, 5
VRFO-1		VRFI-16A	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way)	8,000	9,000	75.0/63.0	70	266.0	PARTIAL DEMAND	7,577.6	6,062.6	FULL DEMAND	5,441.4	1/4 / 1/2	HIGH	315		208/230V/1-phase	0.36/15	3.17	1, 2, 3, 4, 5
VRFO-1		VRFI-16B	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way)	8,000	9,000	75.0/63.0	70	266.0	PARTIAL DEMAND	7,577.6	6,062.6	FULL DEMAND	5,441.4	1/4 / 1/2	HIGH	315		208/230V/1-phase	0.36/15	2.98	1, 2, 3, 4, 5
VRFO-1		VRFI-16C	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way)	8,000	9,000	75.0/63.0	70	266.0	PARTIAL DEMAND	7,577.6	6,062.6	FULL DEMAND	5,441.4	1/4 / 1/2	HIGH	315		208/230V/1-phase	0.36/15	2.79	1, 2, 3, 4, 5
VRFO-1		VRFI-16D	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way)	8,000	9,000	75.0/63.0	70	266.0	PARTIAL DEMAND	7,577.6	6,062.6	FULL DEMAND	5,441.4	1/4 / 1/2	HIGH	315		208/230V/1-phase	0.36/15	2.98	1, 2, 3, 4, 5
VRFO-1		VRFI-16E	TPLFYP008FM1M0A	Ceiling-Cassette (Four-Way)	8,000	9,000	75.0/63.0	70	266.0	PARTIAL DEMAND	7,577.6	6,062.6	FULL DEMAND	5,441.4	1/4 / 1/2	HIGH	315		208/230V/1-phase	0.36/15	3.17	1, 2, 3, 4, 5
VRFO-1		VRFI-11	TPLFYP018EM1M0A	Ceiling-Cassette (Four-Way)	18,000	20,000	75.0/63.0	70	266.0	PARTIAL DEMAND	17,049.7	15,615.8	FULL DEMAND	12,091.9	1/4 / 1/2	HIGH	812		208/230V/1-phase	0.54/15	8.4	1, 2, 3, 4, 5
VRFO-1		VRFI-10	TPEFYP036MA1M0A	Ceiling-Concealed (Ducted)	36,000	40,000	75.0/63.0	70	266.0	PARTIAL DEMAND	34,099.4	27,659.6	FULL DEMAND	24,183.9	3/8 / 5/8	HIGH	1271	0.6	208/230V/1-phase	3.1/15	8.55	1, 2, 3, 4, 5
VRFO-1		VRFI-9A	TPEFYP024MA1M0A	Ceiling-Concealed (Ducted)	24,000	27,000	75.0/63.0	70	266.0	PARTIAL DEMAND	22,732.9	18,705.0	FULL DEMAND	16,324.1	3/8 / 5/8	HIGH	883	0.6	208/230V/1-phase	2.5/15	6.03	1, 2, 3, 4, 5
VRFO-1		VRFI-9B	TPEFYP024MA1M0A	Ceiling-Concealed (Ducted)	24,000	27,000	75.0/63.0	70	266.0	PARTIAL DEMAND	22,732.9	18,705.0	FULL DEMAND	16,324.1	3/8 / 5/8	HIGH	883	0.6	208/230V/1-phase	2.5/15	7.31	1, 2, 3, 4, 5
VRFO-1		VRFI-01	TPEFYP024MA1M0A	Ceiling-Concealed (Ducted)	24,000	27,000	75.0/63.0	70	266.0	PARTIAL DEMAND	22,732.9	18,705.0	FULL DEMAND	16,324.1	3/8 / 5/8	HIGH	883	0.6	208/230V/1-phase	2.5/15	5.71	1, 2, 3, 4, 5
VRFO-1		VRFI-05	TPEFYP012MS1M0A	Ceiling-Concealed (Ducted)	12,000	13,500	75.0/63.0	70	266.0	PARTIAL DEMAND	11,366.5	8,450.4	FULL DEMAND	8,162.1	1/4 / 1/2	HIGH	370	0.2	208/230V/1-phase	1.17/15	3.94	1, 2, 3, 4, 5
VRFO-1		VRFI-06	TPEFYP018MA1M0A	Ceiling-Concealed (Ducted)	18,000	20,000	75.0/63.0	70	266.0	PARTIAL DEMAND	17,049.7	16,383.4	FULL DEMAND	12,091.9	1/4 / 1/2	HIGH	883	0.6	208/230V/1-phase	2.5/15	5.92	1, 2, 3, 4, 5
VRFO-1		VRFI-07	TPEFYP012MS1M0A	Ceiling-Concealed (Ducted)	12,000	13,500	75.0/63.0	70	266.0	PARTIAL DEMAND	11,366.5	8,450.4	FULL DEMAND	8,162.1	1/4 / 1/2	HIGH	370	0.2	208/230V/1-phase	1.17/15	3.94	1, 2, 3, 4, 5
VRFO-1		VRFI-08	TPEFYP012MS1M0A	Ceiling-Concealed (Ducted)	12,000	13,500	75.0/63.0	70	266.0	PARTIAL DEMAND	11,366.5	8,450.4	FULL DEMAND	8,162.1	1/4 / 1/2	HIGH	370	0.2	208/230V/1-phase	1.17/15	3.94	1, 2, 3, 4, 5
VRFO-1		VRFI-12	TPKFYP004LM1M0A	Wall -Mounted	4,000	4,500	75.0/63.0	70	266.0	PARTIAL DEMAND	3,788.8	3,368.6	FULL DEMAND	2,720.7	1/4 / 1/2	HIGH	148		208/230V/1-phase	0.24/15	1.96	1, 2, 3, 4, 5
VRFO-1		VRFI-IT	TPMFYP018CM1M0A	Ceiling Cassette (One-Way)	18,000	20,000	75.0/63.0	70	266.0	PARTIAL DEMAND	17,049.7	11,414.6	FULL DEMAND	12,091.9	1/4 / 1/2	HIGH	420		208-230V/1-phase	/15	3.79	1, 2, 3, 4, 5
VRFO-1		VRFI-02	TPLFYP012FM1M0A	Ceiling-Cassette (Four-Way)	12,000	13,500	75.0/63.0	70	266.0	PARTIAL DEMAND	11,366.5	7,526.2	FULL DEMAND	8,162.1	1/4 / 1/2	HIGH	335		208/230V/1-phase	0.36/15	3.84	1, 2, 3, 4, 5
VRFO-1		VRFI-03	TPEFYP018MA1M0A	Ceiling-Concealed (Ducted)	18,000	20,000	75.0/63.0	70	266.0	PARTIAL DEMAND	17,049.7	16,383.4	FULL DEMAND	12,091.9	1/4 / 1/2	HIGH	883	0.6	208/230V/1-phase	2.5/15	5.92	1, 2, 3, 4, 5
VRFO-1		VRFI-04	TPLFYP018FM1M0A	Ceiling-Cassette (Four-Way)	18,000	20,000	75.0/63.0	70	266.0	PARTIAL DEMAND	17,049.7	12,074.9	FULL DEMAND	12,091.9	1/4 / 1/2	HIGH	460		208/230V/1-phase	0.36/15	4.5	1, 2, 3, 4, 5
VRFO-1		VRFI-AV	TPKFYP004LM1M0A	Wall -Mounted	4,000	4,500	75.0/63.0	70	266.0	PARTIAL DEMAND	3,788.8	3,368.6	FULL DEMAND	2,720.7	1/4 / 1/2	HIGH	148		208/230V/1-phase	0.24/15	1.96	1, 2, 3, 4, 5
VRFO-02		VRFI-19	PEAD-AA12NL	Ceiling-Concealed (Ducted)	12,000	14,000	75.0/63.0	70	266.0	PARTIAL DEMAND	10,344.4	10,061.6	FULL DEMAND	10,624.2	1/4 / 1/2	HIGH	494	0.14/0.20/0.28/0.40/0.60	208/230V/1-phase	2.5/15		1, 2, 3, 4, 5
VRFO-02		VRFI-18	PLA-AE18NL	Ceiling-Cassette (Four-Way)	18,500	24,000	75.0/63.0	70	266.0	PARTIAL DEMAND	15,947.6	13,367.0	FULL DEMAND	18,213.0	1/4 / 1/2	HIGH	600		208/230V/1-phase	1/15		1, 2, 3, 4, 5
VRFO-02		VRFI-20	SEZ-AD12NL	Ceiling-Concealed (Ducted)	11,500	13,600	75.0/63.0	70	266.0	PARTIAL DEMAND	9,913.4	8,773.8	FULL DEMAND	10,320.7	1/4 / 3/8	HIGH	388	0.02/0.06/0.14/0.20	/	/		1, 2, 3, 4, 5
VRFO-02		VRFI-21	SLZ-AF09NL	Ceiling-Cassette (Four-Way)	9,000	14,600	75.0/63.0	70	266.0	PARTIAL DEMAND	7,758.3	7,364.5	FULL DEMAND	11,079.6	1/4 / 3/8	HIGH	300		208/230V/1-phase	1/15		1, 2, 3, 4, 5

Notes & Options:
1 Nominal cooling capacities are based on indoor coil EAT of 80/67°F (DB/WB), outdoor of 95°F (DB)
2 Nominal heating capacities are based on indoor coil EAT of 70°F (DB), outdoor of 43°F (WB)
3 See outdoor unit schedule for outdoor ambient conditions, connected capacity, and other factors associated with corrected capacities
4 See schematic piping/control diagram for indication of required indoor unit remote controllers, system controllers, and integration devices.
5 Full demand corrected capacity includes de-rate associated with indoor vs. outdoor connected capacity indicated on outdoor unit schedule for associated system.
Partial corrected capacity assumes sufficient diversity exists such that the connected capacity de-rate does not apply.
It is the designer's responsibility to ensure "Diamond System Builder" is set in the appropriate output capacity setting (full demand/partial demand) prior to generating this schedule.
6 It is recommended to always base heating corrected capacity on full demand.
7 Provide Condensate Pump for Indoor Units up to 120,000 BTUs 100-240VAC

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PROJECT NUMBER: 25-049

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MECHANICAL SCHEDULES

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M603

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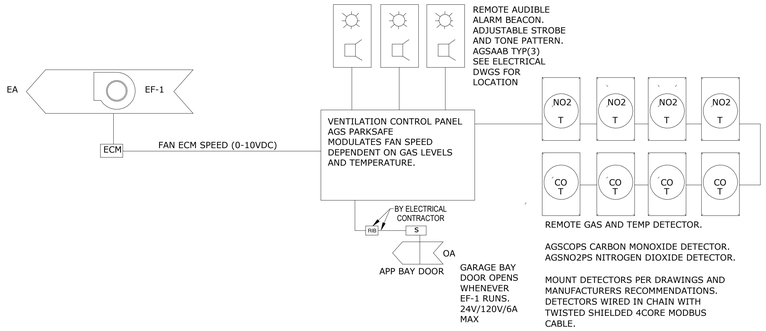
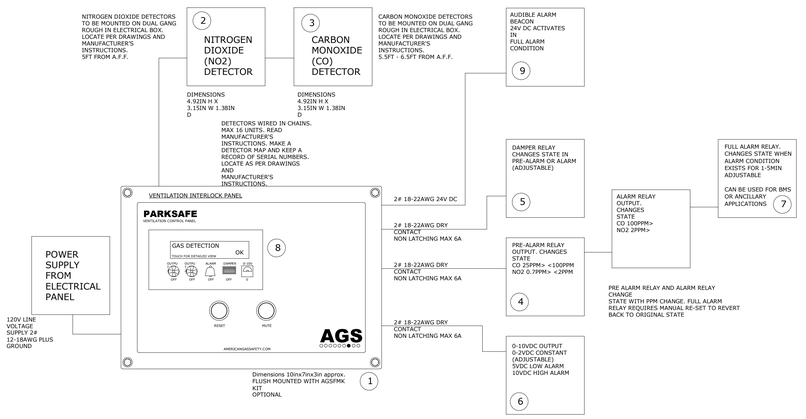




EXHAUST FAN EF-1 NORMAL OPERATION MODE

NOTE:

CONTRACTOR RESPONSIBLE FOR PROVIDING THIS SYSTEM OR APPROVED EQUIVALENT TO CONTROL EF-1 ECM MOTOR.

BAS SYSTEM SHALL DISPLAY ALL PARKSAFE ALARMS / ALERTS

4

RUN CONDITIONS:

EF-1: ON GAS ALARM OR RISE IN TEMPERATURE, SPEED RAMPS UP

EF-1 FAN OVERRIDE:

CONTROLLER PROVIDES FASCIA MOUNTED MANUAL FAN ACTIVATION.

EXHAUST FAN RUN SEQUENCE - NO2 / CO

RUN CONDITIONS:

THE EXHAUST FAN ECM SHALL BE SENT 5VDC WHEN CO (CARBON MONOXIDE) OR NO2 (NITROGEN DIOXIDE) IS ABOVE:
CO 25PPM, NO2 0.7PPM

THE EXHAUST FAN ECM SHALL BE SENT 10VDC AND SET TO MAXIMUM WHEN GAS LEVELS REACH HIGH ALARM LEVELS:
CO >100PPM, NO2 >2PPM

VENTILATION CONTROLLER SHALL PROVIDE A CLEAR COLOR DIGITAL DISPLAY OF ALL CONDITIONS.

IF HIGH ALARM LEVEL EXISTS BEYOND TIMED DELAY (ADJ) CONTROLLER SHALL EMIT AUDIBLE WARNING TONES AND SIGNAL REMOTE AUDIBLE ALARM BEACONS.

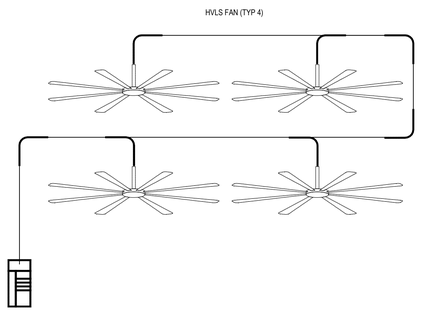
GARAGE BAY DOOR OPERATION MODE

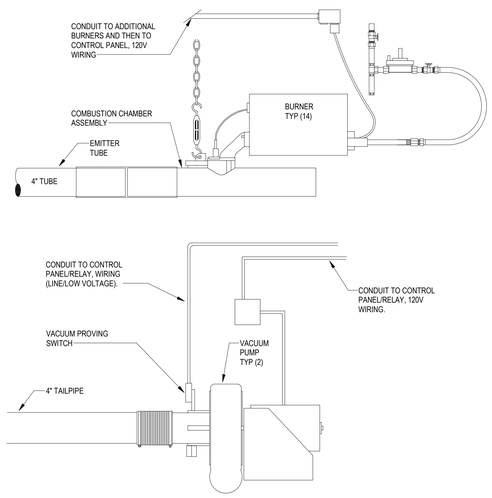
RUN CONDITIONS - INTERLOCKED WITH EF-1

CONTROLLER PROVIDES INTERNAL RELAY TO GOVERN POWER TO THE GARAGE BAY DOOR CONTROL WHENEVER EF-1 IS RUNNING .

1. AGS PARKSAFE VENTILATION CONTROL PANEL MODULATES FANS ON/OFF OR SPEED DEPENDING ON CONCENTRATIONS OF CO (CARBON MONOXIDE) AND NO2 (NITROGEN DIOXIDE) WITHIN THE PARKING STRUCTURE.
2. AGS CO DETECTORS AGSCOP INSTALL VIA CONDUIT OR ELECTRICAL ROUGH IN BOX. MOUNT PER MANUFACTURER'S INSTRUCTIONS. LOCATE PER DRAWINGS. DETECTORS COMMUNICATE WITH PARKSAFE UNIT VIA MODBUS. PARKSAFE UNIT POWERS DETECTORS. WIRE MULTIPLE DETECTORS IN SERIES PER MANUFACTURER'S INSTRUCTIONS
3. AGS NO2 DETECTOR AGSNO2P INSTALL VIA CONDUIT OR ELECTRICAL ROUGH IN BOX. MOUNT PER MANUFACTURER'S INSTRUCTIONS. LOCATE PER DRAWINGS. DETECTORS COMMUNICATE WITH PARKSAFE UNIT VIA MODBUS. PARKSAFE UNIT POWERS DETECTORS. WIRE MULTIPLE DETECTORS IN SERIES PER MANUFACTURER'S INSTRUCTIONS
4. PARKSAFE UNIT PROVIDES RELAY OUTPUTS FOR PRE-ALAM, ALARM AND FULL ALARM CONDITIONS. VOLT FREE NON LATCHING MAX 6A. OUTPUT 1 CHANGES STATE WHEN DETECTORS REACH PRE-ALARM CO >25PPM <100PPM NO2 >0.7PPM <2PPM OUTPUT 2 CHANGES STATE WHEN DETECTORS REACH ALARM CO 100>PPM NO2 >2PPM. FULL ALARM CHANGES STATE AFTER HIGH ALARM CONTINUES 1-5MINS ADJUSTABLE
5. DAMPER RELAY CHANGES STATE WITH PRE-ALARM OR ALARM OUTPUTS ADJUSTABLE. VOLT FREE NON LATCHING MAX 6A.
6. 0-10VDC OUTPUT. 0-2V CONSTANT ADJUSTABLE. 5V LOW ALARM 10V HIGH ALARM
7. RELAYS AND 24V CAN BE UTILIZED FOR BMS CONNECTIVITY. FULL ALARM RELAY CHANGES STATE AFTER DESIRED TIME DELAY OF ALARM CONDITION. REQUIRES MANUAL RESET TO REVERT BACK TO ORIGINAL STATE
8. PANEL PROVIDES COLOR DISPLAY FOR ALARM CONDITIONS. GREEN=GOOD YELLOW-PRE-ALARM ORANGE-ALARM RED-FULL ALARM. TOUCH SCREEN MENU PROVIDES ACCESS TO SETTINGS, SENSOR TYPE AND CONDITION. FAN AND RELAY STATE SHOWN VIA IMAGES.
9. AUDIBLE ALARM BEACON AGSAAB. ACTIVATES IN FULL ALARM CONDITION. LOCATE OUTSIDE PARKING AREA TO WARN OF DANGEROUS ENVIRONMENT.

1 / M703 CONTROLS - APPARATUS BAY EXHAUST FANS EF-1
NOT TO SCALE





APPARATUS BAY HEATING AND HVLS FANS

A. General
- The infrared heating system has two zones, each served by its own vacuum pump. It is controlled by the CORAYVAC Heating Control panel.
- Each zone operates only its own vacuum pump.
- The BAS provides one dry-contact zone call per zone, connected to the panel's 24 V thermostat terminals in place of thermostats.
- HVLS-1 through HVLS-4 are networked to the fan manufacturer's touchscreen controller. The BAS commands them as one group over BACnet MS/TP.
- Heating season is enabled when outdoor air temperature falls below 60°F and disabled when it rises above 65°F (adj.).

B. Infrared heating (heating season)

- Zone 1 is controlled from TS-1, on the left wall, and Zone 2 from TS-2, on the right wall.
- The occupied setpoint is 60°F. The setback setpoint is 55°F, used when a setback schedule is active. (Adj.)
- The BAS starts a zone call when zone temperature falls 1°F below setpoint and ends it 1°F above setpoint (adj.).
- Minimum on time and minimum off time are 10 minutes each (adj.).
- On a zone call, the panel starts and proves that zone's vacuum pump and fires the zone.
- When the zone call ends, the panel runs the post-purge and then stops the pump.

C. HVLS fans

- In heating season, the BAS commands the fans off.
- A local start at the touchscreen is allowed.
- After 30 minutes (adj.), the BAS commands the fans off again.
- Outside heating season, the fans run in forward direction on the average of TS-1 and TS-2.
- They start when the average rises above 78°F.
- Speed resets linearly from 30 percent at 78°F to 100 percent at 84°F.
- They stop when the average falls below 76°F.
- All values adj.
- Outside heating season, a local start, stop, or speed change at the touchscreen holds for 4 hours (adj.). The fans then return to BAS control.

D. Fire alarm

- Each fan has a factory fire alarm relay, wired from a supervised fire alarm control panel module under Division 28.
- On sprinkler waterflow, and on general alarm where the AHJ requires it, each fan stops regardless of any touchscreen or BAS command.
- The fans stay off until the fire alarm system is reset.
- The BAS is not in the shutdown path. It receives a fire alarm status contact so it can suppress fan alarms and log the event.

E. Alarms

- Vacuum pump not proven within 2 minutes of its zone call.
- Zone temperature below 50°F after a zone call lasting 30 minutes.
- Apparatus bay temperature below 40°F.
- Heating control panel fault.
- HVLS fan fault.
- HVLS fan commanded on but not running for 60 seconds, except during fire alarm.
- Loss of communication with the HVLS controller.

All setpoints and times are adjustable from the BAS operator interface.

Points List: APPARATUS BAY INFRARED HEATING ZONE [QTY: 2]

Point Name	GRAPHIC	ANALOG HARDWARE INPUT (AI)	BINARY HARDWARE INPUT (BI)	ANALOG HARDWARE OUTPUT (AO)	BINARY HARDWARE OUTPUT (BO)	SOFTWARE POINT (SFT)	HARDWARE INTERLOCK (HWI)	WIRELESS (WLS)	HIGH ANALOG LIMIT	LOW ANALOG LIMIT	JUMPY	LATCH DIAGNOSTIC	SENSOR FAIL	COMMUNICATION FAIL
SPACE TEMPERATURE, RADIANT-COMPENSATED (TS-1 , TS-2) ZN T	X	X								X				X
ZONE HEAT CALL TO HEATING CONTROL PANEL ZN.CALL	X				X									
VACUUM PUMP STATUS (PRESSURE SWITCH) VP STS	X		X									X		
OCCUPIED HEATING SETPOINT HTG SP OCC	X					X								
UNOCCUPIED HEATING SETPOINT HTG SP UNOCC	X					X								

Points List: INFRARED HEATING CONTROL PANEL [QTY: 1]

Point Name	GRAPHIC	ANALOG HARDWARE INPUT (AI)	BINARY HARDWARE INPUT (BI)	ANALOG HARDWARE OUTPUT (AO)	BINARY HARDWARE OUTPUT (BO)	SOFTWARE POINT (SFT)	HARDWARE INTERLOCK (HWI)	WIRELESS (WLS)	HIGH ANALOG LIMIT	LOW ANALOG LIMIT	JUMPY	LATCH DIAGNOSTIC	SENSOR FAIL	COMMUNICATION FAIL
HEATING CONTROL PANEL FAULT IR FLT			X											
HEATING SEASON ENABLE HTG ENA		X				X								
OUTDOOR AIR TEMPERATURE OAT	X	X											X	

Points List: HVLS FAN CONTROLLER (TOUCHSCREEN) [QTY: 1]

Point Name	GRAPHIC	ANALOG HARDWARE INPUT (AI)	BINARY HARDWARE INPUT (BI)	ANALOG HARDWARE OUTPUT (AO)	BINARY HARDWARE OUTPUT (BO)	SOFTWARE POINT (SFT)	HARDWARE INTERLOCK (HWI)	WIRELESS (WLS)	HIGH ANALOG LIMIT	LOW ANALOG LIMIT	JUMPY	LATCH DIAGNOSTIC	SENSOR FAIL	COMMUNICATION FAIL
FAN GROUP START/STOP COMMAND HVLS SS	X								X					
FAN GROUP SPEED COMMAND HVLS SPD	X								X					
FAN GROUP DIRECTION COMMAND HVLS DIR	X								X					
LOCAL OVERRIDE STATUS HVLS LOC	X								X					
BAY AVERAGE TEMPERATURE AB AVG T	X					X								
HVLS COOLING SETPOINT HVLS CLG SP	X					X								
LOCAL OVERRIDE TIMER HVLS OVR TMR						X								
CONTROLLER COMMUNICATION STATUS HVLS COMM	X								X					X

Points List: HVLS FAN [QTY: 4]

Point Name	GRAPHIC	ANALOG HARDWARE INPUT (AI)	BINARY HARDWARE INPUT (BI)	ANALOG HARDWARE OUTPUT (AO)	BINARY HARDWARE OUTPUT (BO)	SOFTWARE POINT (SFT)	HARDWARE INTERLOCK (HWI)	WIRELESS (WLS)	HIGH ANALOG LIMIT	LOW ANALOG LIMIT	JUMPY	LATCH DIAGNOSTIC	SENSOR FAIL	COMMUNICATION FAIL
FAN RUN STATUS SAF STS	X													
FAN FAULT SAF FLT	X													
FIRE ALARM SHUTDOWN (BY DIV 28 TO FAN RELAY) FA SHTDN							X							

Points List: FIRE ALARM INTERFACE [QTY: 1]

Point Name	GRAPHIC	ANALOG HARDWARE INPUT (AI)	BINARY HARDWARE INPUT (BI)	ANALOG HARDWARE OUTPUT (AO)	BINARY HARDWARE OUTPUT (BO)	SOFTWARE POINT (SFT)	HARDWARE INTERLOCK (HWI)	WIRELESS (WLS)	HIGH ANALOG LIMIT	LOW ANALOG LIMIT	JUMPY	LATCH DIAGNOSTIC	SENSOR FAIL	COMMUNICATION FAIL
FIRE ALARM STATUS FROM FACP FA STS			X											

Notes:
1. Points listed per unit; QTY indicates number of units. Zone points apply to Zone 1 (TS-1, left wall) and Zone 2 (TS-2, right wall).
2. Hardwired points land on BAS controller DDC-AB. Network points are read from or written to the HVLS touchscreen controller over BACnet.
3. Vacuum pump status and heating panel fault require dry contacts from the Roberts-Gordon heating control panel; confirm at submittal.
4. Fire alarm fan shutdown is hardwired by Division 28 to each fan relay; the BAS is not in the shutdown path.

2 / M703 CONTROLS - HVLS & INFRARED HEAT
NOT TO SCALE

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EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
4	11/06/26

LAST PROJECT REVISION: No 4 | 11/06/26

SEQUENCE & CONTROLS DIAGRAMS

SHEET NUMBER:
M703

11/5/2026 12:53:26 PM

General Plan Symbols

- Plan Revision Number
- Detail Number on Sheet / Sheet Number Where Detail is Placed
- Keynote Symbol
- Continuation Symbol
- Point Where New Connects To Existing
- Room / 1 — Room Name / Number
- Area Being Demolished
- Area Not In Contract

Abbreviations

Ø	ROUND	LVR	LOUVER
ABV	ABOVE	LWT	LEAVING WATER TEMPERATURE
AC	AIR CONDITIONING	MIA	MIXED AIR
AD	AREA DRAIN	MAX	MAXIMUM
ADD	ADDENDUM	MBH	ONE THOUSAND BTU PER HOUR
AFF	ABOVE FINISHED FLOOR	MCF	ONE THOUSAND CUBIC FEET
AFUE	ANNUAL FUEL UTILIZATION EFFICIENCY	MD	MOTORIZED DAMPER
ALT	ALTERNATE	MECH	MECHANICAL
AP	ACCESS PANEL	MFR	MANUFACTURER
ARCH	ARCHITECT/ARCHITECTURAL	MIN	MINIMUM
BFF	BELOW FINISHED FLOOR	MISC	MISCELLANEOUS
BLW	BELOW	MTR	MOTOR
BTU	BRITISH THERMAL UNITS	MUA	MAKE-UP/AIR
BTUH	BRITISH THERMAL UNITS PER HOUR	NC	NOISE CRITERIA
CAP	CAPACITY	NC	NORMALLY CLOSED
CB	CATCH BASIN	NIC	NOT IN CONTRACT
CFM	CUBIC FEET PER MINUTE	NO	NUMBER
CLG	CEILING	NO	NORMALLY OPEN
CO	CLEAN OUT	NTS	NOT TO SCALE
CW	COLD WATER	O	OXYGEN
D	DEGREE	O/A	OUTSIDE AIR
DB	DRY BULB	ORD	OVERFLOW ROOF DRAIN
DIA	DIAMETER	PD	PRESSURE DROP
DN	DOWN	PIV	POST INDICATOR VALVE
DW	DISTILLED WATER	PLBG	PLUMBING
EA	EACH	PRESS	PRESSURE
EAT	ENTERING AIR TEMPERATURE	PRV	PRESSURE REDUCING VALVE
ELEC	ELECTRICAL	PSI	POUNDS PER SQUARE INCH
EQUIP	EQUIPMENT	PSIG	POUNDS PER SQUARE INCH GAUGE
EWC	ELECTRIC WATER COOLER	PWR	POWER
EWT	ENTERING WATER TEMPERATURE	R	DUCT RISER
E/A	EXHAUST AIR	R/A	RETURN AIR
EXIST	EXISTING	RCP	RADIANT CEILING PANEL
F	DEGREES FAHRENHEIT	RD	ROOF DRAIN
FCO	FLOOR CLEAN OUT	REC	RECESSED
FD	FLOOR DRAIN	RED	REDUCER
FDC	FIRE DEPARTMENT CONNECTION	RH	RELATIVE HUMIDITY
FL	FLOOR	RL/A	RELIEF AIR
FO	FUEL OIL	RM	ROOM
FOV	FUEL OIL VENT	RPM	REVOLUTIONS PER MINUTE
FOR	FUEL OIL RETURN	RW	RAIN WATER
FOS	FUEL OIL SUPPLY	SF	SQUARE FOOT
FPM	FEET PER MINUTE	S/A	SUPPLY AIR
FS	FLOOR SINK	SAN	SANITARY
FT	FOOT/FEET	SF	SQUARE FOOT
FTR	FIN TUBE RADIATION	SD	SMOKE DAMPER
GAL	GALLON	SM	SURFACE MOUNT
GF	GAS-FIRED	SP	STANDPIPE
GC	GENERAL CONTRACTOR	SP	STATIC PRESSURE
GPM	GALLONS PER MINUTE	STM	STEAM
GW	GREASE WASTE	T	THERMOSTAT
HB	HOSE BIB	TD	TEMPERATURE DROP
HP	HORSE POWER	TDR	TRENCH DRAIN
HTG	HEATING	TEMP	TEMPERATURE
HTR	HEATER	TYP	TYPICAL
HW	HOT WATER	UG	UNDERGROUND
HYD	HYDRANT	VAC	VACUUM
ID	INDIRECT	V	VENT
IN	INCH	VAV	VARIABLE AIR VOLUME
INV	INVERT	VENT	VENTILATION
LB	POUND	VTR	VENT THROUGH ROOF
LB/HR	POUNDS PER HOUR	W	WASTE
LAT	LEAVING AIR TEMPERATURE	WB	WET BULB
LP	LOW PRESSURE	WCO	WALL CLEAN OUT
LPG	LIQUEFIED PETROLEUM GAS	WH	WALL HYDRANT

Equipment Abbreviations

AC	AIR CONDITIONING UNIT	EXP	EXPANSION TANK
ACCU	AIR COOLING CONDENSING UNIT	EWH	ELECTRIC WATER HEATER
AHU	AIR HANDLING UNIT	FCU	FAN COIL UNIT
AS	AIR SEPARATOR	FP	FIRE PUMP
B	BOILER	GHW	GAS-FIRED WATER HEATER
CH	CHILLER	GI	GREASE INTERCEPTOR
CT	COOLING TOWER	GRV	GRAVITY ROOF VENTILATOR
CUH	CABINET UNIT HEATER	HWP	HEATING WATER PUMP
CHWP	CHILLED WATER PUMP	HRU	HEAT RECOVERY UNIT
DBP	DOMESTIC WATER BOOSTER PUMP	PRV	POWER ROOF VENTILATOR
DC	DUCT MOUNTED COIL	RE	RETURN/EXHAUST FAN
DCP	DOMESTIC WATER CIRCULATING PUMP	RTU	ROOFTOP UNIT
EF	EXHAUST FAN	SP	SUMP PUMP
EDC	ELECTRIC DUCT COIL	UH	UNIT HEATER
		WH	WATER HEATER

* NOTE *
ALL OF GENERAL NOTES ON THIS SHEET ARE TO BE APPLIED TO ALL OTHER DRAWINGS IN THIS SET. THE SYMBOLS AND ABBREVIATIONS SHOWN ON THIS SHEET MAY OR MAY NOT BE USED IN THIS SET OF DRAWINGS.

Plumbing Symbols

- 2" — Nominal Pipe Size
- Above Ground Piping
- Below Ground Piping
- 1/8" / 12" SLOPE — Pipe Slope (When Applicable)
- (E) — Existing Pipe To Remain
- Pipe To Be Demolished
- CW — Domestic Cold-Water
- NPW — Non-Potable Water
- S-CW — Soft Cold-Water
- F-CW — Filtered Cold-Water
- RO — Reverse Osmosis Water
- HW — Domestic Hot-Water
- HW 140° — Domestic Hot-Water 140°
- HW-R — Hot-Water Recirculation
- HW-R 140° — Hot-Water Recirculation 140°
- SS — Sanitary Drain
- V — Sanitary Vent
- WV — Sanitary Wet Vent
- CWV — Combination DWV
- CD — Condensate Drain
- ID — Indirect Drain
- GW — Grease Waste
- GV — Grease Vent
- OW — Oil Waste
- OV — Oil Vent
- PD — Pump Discharge
- RGC — Radon Gas Collection
- SD — Storm Drain
- OSD — Storm Overflow
- CA — Compressed Air
- NG — Natural Gas
- LP — Liquid Propane
- Pipe Rise / Drop

Pipe Accessory Notes

- 4" FCO — Cleanout
- 2" BACKWATER — Swing Check
- 2" CHECK — Check Valve
- 2" CHECK — Alternate Check Valve
- 2" BALANCE — Balancing Valve
- 2" CIRC — Circuit Setter
- 2" GATE — Gate Valve
- 2" QUICK — Quick Opening Valve
- 2" S/O — Ball Valve
- 2" STRAIN — Fluid Strainer
- S — 1" GAS-CNTRL — Emergency Gas Shutoff
- 1" PLUG — Plug Valve
- 1" GAS COCK — Gas Shutoff Cock
- 1" REG — Gas Regulator
- TP — 1" T/V — Thermostatic Valve
- TP — PRIMER — Trap Primer
- M — 2" M-CNTRL — Elec. Control Valve
- TMV-XT/P — Mixing Valve
- EM — TMVEM — Emergency Mixer
- 2" PRV — Pressure Reducing Valve
- W — 2" METER — Water Meter
- IR — 1 1/2" METER — Irrigation Meter
- Double Check Valve
- Reduced Pressure Zone

Plumbing Fixture Notes

- Floor Drain — Design Size
- 0" FD-1 / 2 DFU — Identity Type / Drainage Fixture Units
- 2" FD-3 — Floor Drain w/ Deep Seal Trap
- 2" FD-3P — Floor Drain w/ Trap Primer ("P" Indicates Primer Connection)
- 2" FD-7 — Floor Drain w/ Integral Cleanout
- 3" AD-1 — Area Drain (No Trap)
- 6" DD-1 — Deck Drain
- 3" HD-1 — Hub Drain (Funnel Type)
- 3" FS-4 — Floor Sink
- 8" SD-12 — Roof Drain
- 6" SD-1 / 2000 SF — Combination Drain / Rainfall Surface Area

Project Requirements

A. COORDINATE INSTALLATION OF PIPING, DUCTWORK, CONDUIT, LIGHTS, CABLE TRAY, STRUCTURE, AND EQUIPMENT TO PREVENT CONFLICTS.

B. FINAL PRODUCT SHALL BE A COMPLETE AND FUNCTIONING SYSTEM, AND SHALL CONFORM TO ALL REQUIREMENTS OF APPLICABLE FEDERAL, STATE, AND LOCAL CODES, INCLUDING BUT NOT LIMITED TO THE INTERNATIONAL BUILDING CODE AND INTERNATIONAL MECHANICAL CODE.

C. LOCATE EQUIPMENT REQUIRING ACCESS 2'-0" MAXIMUM ABOVE CEILING.

D. ALL ROOF MOUNTED EQUIPMENT SHALL BE A MINIMUM 10'-0" FROM EDGE OF ROOF.

E. LOCATE DUCTWORK, PIPING AND MECHANICAL EQUIPMENT AWAY FROM THE SPACE ABOVE ELECTRICAL PANELS. TRANSFORMERS AND OTHER ELECTRICAL EQUIPMENT.

F. PENETRATIONS OF RATED ASSEMBLIES SHALL BE FIRE STOPPED. FIRE STOPPING SHALL BE AN APPROVED MATERIAL AS PRESCRIBED IN CSFM STANDARD 43-1 AND SHALL BE U.L. LISTED.

G. PROVIDE SLEEVES AND/OR OPENINGS TO RUN PIPES AND DUCTS THROUGH FOUNDATIONS, FLOORS, WALLS, AND ROOF.

H. MAINTAIN CLEAR ACCESS TO SERVICE EQUIPMENT AND OTHER ACCESSORIES REQUIRING SERVICE, VISUAL INSPECTION OR HAND OPERATION. WHERE INDICATED OR REQUIRED, PROVIDE ACCESS PANELS OF THE TYPE SELECTED TO SUIT MATERIALS IN WHICH INSTALLED.

I. ADJUST PIPING AND DUCTWORK SIZES TO PROPERLY CONNECT TO MECHANICAL EQUIPMENT.

J. REFER TO HVAC SERIES DRAWINGS FOR GAS AND A.C. CONDENSATE DRAIN PIPING.

K. PIPE SIZES SHOWN SHALL BE CONTINUED IN THE DIRECTION OF FLOW UNTIL ANOTHER SIZE IS SHOWN.

L. FOR DETAILS, EQUIPMENT CONNECTIONS, AND PIPE SIZES NOT SHOWN ON THE SEGMENTS, REFER TO DETAILS, SCHEDULES, AND SPECIFICATIONS.

M. INSTALL ALL EQUIPMENT IN ACCORDANCE WITH THE RESPECTIVE MANUFACTURER'S WRITTEN INSTALLATION INSTRUCTIONS, AT A LEVEL OF QUALITY AND WORKMANSHIP CONSISTENT WITH THE SPECIFICATIONS.

N. LOCATIONS OF PIPING, DUCTWORK AND EQUIPMENT AS INDICATED ON THE DRAWING, ARE APPROXIMATE, AND SUBJECT TO MINOR ADJUSTMENTS IN THE FIELD. WORK SHALL BE COORDINATED WITH ALL OTHER TRADES TO AVOID INTERFERENCE IN THE FIELD.

O. INSTALL EXPOSED PIPING AND DUCTWORK AS HIGH AS PRACTICAL IN ROOMS WITHOUT CEILINGS.

P. THE CONTRACTOR'S WORK SCHEDULE SHALL BE SUBMITTED TO AND APPROVED BY THE OWNER.

Q. PRIOR TO STARTING WORK, SUBMIT SHOP DRAWINGS FOR ALL MECHANICAL EQUIPMENT, PLUMBING FIXTURES, AND DIFFUSERS.

R. CONTRACTOR SHALL OBTAIN AND PAY FOR ALL NECESSARY PERMITS AND SHALL ARRANGE FOR ALL INSPECTIONS AS REQUIRED.

S. PROVIDE ONE YEAR WARRANTY FOR ALL WORKMANSHIP AND MATERIALS AFTER THE DATE OF FINAL ACCEPTANCE.

Plumbing General Notes

A. FIELD VERIFY ALL NEW WATER, WASTE, AND VENT PIPING CONNECTIONS AND PROVIDE NEW CONNECTIONS AS REQUIRED FOR PROPERLY OPERATING SYSTEMS.

B. PITCH UNDERFLOOR SANITARY WASTE PIPING AT 1/4" PER FOOT, UNLESS NOTED OTHERWISE.

C. PITCH UNDERFLOOR STORM PIPING 3" AND GREATER AT 1/8" PER FOOT, UNLESS NOTED OTHERWISE. PITCH ALL OTHER STORM PIPING AT 1/4" PER FOOT UNLESS OTHERWISE NOTED.

D. FIELD VERIFY LOCATION AND INVERTS OF SITE UTILITIES PRIOR TO INSTALLATION.

E. ROUTE DOMESTIC WATER, FIRE PROTECTION, SANITARY SEWER, AND STORM SEWER SERVICES TO SITE UTILITIES 5'-0" FROM BUILDING UNLESS NOTED OTHERWISE. REFER TO CIVIL PLANS.

F. WASTE AND VENT PIPING BELOW FLOOR AND THROUGH FLOOR SHALL BE 2" MINIMUM.

G. PROVIDE CLEANOUT IN ACCESSIBLE LOCATION AT THE BASE OF ALL PLUMBING RISERS.

Plumbing Sheet Index

P000	PLUMBING TITLE SHEET
P101	FIRST FLOOR - SANITARY PIPING PLAN
P201	FIRST FLOOR - SERVICE PIPING PLAN
P202	MEZZANINE - SERVICE PIPING PLAN
P401	FIRST FLOOR - ENLARGED SANITARY PIPING PLANS
P402	FIRST FLOOR - ENLARGED SERVICE PIPING PLANS
P403	FIRST FLOOR - ENLARGED SERVICE PIPING PLANS
P501	GAS RISER DIAGRAM
P502	DOMESTIC WATER RISER DIAGRAM
P503	SANITARY / VENT RISER DIAGRAM
P601	PLUMBING SCHEDULES & DETAILS
P602	PLUMBING SCHEDULES & DETAILS
P603	PLUMBING SCHEDULES & DETAILS

Code Fixture Unit Table

Qty	UPC	IPC	NPC	Code Fixture Unit Table	Design Total WSFU	Design Total DFU
101	Yes	No	No	UPC Fixture Unit Summary	230	357

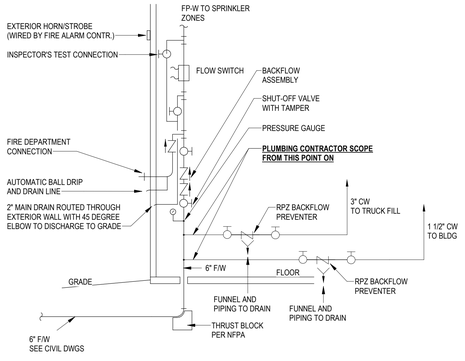
Drainage Fixture Units

Qty	Description	Product Type	Emergency Drain	DFU Each	DFU Total
1	Bottle Filler	Bottle Filling Station		0.5	0.5
1	Commercial Sink	1-Compartment		4	4
1	Commercial Sink	1-Compartment		4	4
2	Commercial Sink	3-Compartment		4	8
2	Commercial Sink	1-Compartment		4	8
24	Floor Drain	Round Strainer	No	8	192
2	Floor Sink	12" Square X 6" Deep	No	4	8
1	Lavatory	Wall Hung		1	1
1	Lavatory	Wall Hung ADA		1	1
9	Lavatory	Counter Mount		1	9
3	Lavatory	Counter Mount ADA		1	3
4	Outlet Box	Ice Maker		0	0
6	Outlet Box	Washing Machine		3	18
2	Outlet Box	Dishwasher		3	6
1	Outlet Box	Coffee Maker		0	0
7	Shower Stall - ADA	Shower Fixtures		2	14
4	Sink	Janitor		3	12
3	Sink	Laundry Tub		2	6
7	Urinal	Wall Hung		2	14
6	Water Closet	Pressure Assist Water Closet		4	24
6	Water Closet	Pressure Assist Water Closet		4	24
1	Water Cooler	Electric Water Cooler - Dual Height		0.5	0.5
Grand total: 94					357

Water Supply Properties

Standard Water Density = 62.4 lb/ft³ or 1000 kg/m³
Standard Water Specific Heat = 1.000 BTU/(lb·°F) or 4.187 J/(g·°C)
Water Supply Temp. = Estimated Ground Water Temp.

Qty	Water Properties: Density	Water Properties: Specific Heat	Water Meter Pressure	Water Supply Temp.
8	62.4 lb/ft³	1.000 BTU/(lb·°F)	0 psi	40 °F



1 / P000 FIRE PROTECTION RISER ASSEMBLY DETAIL
NOT TO SCALE
FOR TRADE COORDINATION

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EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
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ORIGINAL ISSUE DATE:
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3	10/29/26
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PLUMBING TITLE SHEET

SHEET NUMBER:
P000

11/5/2026 12:53:31 PM

Plumbing Fixture Schedule

Identity	Description	Manufacturer	Model	Qty	Product Type	Installation Type	ADA	Material Description	Finish	Faucet / Valve		Domestic Connections			Product Specification	Notes
										Manufacturer M/N	Type	Cold Water	Hot Water	Piping Size(s)		
EWC-1	Water Cooler	Elkay	EMABFTL8WSLK	1	Electric Water Cooler - Dual Height	Wall Hung	Yes	Galvanized Steel	Light Gray Granite			Yes	No	1/2"	ezH2O® Bottle Filling Station with Mechanically Activated Bi-Level ADA Cooler Non-Filtered Refrigerated Light Gray.	
EWC-2	Bottle Filler	Elkay	LZWSSM	1	Bottle Filling Station	Wall Hung	No	Galvanized Steel	Stainless Steel			Yes	No	1/2"	Stainless. Features shall include Antimicrobial*, Filtered, Green Ticker™, Hands Free, Laminar Flow, Real Drain, Visual Filter Monitor, Electronic Bottle Filler Sensor activation. Product shall be Wall Mount (On Wall), for Indoor applications, serving 1 station(s). Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120.	
FD-1	Floor Drain	Watts	FD-100-A	24	Round Strainer			Cast Iron							Epoxy Coated Cast Iron Floor Drain With Anchor Flange, Reversible Clamping Collar With Primary & Secondary Weepholes, Adjustable Round Heal Proof Nickel Bronze Strainer, And No Hub Outlet.	1
FS-1	Floor Sink	Watts	FS-730	2	12" Square X 6" Deep			Cast Iron							12" Square X 6" Deep Sanitary Floor Sink With White Porcelain Enamel Coated Interior, Loose Set Porcelain Enamel Coated Cast Iron Grate, Polypropylene Dome Bottom Strainer, And No Hub Outlet.	
GB-1	Gas Connection	Burnaby Manufacturing LTD	G0-102-DBL-SS	2	Gas Connection	Wall Mount	No	Stainless Steel	Stainless Steel			Yes	No	1/2"	Recessed Stainless Steel Gas Plug with (2) 1/2" Hose Connections. 125,000 BTU NG Each Side. 1/2" Inlet Connection.	
GB-2	Gas Connection	Burnaby Manufacturing LTD	VGP-GO-102-CDN	1	Gas Connection	Set in Concrete	No	Stainless Steel	Stainless Steel			Yes	No	1/2"	Recessed Stainless Steel Gas Plug with (1) 1/2" Hose Connections. 125,000 BTU NG. 1/2" Inlet Connection.	
HB-1	Hose Bibb	Zurn	Z1320XL-EZ	3	Wall Hydrant	Wall Mount	No					Yes	No	3/4"	Encased, EcolotrolTM, lead-free, non-freeze automatic draining wall hydrant for flush installation.Hydrant features integral backflow preventer with anti-siphon technology.copper casing, all-bronze interior components with 1/2 turn long-life ceramic disc cartridge,combination 3/4" [19] female solder and 3/4" [19] male pipe thread inlet connection, and 3/4" [19] male hose connection. Hydrant furnished with type 304 stainless steel housing with locking hinged cover stamped "WATER" and includes operating key. Hydrant housing fits within one standard modular masonry course.Recommended wall opening: 3-3/16" [81] X 8-1/2" [216].	
HR-1	Water Hose Reel	Reelcraft	D830-75 OLP	8	Dual Pedestal Hose Reels	Wall Mount								3/4"	Base Mounted Dual Pedestal with heat treated aluminum casting, two sealed ball bearings for smooth rotation of the main shaft, guide arm with 4 different adjustable positions, with Low-Pressure 3/4 in. x 75 ft PVC hose included. 3/4" Connection.	
HR-2	Air Hose Reel	Reelcraft	RS7850 OLP	5	Dual Pedestal Hose Reels	Wall Mount								1/2"	Reelcraft REELSAFE® RS7850 OLP, 1/2 in. x 50 ft. low pressure oil hose. Spring return with integral centrifugal clutch limiting retraction to approx. 2 mph; no field adjustment required. Column mounted; provide manufacturer's wall mounting bracket.	
JS-1	Sink	Fiat	MSB-2424	4	Janitor	Floor Set	No	Molded Stone		Chicago Faucets / 897-Cp	Manual	Yes	Yes	3/4"	Service Basin With Cap On Two Sides, With Chrome Plated 3" Drain And Cast Iron Trap. Faucet Shall Include Pail Hook And Atmospheric Vacuum Breaker Spout. Furnish 5'-0" Length Of 5-Ply Garden Hose And Fittings.	
JS-2	Sink	ADVANCE TABCO	FS-FM-2721-F	3	Laundry Tub	Floor Set	No	Stainless Steel	Stainless Steel	Included		Yes	Yes	1/2"	Advance Tabco Heavy Duty Floor Mounted Stainless Steel Service Sink FS-FM-2721-F w/ K-159 Gooseneck Faucet, 8" centerset, 3-1/2" gooseneck spout, 24" x 18" x 12" deep bowl, 8-1/2" backsplash, stainless steel tubular legs with flanged feet, and 3-1/2" rear basket drain.	
KE-01	Commercial Sink	Elkay	ELUHAD121255PD	1	1-Compartment	Undermount	Yes	Stainless Steel	Luminous Satin	Kohler K-28358		Yes	Yes	1/2"	Single-Compartment Kitchen Style Sink and Pulldown Faucet	
KE-02	Commercial Sink	Elkay	ELUHAD281655PD	1	1-Compartment	Undermount	Yes	Stainless Steel	Lustrous Satin	Kohler K-28358		Yes	Yes	1/2"	Single-Compartment Kitchen Style Sink and Pulldown Faucet	
KE-03	Commercial Sink	Elkay	RNSF83544	2	3-Compartment	Undermount	No	Stainless Steel	Stainless Steel	Elkay LK940GN05T4H		Yes	Yes	1/2"	3-Compartment Stainless Steel Sink with Wall-Mounted Faucet	
KE-04	Commercial Sink	Elkay	ECTRU35179TC	2	1-Compartment	Undermount	Yes	Stainless Steel	Polished Satin	Kohler K-28358		Yes	Yes	1/2"	Single-Compartment Kitchen Style Sink and Pulldown Faucet	
LAV-1	Lavatory	Elkay	WCLWO1923OSDC	1	Wall Hung	Wall Hung	No	Stainless Steel	Lustrous Satin	Chicago Faucets / 3511-E2805AB	Manual	Yes	Yes	1/2"	Lavatory With Backsplash, Faucet Holes On 4" Centers. Deck-Mounted Faucet With Manual Operation, Vandal Resistant Spray, External Asse 1070 Compliant Thermostatic Mixing Valve, Grid Drain, Loose Key Angle Stops And Supplies. Insulate Water And Waste With Insulation Kit.	
LAV-1A	Lavatory	Elkay	WCLWO1923OSDC	1	Wall Hung ADA	Wall Hung	Yes	Stainless Steel	Lustrous Satin	Chicago Faucets / 3511-E2805AB	Manual	Yes	Yes	1/2"	Lavatory With Backsplash, Faucet Holes On 4" Centers. Deck-Mounted Faucet With Manual Operation, Vandal Resistant Spray, External Asse 1070 Compliant Thermostatic Mixing Valve, Grid Drain, Loose Key Angle Stops And Supplies. Insulate Water And Waste With Insulation Kit.	
LAV-2	Lavatory	Kohler	K-37626	9	Counter Mount	Undermount	No	White Vitreous China	White	Chicago Faucets / 3511-E2805AB	Manual	Yes	Yes	1/2"	Undermount Vitreous China Lavatory With Overflow. Single-Hole Deck-Mounted Faucet With Manual Operation, Vandal-Resistant 0.5 GPM Spray, Integral Temperature Control Mixer, And Flexible Hot And Cold Water Supplies.	
LAV-2A	Lavatory	Kohler	K-37626	3	Counter Mount ADA	Undermount	Yes	White Vitreous China	White	Chicago Faucets / 3511-E2805AB	Manual	Yes	Yes	1/2"	Undermount Vitreous China Lavatory With Overflow. Single-Hole Deck-Mounted Faucet With Manual Operation, Vandal-Resistant 0.5 GPM Spray, Integral Temperature Control Mixer, And Flexible Hot And Cold Water Supplies.	
OB-1	Outlet Box	IPS Corporation	MIB1HAAB	4	Ice Maker	Recessed		Steel	White			Yes	No	1/2"	Recessed, White Powder-Coated Ice Maker Outlet Box With A Brass Quarter Turn Hammer Arrester Valve. Unit Shall Be Guy Gray™ Product Code Checked Below As Manufactured By IPS Corporation. The Brass Quarter Turn Valves Shall Comply With NSF61, NSF/ANSI 372, And ASME A112.18.1/CSA B125.1 And Shall Feature White Handle And Check-Mark Logo For Easy Lead-Free Identification.Hammer Arrester Shall Comply With ASSE 1010.	
OB-2	Outlet Box	IPS Corporation	MWB13	6	Washing Machine	Recessed		Steel	White			Yes	Yes	1/2"	Center Drain White Powder Coated Metal Washing Machine Outlet Box. Unit Shall Be Guy Gray Product Code As Manufactured By IPS Corporation. Qtr. Turn Valve With 1/2" Sweat/MIP, PEX, Wirsbo, Or CPVC Connection. 2" Slipnut Drain Kit Included. Valves Comply With ASME A112.18.1.	
OB-3	Outlet Box	IPS Corporation	DW1200HA	2	Dishwasher	Recessed		Hi-Impact Resin	White			No	Yes	1/2"	Recessed, White Powder-Coated Dishwasher Outlet Box, w/ Lead Free Qtr. Turn Arrester Valve with 3/8" Compression Outlet Available For Sweat.	
OB-4	Outlet Box	IPS Corporation	MIB1HAAB	1	Coffee Maker	Recessed		ABS Plastic	White			No	Yes	1/2"	Recessed, White Powder-Coated Coffee Maker Outlet Box With A Brass Quarter Turn Hammer Arrester Valve. Unit Shall Be Guy Gray™ Product Code Checked Below As Manufactured By IPS Corporation.	
PF-1	Pot Filler	Kohler	K-35745-CP	1	Single-Hole-Wall-Mounted Pot and Kettle Filler	Wall Mount	No					Yes	No	1/2"	Kohler Wall-Mounted Pot Filler K-35745-CP with articulating 360° rotating spout, single lever handle with main shutoff, ceramic disc valves, 7" spout reach, 5.2 GPM maximum flow rate, and polished chrome finish.	
SH-1A	Shower Stall - ADA	By Others	By Others	7	Shower Fixtures	Floor Set	Yes			Symmons / C-96-500-B30-V		Yes	Yes	1/2"	The Individual Shower Stall Is Specified In Another Division. See this schedule for Shower Drains. Shower System With Asse 1016 Compliant Type "T/P" Thermostatic/Pressure Balancing Combination Valve With Adjustable Stop Screw To Limit Handle Turn. Concealed 3-Port Diverter Valve With Lever Handle With Arm And Flange, Integral Stops, And In-Line Vacuum Breaker. Hand Shower System With Standard Hand Shower, 60" Flexible Metal Hose, And 48" Slide Bar For Hand Shower Mounting. Provide ManufacturerS Flow Rate Restrictor On Showerhead.	
TD-1	Trench Drain	Watts	Dead Level D	57	Wide Reveal Trench Drain System	Set in Concrete		Polypropylene							6"(152) wide x 48"(1219) long (standard) UV stabilized glass-filled polypropylene frame, UV stabilized talc-filled polypropylene channels with integral 4°(102) No Hub bottom outlet(s). System shall be frame-anchored, with DI grating to suit DIN Class E load rating with Frame Guards. Installed length (number of sections) varies per architectural plans	
TD-2	Shower Linear Drain	Oatey	PLD36-N	13	QuickDrain ProLine Drain	Set in Concrete		Stainless Steel							18 Gauge 316L Stainless Steel Linear Shower Drain with "Lines" grate. Fully sloped trough to prevent standing water and solids from being deposited in the trough. 2" I.D. Schedule 10 stainless steel downspout waste outlet. Drain cover sold separately.	
U-1	Urinal	American Standard	Washbrook	7	Wall Hung	Wall Hung	No	White Vitreous China	White	Sloan / REGAL 186-0.5	Manual	Yes	No	3/4"	Wall Hung Urinal With Washout Action, Top Spud, Size 18" With Integral Extended Shields Supported By Through Going Bolts And C.P. Nuts. Manual Flushometer 0.5GPF	
WC-1	Water Closet	Kohler	K3505	6	Pressure Assist Water Closet	Floor Set	No	White Vitreous China	White	Sloan / Flushmate III	Manual	Yes	No	1/2"	Elongated Floor Mounted Pressure Assist Tank Type Water Closet, With Kohler Stronghold K-4731-GC Commercial elongated toilet seat with integrated handle and Quiet-Close™ check hinge. Provide A 1/4" Brass Ball Valve At Wall Connection.	
WC-1A	Water Closet	Kohler	K3493	6	Pressure Assist Water Closet	Floor Set	Yes	White Vitreous China	White	Sloan / Flushmate III	Manual	Yes	No	1/2"	ADA Height Elongated Floor Mounted Pressure Assist Tank Type Water Closet, With Kohler Stronghold K-4731-GC Commercial elongated toilet seat with integrated handle and Quiet-Close™ check hinge. Provide A 1/4" Brass Ball Valve At Wall Connection.	

NOTES:
1. ALL FLOOR DRAINS (NOT INCLUDING TRENCH DRAINS, AND FLOOR SINKS) SHALL HAVE DOMESTIC WATER PIPING ROUTED FROM TRAP PRIMERS UNLESS OTHERWISE NOTED.

Thermal Expansion Tank Schedule

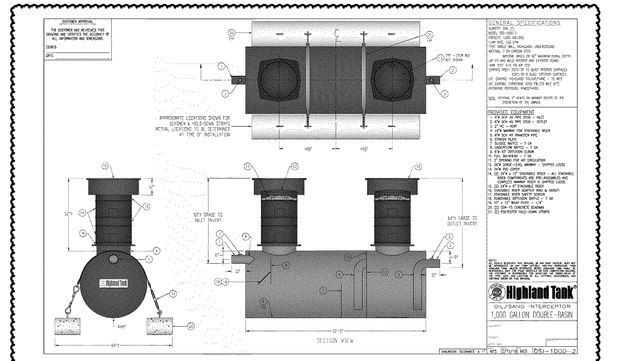
Identity	Location Name	Location No.	Manufacturer	Model	Product Type	System Fluid	Water Supply Temp.	ASME	Tank Fill Pressure	Tank Fill Temp.	Tank Acceptance Factor	Tank Acceptance Volume	Tank Capacity	Product Weight	Operating Weight	Notes
DET-1	MECHANICAL	124	Bell & Gossett	PT-12	Diaphram	Dom. Water	40 °F	Yes	38 psi	40 °F	73%	3.2 gal	4.4 gal	9 lb	128 lb	
DET-2	COMPRESSOR	201	Bell & Gossett	PT-12	Diaphram	Dom. Water	40 °F	Yes	38 psi	40 °F	73%	3.2 gal	4.4 gal	9 lb	128 lb	
PT-1	MECHANICAL	124	Amtrol	ST-70VC	Fixed Diaphram	Dom. Water	40 °F	Yes	0 psi	40 °F	32%	10.9 gal	34.0 gal	99 lb	190 lb	
UT-40	MECHANICAL	124	Amtrol	ST-210VC	Fixed Diaphram	Dom. Water	40 °F	Yes	0 psi	40 °F	39%	35.1 gal	90.0 gal	319 lb	612 lb	

Air Compressor Schedule

Identity	Location Name	Location No.	Manufacturer	Model	HP	Capacity (CFM @ 90 psi)	Max Pressure	Tank Capacity	Electrical	Weight (lbs)	Notes
AC-1	COMPRESSOR	201	Ingersoll Rand	2340L5	5	14.3	175	60 gal	460-3-60	433	

Domestic Circulator Pump Schedule

Identity	Location Name	Location No.	Manufacturer	Model	Product Type	Connections Suction	Connections Discharge	Motor Power	Motor RPM	Electrical FLA	Electrical Voltage	Electrical Phase	Notes
DCP-1	MECHANICAL	124	Taco	008IQSF6-IFC	Inline	3/4"	3/4"	19 W	3250	0.84 A	120 V	1	
DCP-2	COMPRESSOR	201	Taco	008IQSF6-IFC	Inline	3/4"	3/4"	19 W	3250	0.7 A	120 V	1	



1 / P601 OIL/SAND SEPERATOR DETAIL
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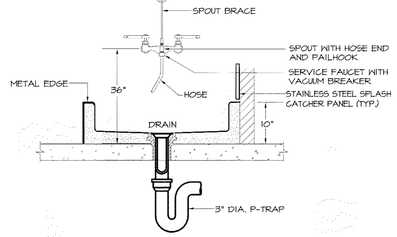
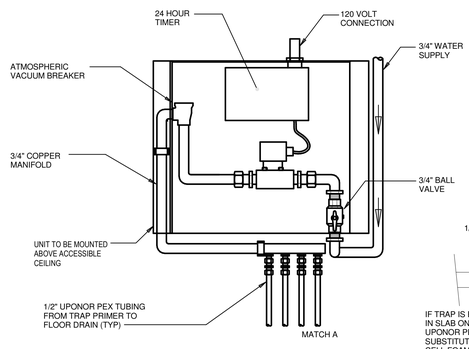


4 / P601 DETAIL - JANITOR SINK
NOT TO SCALE

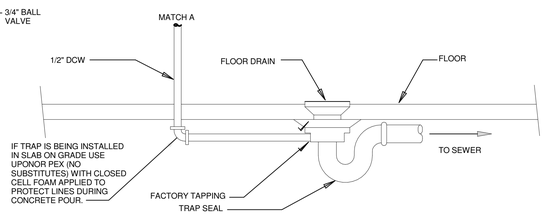
Gas-Fired Water Heater Schedule

Identity	Location Name	Location No.	Manufacturer	Model	Product Type	Temp. Rise	Recovery Capacity	Storage Capacity	MAWP	ASME	Gas Burner Type	Gas Burner Input Rating	Gas Burner Output Rating	Gas Burner Efficiency	Electrical Voltage	Electrical Phase	Breaker Size	Product Weight	Operating Weight	Notes
GWH-1	MECHANICAL	124	Rheem	GHE100SS-250(A)	Gas Tank	100F	291gph	100gal	160 PSI	Y	NG	250MBH	240MBH	96%	110	1	7.5A	775lbs	-	
GWH-2	COMPRESSOR	201	Rheem	GHE80SS-130 (A)	Gas Tank	100F	153gph	80gal	160 PSI	Y	NG	130MBH	120MBH	96%	110	1	7.5A	775lbs	-	



TRAP PRIMING MANIFOLD SCHEDULE

TAG	SYSTEM	LOCATION	VOLTAGE	PHASE	MANUFACTURER	MODEL	REMARKS
TP-1	ELECTRONIC TRAP PRIMING MANIFOLD	LAUNDRY 125	120 V	1	PPP INC.	PTS-10	
TP-2	ELECTRONIC TRAP PRIMING MANIFOLD	CORRIDOR 106	120 V	1	PPP INC.	PTS-10	
TP-3	ELECTRONIC TRAP PRIMING MANIFOLD	EMS OFFICE I 152	120 V	1	PPP INC.	PTS-6	



6 / P601 DETAIL - ELECTRONIC TRAP PRIMER
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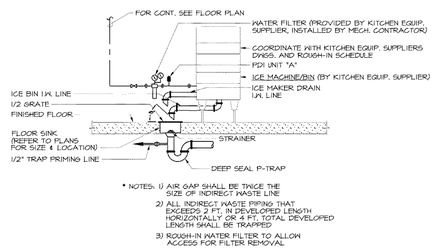

5 / P601 DETAIL - ICE MACHINE
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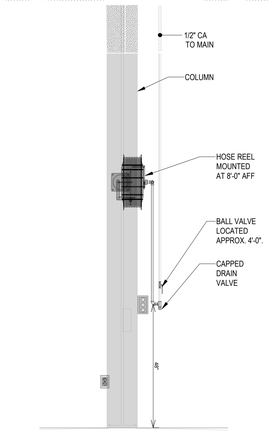

7 / P601 AIR HOSE REEL DETAIL
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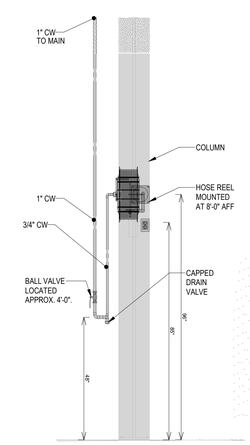

2 / P601 WATER HOSE REEL DETAIL
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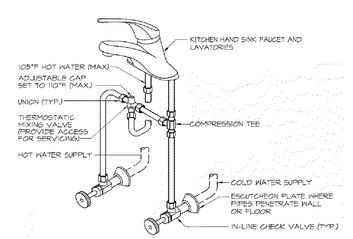

3 / P601 DETAIL - FAUCET
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EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
1	10/15/26
2	10/22/26
3	10/29/26
4	11/06/26

LAST PROJECT REVISION: No 4 | 11/06/26

PLUMBING SCHEDULES & DETAILS

SHEET NUMBER:
P601

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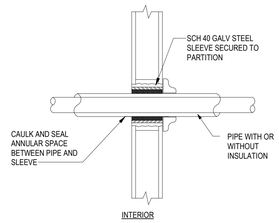
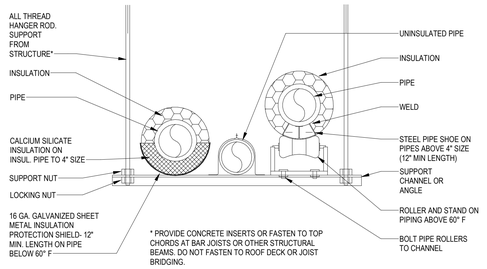
4



NOTES:
1. TYPICAL FOR NON-INSULATED PIPE AND CONDUIT.
2. ALL CAULKING AND SEALANT SHALL BE FIRE RATED (SEE SPECIFICATIONS).
3. WHERE PIPING IS EXPOSED AT FINISHED WALL, FLUSH MOUNT SLEEVE AND PROVIDE AN ESCUTCHEON PLATE.

2 / P602 PIPE PENETRATION THRU INTERIOR WALLS
NOT TO SCALE



3 / P602 TRAPEZE PIPE HANGER DETAIL
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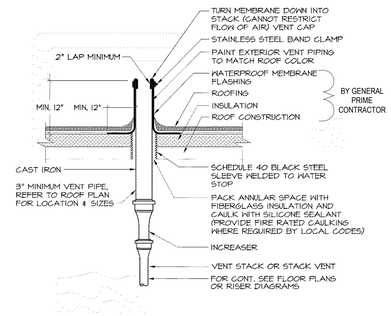

6 / P602 DETAIL - PLUMBING VENT THRU ROOF
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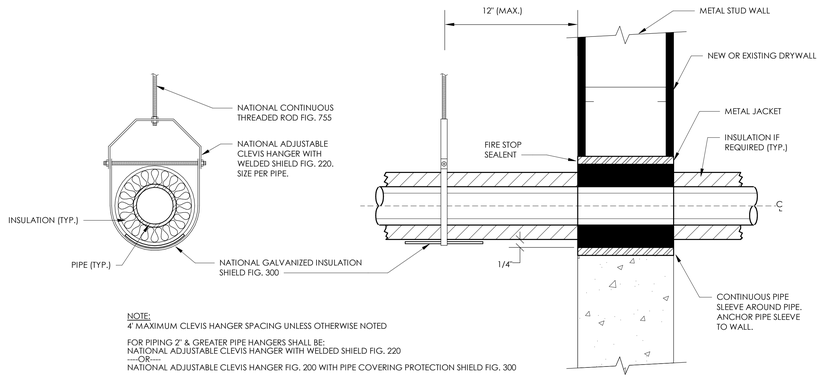

NOTE:
4' MAXIMUM CLEVIS HANGER SPACING UNLESS OTHERWISE NOTED

FOR PIPING 2" & GREATER PIPE HANGERS SHALL BE:
NATIONAL ADJUSTABLE CLEVIS HANGER WITH WELDED SHIELD FIG. 220
----OR----
NATIONAL ADJUSTABLE CLEVIS HANGER FIG. 200 WITH PIPE COVERING PROTECTION SHIELD FIG. 300

SUSPENDED PIPE SHALL BE ATTACHED TO WOOD OR STEEL STRUCTURAL MEMBERS. SUSPENDED PIPE SHALL NOT HAND OR BE ATTACHED TO FLOOR OR ROOF DECK.

4 / P602 DETAIL - TYPICAL WALL PENETRATION & HANGER
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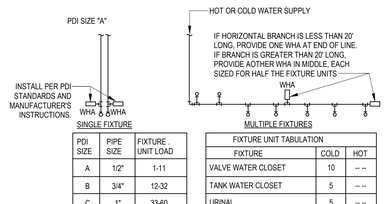

PDI SIZE	PIPE SIZE	FIXTURE UNIT LOAD
A	1/2"	1-11
B	3/4"	12-32
C	1"	33-60
D	1-1/4"	61-113
E	1-1/2"	114-154
F	2"	155-330

FIXTURE UNIT TABULATION

FIXTURE	COLD	HOT
VALVE WATER CLOSET	10	-- --
TANK WATER CLOSET	5	-- --
URINAL	5	-- --
LAVATORY/SINK	1.5	1.5
JANITOR'S SINK	3	3
SHOWER/BATHTUB	2	2

WATER HAMMER ARRESTERS BY SIOUX CHIEF, PRECISION PLUMBING PRODUCTS, WATTS OR APPROVED EQUIVALENT WITH PISTON AND O-RING CONSTRUCTION. HAVING PDI #WH-201, ASSE #1010 AND ANSI #A112.26.1M CERTIFICATION. INSTALL IN LINE WITH OR VERTICAL POSITION, BUT NEVER UPSIDE DOWN. SIZE THE UNITS PER THE TABLES SHOWN ABOVE.

5 / P602 DETAIL - WATER HAMMER ARRESTOR
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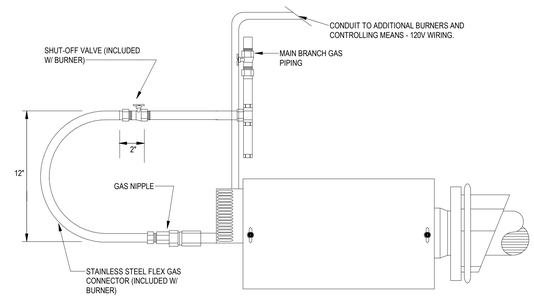

7 / P602 INFRARED DETAIL 6
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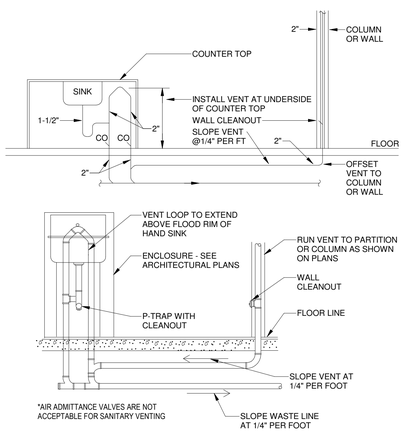

8 / P602 DETAIL - ISLAND VENT PIPING
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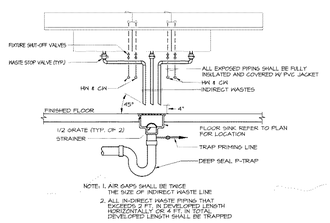

9 / P602 TYPICAL 3-COMPARTMENT SINK DETAIL
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EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
4	11/06/26

LAST PROJECT REVISION: No 4 | 11/06/26

PLUMBING SCHEDULES & DETAILS

SHEET NUMBER:
P602

11/5/2026 12:53:45 PM

General Plan Symbols

- Plan Revision Number
- Detail Number on Sheet / Sheet Number Where Detail is Placed
- Keynote Symbol
- Continuation Symbol
- Point Where New Connects To Existing
- Room / Room Name / Number
- Area Being Demolished
- Area Not In Contract

Fire Protection Symbols

- Nominal Pipe Size
- Above Ground Piping
- Below Ground Piping / Pipe Slope (When Applicable) (1/8" / 12" SLOPE)
- Existing Pipe To Remain
- Pipe To Be Demolished
- Wet Fire Sprinkler
- Dry Fire Sprinkler
- Preaction Fire Sprinkler
- Fire & Water Service
- Fire Sprinkler (Other)
- Upright Sprinkler
- Pendent Sprinkler
- Recessed Sprinkler
- Concealed Head
- Upright Sprinkler
- Sidewall Sprinkler
- Extended Coverage Sprinkler
- Standpipe Valve
- Obstruction From Ductwork 48" and Greater (48"x18" S/A)
- Check Valve
- Alarm Check Valve
- Tamper Detection Valve
- Dry Pipe Valve
- Indicating Butterfly Valve
- Post Indicator Valve
- Valve Norrising Stem
- OS&Y Valve
- Preaction Valve
- Deluge Valve
- Thrust Block
- Pipe Anchor
- Freestanding Siamese Fire Department Connection
- Siamese Fire Department Connection
- Single Fire Department Connection
- Riser Assembly
- Double Check (OS&Y)
- Double Check (Butterfly with Tamper)
- Reduced Pressure Zone
- Equipment Identity (X)

ABBREVIATIONS

Ø	ROUND	LVR	LOUVER
ABV	ABOVE	MAX	MAXIMUM
AD	AREA DRAIN	MD	MOTORIZED DAMPER
ADD	ADDENDUM	MECH	MECHANICAL
AFF	ABOVE FINISHED FLOOR	MFR	MANUFACTURER
ALT	ALTERNATE	MIN	MINIMUM
AP	ACCESS PANEL	MISC	MISCELLANEOUS
ARCH	ARCHITECT/ARCHITECTURAL	MTR	MOTOR
BFF	BELOW FINISHED FLOOR	NC	NORMALLY CLOSED
BLW	BELOW	NIC	NOT IN CONTRACT
CAP	CAPACITY	NO	NUMBER
CB	CATCH BASIN	NO	NORMALLY OPEN
CLG	CEILING	NTS	NOT TO SCALE
CO	CLEAN OUT	PD	PRESSURE DROP
CW	COLD WATER	PIV	POST INDICATOR VALVE
D	DEGREE	PRESS	PRESSURE
DIA	DIAMETER	PRV	PRESSURE REDUCING VALVE
DN	DOWN	PSI	POUNDS PER SQUARE INCH
EA	EACH	PSIG	POUNDS PER SQUARE INCH GAUGE
ELEC	ELECTRICAL	PWR	POWER
EQUIP	EQUIPMENT	REC	RECESSED
E/A	EXHAUST AIR	RED	REDUCER
F	DEGREES FAHRENHEIT	RM	ROOM
FD	FLOOR DRAIN	RPM	REVOLUTIONS PER MINUTE
FDC	FIRE DEPARTMENT CONNECTION	SF	SQUARE FOOT
FL	FLOOR	SAN	SANITARY
FO	FUEL OIL	SF	SQUARE FOOT
FOV	FUEL OIL VENT	SD	SMOKE DAMPER
FOR	FUEL OIL RETURN	SM	SURFACE MOUNT
FOS	FUEL OIL SUPPLY	SP	STANDPIPE
FPM	FEET PER MINUTE	SP	STATIC PRESSURE
FT	FOOT/FEET	T	THERMOSTAT
GAL	GALLON	TD	TEMPERATURE DROP
GF	GAS-FIRED	TEMP	TEMPERATURE
GC	GENERAL CONTRACTOR	TYP	TYPICAL
GPM	GALLONS PER MINUTE	UG	UNDERGROUND
HB	HOSE BIB	V	VENT
HP	HORSE POWER	VENT	VENTILATION
HTR	HEATER	W	WASTE
HYD	HYDRANT	WH	WALL HYDRANT
ID	INDIRECT		
IN	INCH		
INV	INVERT		
LB	POUND		

EQUIPMENT ABBREVIATIONS

AC	AIR CONDITIONING UNIT	ET	EXPANSION TANK
ACCU	AIR COOLING CONDENSING UNIT	EWH	ELECTRIC WATER HEATER
AHU	AIR HANDLING UNIT	FCU	FAN COIL UNIT
AS	AIR SEPARATOR	FP	FIRE PUMP
B	BOILER	GI	GREASE INTERCEPTOR
CH	CHILLER	GRV	GRAVITY ROOF VENTILATOR
CT	COOLING TOWER	HWP	HEATING WATER PUMP
CUH	CABINET UNIT HEATER	HRU	HEAT RECOVERY UNIT
CHWP	CHILLED WATER PUMP	PRV	POWER ROOF VENTILATOR
DBP	DOMESTIC WATER BOOSTER PUMP	RE	RETURN/EXHAUST FAN
DC	DUCT MOUNTED COIL	RTU	ROOFTOP UNIT
DCP	DOMESTIC WATER CIRCULATING PUMP	SP	SUMP PUMP
EF	EXHAUST FAN	UH	UNIT HEATER
EDC	ELECTRIC DUCT COIL	WH	WATER HEATER

* NOTE *

ALL OF GENERAL NOTES ON THIS SHEET ARE TO BE APPLIED TO ALL OTHER DRAWINGS IN THIS SET.THE SYMBOLS AND ABBREVIATIONS SHOWN ON THIS SHEET MAY OR MAY NOT BE USED IN THIS SET OF DRAWINGS.

Fire Protection General Notes

A. PROVIDE A COMPLETE WET TYPE FIRE PROTECTION SYSTEM AS REQUIRED TO ACCOMMODATE THE FLOOR PLAN AND CEILING TYPES INCLUDING MAINS, BRANCHES, HEADS, VALVES, AND ACCESSORIES AS REQUIRED. THE SYSTEM SHALL BE INSTALLED ACCORDING TO MANUFACTURER'S SPECIFICATIONS AND RECOMMENDATIONS OF THE STATE BUILDING CODE, LOCAL FIRE DEPARTMENT, AND ALL FEDERAL, STATE, AND LOCAL AUTHORITIES, NFPA, AND FACTORY MUTUAL.

B. THE SPRINKLER SYSTEM SHALL BE DESIGNED BASED UPON ACTUAL WATER FLOW TEST DATA OBTAINED AT OR NEAR THE JOB SITE.

C. REFER TO REFLECTED CEILING PLANS FOR ADDITIONAL INFORMATION REGARDING SPRINKLER HEAD LOCATION AND PIPE, UNLESS NOTED OTHERWISE.

D. DIVISION 21 CONTRACTOR SHALL COORDINATE WITH THE ELECTRICAL CONTRACTOR FOR PROPER INSTALLATION OF THE FIRE PROTECTION SYSTEMS ALARM DEVICES INVOLVED WITH FIRE SPRINKLER SYSTEM.

E. ALL SPRINKLER SYSTEM PIPING SHALL BE CONCEALED ABOVE THE SUSPENDED CEILING SYSTEM. UNLESS NOTED OTHERWISE. WRITTEN AUTHORIZATION SHALL BE OBTAINED FROM THE ARCHITECT PRIOR TO EXPOSING ANY PIPING IN ANY ROOM WHICH HAS A SUSPENDED CEILING.

F. THIS CONTRACTOR SHALL PROVIDE ALL ADDITIONAL SPRINKLER HEADS AS REQUIRED TO ENSURE AN APPROVED FIRE PROTECTION SYSTEM AT NO ADDITIONAL COST TO THE OWNER.

G. AUXILIARY DRAINS SHALL BE EXPOSED WITH 1" DRAIN VALVES. WHEN 5 OR MORE GALLONS ARE TRAPPED, THIS CONTRACTOR SHALL PROVIDE FIXED PIPING TO AN ADEQUATELY SIZED RECEPTOR WHICH IS CAPABLE OF ACCEPTING THE FULL FLOW OF THE DRAIN. WHEN LESS THAN 5 GALLONS ARE TRAPPED, A HOSE BIB SHALL BE PROVIDED AT THE DRAIN VALVE.

H. AUXILIARY DRAINS SHALL NOT BE LOCATED ABOVE PLASTER OR GYPSUM BOARD CEILING SYSTEMS. ONLY BY A SPECIFIC WRITTEN INSTRUCTION FROM THE ENGINEER WILL A VARIANCE BE PROVIDED.

I. AN INSPECTOR'S TEST CONNECTION SHALL BE PROVIDED FOR EACH FIRE SPRINKLER ZONE. THIS CONTRACTOR SHALL PROVIDE FIXED PIPING FROM THE TEST CONNECTION TO AN ADEQUATELY SIZED RECEPTOR WHICH IS CAPABLE OF ACCEPTING THE FULL FLOW OF THE TEST. EXTERIOR DISCHARGE OF THE TEST CONNECTION SHALL BE PERMITTED ONLY BY SPECIFIC WRITTEN INSTRUCTION FROM THE ENGINEER.

J. SHOW ALL ROOM NUMBERS ON SHOP DRAWING PLANS.

K. FLOW TEST DATA FROM 01/08/26 INDICATES THE FOLLOWING: STATIC PRESSURE: 90 PSI. RESIDUAL PRESSURE: 87 PSI AT 1,405 GPM. FLOW WAS MEASURED AT HYDRANT FH HEX-141, LOCATED AT THE WESTERN CORNER OF EXETER MEDICAL CENTER. THE FLOW TEST DATA DOES NOT ACCOUNT FOR LOSSES DUE TO ELEVATION CHANGE OR PIPE FRICTION FROM THE WATER MAIN TO THE BUILDING. SEE CIVIL PLANS FOR HYDRANT LOCATIONS. THE CONTRACTOR SHALL PERFORM A FIRE FLOW TEST IN ACCORDANCE WITH NFPA 291 TO VERIFY THE FLOW TEST DATA GIVEN ABOVE. THE DATA GIVEN ABOVE SHALL BE THE BASIS OF DESIGN UNLESS THE AVAILABLE PRESSURE OR FLOW HAS DECREASED. NOTIFY OWNER'S REPRESENTATIVE IF FLOW TEST DATA DIFFERS FROM THE DATA ABOVE. A FIRE PROTECTION ENGINEER OR AN ENGINEER EXPERIENCED IN WATER FLOW TESTING SHALL PERFORM OR WITNESS THE REQUIRED FLOW TESTING AND SIGN THE REPORT PRIOR TO THE FIRST SPRINKLER SYSTEM SUBMITTAL.

L. ROUTE SPRINKLER PIPING SUCH THAT IT DOES NOT RUN ABOVE ELECTRICAL PANELS, SWITCHGEAR, OR SIMILAR EQUIPMENT. SPRINKLER MAINS SHALL NOT RUN THROUGH ELECTRICAL OR COMMUNICATION ROOMS. SPRINKLER HEADS IN THESE ROOMS SHALL BE SERVED BY A DEDICATED BRANCH LINE FOR EACH ROOM.

M. THIS DRAWING INDICATES A GENERAL PIPING ARRANGEMENT AND SUGGESTED SIZING ONLY. THIS CONTRACTOR SHALL DETERMINE THE ACTUAL PIPE SIZING REQUIRED AND COORDINATE WORK WITH ALL OTHER TRADES TO AVOID CONFLICTS.

N. THIS CONTRACTOR SHALL PREPARE HYDRAULIC CALCULATIONS BASED UPON THE CONFIGURATION OF THE ACTUAL SYSTEM DESIGN AS SHOWN ON THIS CONTRACTOR'S SHOP DRAWINGS.

Fire Protection Sheet Index

F000	FIRE PROTECTION TITLE SHEET
F111	FIRST FLOOR FIRE PROTECTION PLAN
F112	MEZZANINE & APP BAY FIRE PROTECTION PLAN

(DESIGN: 0.20 / 1,125 SQFT)
9 SPRINKLERS AT 1,170 SQFT TOTAL
43.6 PSI 509 GPM

Sprinkler (K-11.2): 7 psi
Branch (2-in): 8.5 psi
Mains (4-in): 5.3 psi
Riser (4-in): 8.4 psi
Elevation: 9.1 psi
Underground (6-in): 2.3 psi

System	
NFPA 13 Edition	2019
Configuration	Tree
System Type	Wet
Hazard	Ordinary 2
Density	0.20 gpm/sqft
C-Factor	120
Inside Hose	100 gpm
Outside Hose	150 gpm
K-Factor	11.2
Minimum Pressure	7 psi

Layout	
Width of Area	100-ft
Sprinkler Spacing (feet)	10 x 13
Sprinkler Coverage	130 sqft
Sprinklers per Branch	10 sprinklers
Main Located After	4 sprinklers
Ceiling Height	28-ft
Sprinkler Height	20-ft
Branch Height	21-ft
Source Height	0-ft

Remote Area	
Original Remote Area	1,500 sqft
OR Reduction	Yes
Slope Increase	No
Dry / Double Interlock	No
High-Temp Increase	No
Adjusted Remote Area	1,125 sqft
Sprinklers Calculated	9 at 130 sqft
Actual Remote Area	1,170 sqft
Flow Overage	+126%

Schematic

Riser	
Valve Size	4-in
Valve Type	Butterfly
Monitoring	Waterflow
Backflow Size	6-in
Backflow Loss	6 psi

Mains	
Diameter	4-in
Length to Riser	300-ft
Schedule	Schedule 10

Riser Nipple	
Diameter	2.5-in
Height	1-ft
Schedule	Schedule 40

Underground	
Diameter	6-in
Length	500-ft
C-Factor	140

Branch Pipe	
Style	Return-Bend
Sizing	No Override
Largest Diameter	2-in
Schedule	Schedule 40
Return-Bend	1-in

WATER SUPPLY ANALYSIS

Test 1

SITE INFORMATION

Address	Location	Date	Time	Performed By
Exeter Fire Co	Western corner of Exeter Medical	01/08/2026		PA American Water

HYDRANTS

STATIC & RESIDUAL HYDRANT	FLOW HYDRANT 1	FLOW HYDRANT 2 (OPTIONAL)
Static (psi): 90	Flow Override (gpm): 1405	Flow Override (gpm):
Residual (psi): 87	If provided, this flow overrides pitot-based calculation	If provided, this flow overrides pitot-based calculation
Location: Exeter Medical hydrant hydrate	Pitot (psi): 88	Pitot (psi): 0
Elevation (ft): Example: 525 ft	Number of Outlets: 1	Number of Outlets: 0
	Outlet Diameter (in): 2.5 Outlet Coefficient: 0.9	Outlet Diameter (in): 2.5 Outlet Coefficient: 0.9
	Location:	Location:
	Flow: 1405 gpm	Flow: 0 gpm

FIRE FLOW (GLOBAL)
Expected Flow at 20 psi: **7698** gpm

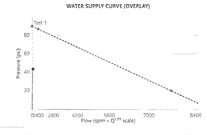
SYSTEM DEMAND (GLOBAL)

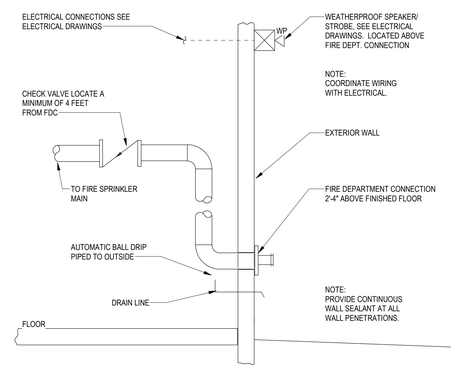
Demand P	Demand Q	Hose	Margin
43.6 psi	509 gpm	250 gpm	-45.9 psi 51.3 %

WATER SUPPLY ANALYSIS (ALL TESTS)

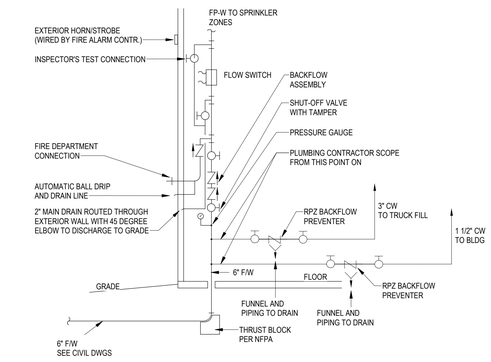
TEST 1	
Site	Address: Exeter Fire Co • Location: Western corner of Exeter Medical Center • Date: 2026-01-08 • By: PA American Water
Static Pressure	90.0 psi
Residual Pressure	87.0 psi
Total Flow	1405 gpm
Expected Flow at 20 psi	7698 gpm
System Demand	43.6 psi 509 gpm
Hose Allowance	250 gpm
Margin	-45.9 psi 51.3 %

WATER SUPPLY CURVE (OVERLAY)

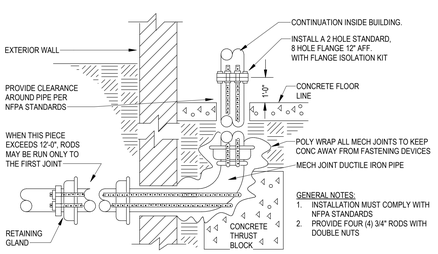




1 F000 FIRE DEPARTMENT CONNECTION DETAIL
NOT TO SCALE

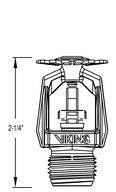


2 F000 FIRE PROTECTION RISER ASSEMBLY DETAIL
NOT TO SCALE

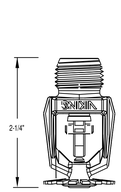


NOTE: ACCEPTABLE ALTERNATIVE TO MECHANICAL JOINTS AND FITTINGS FOR LEAD-IN PIPING IS STAINLESS STEEL, SINGLE PIECE 90 DEGREE FITTING AS DESCRIBED IN SPECIFICATION.

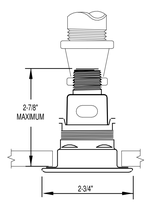
3 F000 WATER SERVICE LINE EXTENSION DETAIL
NOT TO SCALE



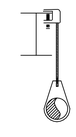
VIKING QUICK RESPONSE SERIES VK300, K= 5.6, 1/2" NPT, UPRIGHT, BRONZE FINISH.
NO SCALE



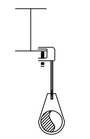
VIKING QUICK RESPONSE SERIES VK302, K=5.6, 1/2" NPT, PENDENT & VIKING SERIES VK352, K=8.0, 3/4" NPT, PENDENT, BRONZE FINISH
NO SCALE



VIKING QUICK RESPONSE SERIES VK462, K=5.6, 1/2" NPT, CONCEALED WITH WHITE COVER PLATE.
NO SCALE



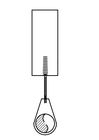
HANGER #1 DETAIL
1 – ALL THREAD ROD
1 – RING
1 – UNIVERSAL TOP BEAM CLAMP



HANGER #2 DETAIL
1 – ALL THREAD ROD
1 – RING
1 – UNIVERSAL TOP BEAM CLAMP



HANGER #4 DETAIL
1 – ALL THREAD ROD
1 – RING
1 – CONCRETE DROP-IN



HANGER #8 DETAIL
1 – THUNDERBOLT
1 – ROD
1 – RING

Protection Areas and Maximum Spacing
(Standard Spray Upright/Standard Spray Pendent)

	LIGHT HAZARD		ORDINARY HAZARD		EXTRA HAZARD		HIGH-PILED HAZARD	
CONSTRUCTION TYPE	Protection Area ft²	Spacing (max.) ft	Protection Area ft²	Spacing (max.) ft	Protection Area ft²	Spacing (max.) ft	Protection Area ft²	Spacing (max.) ft
Noncombustible obstructed and unobstructed and combustible unobstructed	225	15	130	15	100	12	100	12
Combustible obstructed	168	15	130	15	100	12	100	12
Note: For hydraulically calculated systems only.								

MAXIMUM DISTANCE BETWEEN HANGERS

NOMINAL PIPE SIZE (in.)	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"
STEEL PIPE EXCEPT THREADED LIGHTWALL	N/A	12-0	12-0	15-0	15-0	15-0	15-0	15-0	15-0	15-0	15-0	15-0
THREADED LIGHTWALL STEEL PIPE	N/A	12-0	12-0	12-0	12-0	12-0	12-0	N/A	N/A	N/A	N/A	N/A

SPRINKLER NOTES:

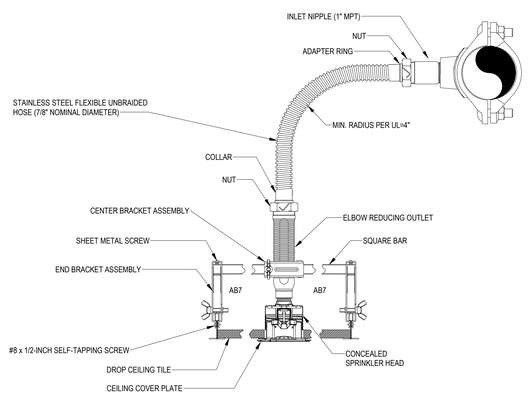
1. ALL PIPE TO BE SCHEDULE 40 BLACK STEEL PIPE MEETING OR EXCEEDING ASTM A-135 REQUIREMENTS.

2. ALL SCREW FITTINGS TO BE CAST IRON AND OR MALLEABLE IRON MEETING OR EXCEEDING ANSI B16.4 AND ANSI B16.3.

3. ALL GROOVED FITTINGS TO BE MALLEABLE IRON MEETING OR EXCEEDING ASTM A-536 REQUIREMENTS.

4. ALL HANGERS TO MEET OR EXCEED NFPA PAMPHLET REQUIREMENTS.

4 F000 SPRINKLER & HANGER DETAILS
NOT TO SCALE



NOTE: ALL CONCEALED HEADS TO USE FLEXIBLE HOSE CONNECTIONS

5 F000 CONCEALED SPRINKLER HEAD INSTALLATION DETAIL
NOT TO SCALE

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EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
1	10/15/26
3	10/29/26
4	11/06/26

LAST PROJECT REVISION: No 4 | 11/06/26

FIRE PROTECTION TITLE SHEET

SHEET NUMBER:
F000

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ELECTRICAL SYMBOL LEGEND

ELECTRICAL DEVICES & EQUIPMENT

SYMBOL	DESCRIPTION
	20A, 120V AC, NEMA 5-20R, DUPLEX RECEPTACLE, SINGLE GANG BOX, TILE RING (DEPTH AS REQUIRED), AND COVERPLATE.
	20A, 120V AC, NEMA 5-20R, DOUBLE DUPLEX RECEPTACLE, DOUBLE GANG BOX, TILE RING (DEPTH AS REQUIRED), AND COVERPLATE.
XX-XXR	SPECIAL PURPOSE ELECTRICAL RECEPTACLE, XX-XXR = NEMA CONFIGURATION, MH = 18" A.F.F. AS MEASURED TO CENTER OF DEVICE BOX U.O.N. (COORDINATE WITH MILLWORK).
S	RECESSED JUNCTION BOX, CONDUIT STUBBED UP TO EASILY ACCESSIBLE SPACE ABOVE CEILING.
CLNG	FLOOR/CEILING RECESSED JUNCTION BOX
PB	PULL BOX
XX-XXR WP	ELECTRIC CORD REEL, FED FROM GFCI BRANCH CIRCUIT BREMER, 20A, 250V AC RATED, NEMA 5-20R, YELLOW INDUSTRIAL REEL, UL TYPE 1, 39FT #12/3 SJO CORD, 90° YELLOW FEMALE WATERPROOF SINGLE RECEPTACLE. CORD REEL SHALL BE MODEL #HBL5361I22Y WITH RECEPTACLE END #HBL1553 AS MANUFACTURED BY HUBBELL. PROVIDE BALL STOP #HBL0053 AND PIVOT BASE #HHU3400PB AS MANUFACTURED BY HUBBELL. XX-XXR = SPECIAL RECEPTACLE NEMA CONFIGURATION. WP = WEATHERPROOF REEL, UL TYPE 4, WITH IN-USE WEATHERPROOF COVER.
WM	4" WIDE STAINLESS STEEL RACEWAY, 20A-120V DUPLEX RECEPTACLE @ EVERY 24" O.C. RACEWAY SHALL BE #S4000 AS MANUFACTURED BY WIREMOLD LEGRANCE. PROVIDE RACEWAY WIRE DIVIDER FOR COMMUNICATIONS INSTALLATIONS WHERE SHOWN ON DRAWINGS.
MM	MULTIMEDIA STATION WITH (4) GANGS FOR (1) 5-20R QUAD RECEPTACLE, ONE GANG FOR (1) CONA "X". (1) HDMI AND ONE GANG FOR (2) RJ-45 ETHERNET CONNECTIONS. AND ONE SPARE BOX MOUNTING HEIGHT TO BOTTOM OF OUTLETS SHALL BE AS COORDINATED WITH ARCHITECTURAL DRAWINGS.
FB1	CAST-IRON ON-GRADE STYLE FLOORBOX WITH 10 GANGS, PROVIDE (2) HDMI OUTLETS, (4) RJ-45 ETHERNET OUTLETS, AND (2) 5-20R DUPLEX RECEPTACLES. FURNISH MODEL #EFB105-OG AS MANUFACTURED BY WIREMOLD LEGRANDE. S = (1) DUPLEX RECEPTACLE SHALL BE SWITCHED.
FRPT1	FIRE-RATED POKE-THRU W/ (2) 20A, 120V AC DUPLEX RECEPTACLES. (1) 4-PORT DATA OUTLET & SURFACE COVER. FIRE RATED POKE-THRU SHALL BE MODEL # 84TC28K AS MANUFACTURED BY WIREMOLD LEGRAND.
M	SINGLE-POLE OR TWO-POLE (AS REQUIRED), 250V AC, 1 HP RATED, TOGGLE TYPE MANUAL MOTOR STARTED UNIT WITH MELTING ALLOY TYPE THERMAL OVERLOAD RELAY, APPROPRIATELY SIZED THERMAL UNITS. NEMA TYPE 1 OR 4 (AS REQUIRED) ENCLOSURE, AND HANDLE GUARDLOCK-OFF. SQUARE D CLASS 2510 FG OR FW TYPES (AS REQUIRED) OR APPROVED EQUAL.
M3Ø	THREE-POLE, 250V AC, 1 OR 2 HP RATED (AS REQUIRED), TOGGLE TYPE MANUAL MOTOR STARTER UNIT WITH MELTING ALLOY TYPE THERMAL OVERLOAD RELAY, APPROPRIATELY SIZED THERMAL UNITS, NEMA TYPE 1 ENCLOSURE AND HANDLE GUARDLOCK-OFF. SQUARE D CLASS 2510 K TYPE OR APPROVED EQUAL.
6A 8AF NEMA4	FUSIBLE SWITCH TYPE COMBINATION STARTER UNIT WITH DOOR MOUNTED H-O-A SWITCH AND RED "MOTOR RUNNING" LED TYPE PILOT LIGHT. PROVIDE AUXILIARY CONTACT.
6A NEMA4	NON-FUSIBLE DISCONNECT SWITCH
6A 8AF NEMA4	FUSIBLE DISCONNECT SWITCH
	POWER OR DISTRIBUTION PANEL. HIDDEN LINE REPRESENTS ELECTRICAL CLEARANCE SPACE.
	TRANSFORMER (SIZE AS DENOTED). HIDDEN LINE REPRESENTS ELECTRICAL CLEARANCE SPACE.
XX-1	MOTOR
	BUS DUCT WITH PLUG IN DISCONNECT (FUSED)

DATA, SECURITY, & FIRE ALARM

SYMBOL	DESCRIPTION
	TELEPHONE OUTLET, 4 PORT COVERPLATE, PORTS CABLE
	COMBINATION VOICE/DATA OUTLET. 4 PORT COVERPLATE, CAT-6A CABLE (# = NUMBER OF PORTS AND RUNS)
	WIRELESS ACCESS POINT WITH CAT-6A CABLE
	TELEVISION OUTLET WITH RG-6 COAX CABLE INSTALLED BACK TO IT ROOM WITH 10' SLACK.
ES	ELECTRIC STRIKE. (AS PROVIDED BY ELECTRICAL CONTRACTOR) JUNCTION BOX AT DOOR STRIKE LOCATION.
EH	ELECTRONIC DOOR HOLDER. (AS PROVIDED BY ELECTRICAL CONTRACTOR) JUNCTION BOX AT DOOR HOLDER LOCATION.
HDR	CARD ACCESS READER, CONSISTING OF 2" SQUARE JUNCTION BOX AT 48" A.F.F., 120VOAV LOW VOLTAGE TRANSFORMER.
	SINGLE BUTTON "DOOR RELEASE" DEVICE. E.C. SHALL FURNISH AND INSTALL J-BOX AND 3/4" CONDUIT STUBBED UP ABOVE CEILING AND WIRE INSTALLED FROM DEVICE BOX TO DOOR RELEASE CONTACT.
	SINGLE BUTTON "PANIC" DEVICE. E.C. SHALL FURNISH AND INSTALL J-BOX AND 3/4" CONDUIT STUBBED UP ABOVE CEILING AND WIRE INSTALLED FROM DEVICE BOX TO SECURITY SYSTEM HEAD-END EQUIPMENT LOCATION. SECURITY VENDOR TO FURNISH AND INSTALL DEVICES, DEVICE PLATES, TERMINATIONS AND PROGRAMMING.
	SECURITY KEYPAD. E.C. SHALL FURNISH AND INSTALL J-BOX AND 3/4" CONDUIT STUBBED UP ABOVE CEILING AND WIRE INSTALLED FROM DEVICE BOX TO I.T. ROOM WITH 10' SLACK COILED UP IN ROOM.
INT	INTERIOR CAMERA LOCATION. CAT6 CABLE
EXT	EXTERIOR WEATHERPROOF RATED CAMERA LOCATION. CAT6 CABLE
EPO	EMERGENCY POWER OFF BUTTON
SCP	SECURITY CONTROL PANEL
FACP	FIRE ALARM CONTROL PANEL
FAA	FIRE ALARM REMOTE ANNUNCIATOR
S	PHOTOVOLTAIC SYSTEM SMOKE DETECTOR. R = ELEVATOR RECALL
H	RATE OF RISE SYSTEM HEAT DETECTOR
S	PHOTOELECTRIC SYSTEM DUCT SMOKE DETECTOR WITH REMOTE TEST STATION.
S	FIRE ALARM SYSTEM CARBON MONOXIDE DETECTOR.
S	FIRE ALARM SYSTEM COMBINATION SMOKE/CO DETECTOR.
	FIRE ALARM WALL MOUNTED STROBE LIGHT.
	FIRE ALARM HORN STROBE.
	FIRE SPEAKER STROBE.
F	FIRE ALARM BELL
F	FIRE ALARM PULLSTATION.
	SPRINKLER FLOW SWITCH
	SPRINKLER VALVE TAMPER SWITCH
FR	FIRE ALARM SHUT-DOWN RELAY
	FIRE ALARM EMERGENCY PHONE

LIGHTING DEVICES & CONTROLS

SYMBOL	DESCRIPTION
$S_{\#}$	20A, 120-277V AC, SINGLE POLE TOGGLE SWITCH. "3" = THREE WAY TOGGLE SWITCH, "4" = FOUR WAY TOGGLE SWITCH
S_D	24V DC, DIGITAL, TOGGLE, SINGLE BUTTON WALL SWITCH. SWITCH SHALL BE MODEL #LOKON-C1x AS MANUFACTURED BY LEVITON OR EQUAL.
S_{DD}	24V DC, DIGITAL, DIMMING, DOUBLE BUTTON WALL SWITCH. SWITCH SHALL BE MODEL #LOKON-C2x AS MANUFACTURED BY LEVITON OR EQUAL.
S_A	28V DC, ANALOG, TOGGLE, LOW VOLTAGE, SINGLE BUTTON WALL SWITCH. SWITCH SHALL BE MODEL #PLVSW-1x AS MANUFACTURED BY LEVITON OR EQUAL.
S_{AD}	28V DC, ANALOG, DIMMING, LOW VOLTAGE, FOUR BUTTON WALL SWITCH. SWITCH SHALL BE MODEL #PLVSW-4x AS MANUFACTURED BY LEVITON OR EQUAL.
S_{OC1}	20A, 120-277V AC, SINGLE BUTTON WALL MOUNT, PASSIVE INFRARED SINGLE RELAY ON/OFF OCCUPANCY SENSOR AS MANUFACTURED BY LEVITON MODEL #OD510-IDx OR EQUAL.
S_{OC2}	20A, 120-277V AC, TWO BUTTON WALL MOUNT, DUAL TECHNOLOGY (PASSIVE INFRARED AND ULTRASONIC), DUAL RELAY OCCUPANCY SENSOR AS MANUFACTURED BY LEVITON MODEL #OD502-IDx OR EQUAL.
S_{OC3}	20A, 120-277V AC, SINGLE BUTTON 0-10V DIMMING WALL MOUNT, PASSIVE INFRARED. SINGLE RELAY OCCUPANCY SENSOR AS MANUFACTURED BY LEVITON MODEL #OD010-IDM OR EQUAL.
S_{D10}	20A, 120-277VAC, ELECTRO-MECHANICAL, 0-10V DIMMING SWITCH AS MANUFACTURED BY LEVITON MODEL #IP710-0DZ.
S_{CC}	20A, 120-277VAC, RGBW LED LIGHTING CONTROLLER SWITCH. COLORDIAL PRO AS MANUFACTURED BY COLOR KINETICS OR EQUAL. E.C. SHALL FURNISH AND INSTALL ALL WIRING TO CONTROLLER SWITCH FROM CONTROLLER IN WATCH OFFICE.
OC	2000 SQ. FT. COVERAGE SMART CEILING MOUNTED OCCUPANCY SENSOR, 120-277V AC, DUAL TECHNOLOGY (ULTRASONIC AND PASSIVE INFRARED). SENSOR SHALL BE MODEL #ACSD-OAM AS MANUFACTURED BY LEVITON OR EQUAL.
OC1	1500 SQ. FT. COVERAGE CEILING MOUNTED OCCUPANCY SENSOR AND PHOTOCELL, 24V DC, DUAL TECHNOLOGY (MICROWAVE AND PASSIVE INFRARED). SENSOR SHALL BE MODEL #OSP15-MOW AS MANUFACTURED BY LEVITON OR EQUAL. OCCUPANCY SENSOR SHALL BE FED FROM DIGITAL ROOM CONTROLLER.
OC2	2000 SQ. FT. COVERAGE CEILING MOUNTED OCCUPANCY SENSOR, 24V DC, DUAL TECHNOLOGY (ULTRASONIC AND PASSIVE INFRARED). SENSOR SHALL BE MODEL #OSC2B-MAW AS MANUFACTURED BY LEVITON OR EQUAL. OCCUPANCY SENSOR SHALL BE FED FROM DIGITAL ROOM CONTROLLER. OCCUPANCY SENSOR SHALL BE PROVIDED WITH A 2-PORT ANALOG INTERFACE, MODEL NUMBER #DRDD-C82 AS MANUFACTURED BY LEVITON.
	1200 SQ. FT. COVERAGE WALL MOUNTED OCCUPANCY SENSOR, 24V DC, DUAL TECHNOLOGY (ULTRASONIC AND PASSIVE INFRARED). SENSOR SHALL BE MODEL #OSPW12-MOW AS MANUFACTURED BY LEVITON OR EQUAL. OCCUPANCY SENSOR SHALL BE FED FROM DIGITAL ROOM CONTROLLER. OCCUPANCY SENSOR SHALL BE PROVIDED WITH A 2-PORT ANALOG INTERFACE, MODEL NUMBER #DRDD-C82 AS MANUFACTURED BY LEVITON.
RCD1	20A, 120V-277V AC, 60HZ, ON/OFF/0-10V DIMMING DIGITAL ROOM CONTROLLER. SINGLE RELAY, UL LISTED, AS MANUFACTURED BY LEVITON MODEL #DRCD1-E00 OR EQUAL.
RCSP	20A, 120V-277V AC, 60HZ, ON/OFF/0-10V DIGITAL ROOM CONTROLLER SMART PACK, SINGLE RELAY, UL LISTED, MODEL #DRDDT-E00 AS MANUFACTURED BY LEVITON OR EQUAL.

COMMUNICATION DEVICES

SYMBOL	DESCRIPTION
AS	ALERTING SYSTEM CEILING MOUNTED SPEAKER, 70V 2.5KW
BS	ALERTING SYSTEM CEILING MOUNTED BATHROOM SPEAKER, 1 W
WS	ALERTING SYSTEM WALL MOUNTED SPEAKER, 2W
SS	ALERTING SYSTEM CEILING MOUNTED OMNIDIRECTIONAL SPEAKER, 7.5W
HS	ALERTING SYSTEM WALL MOUNTED EXTERIOR SPEAKER, 7.5W
LED	ALERTING SYSTEM CEILING MOUNTED LED LIGHT/SPEAKER, 2.5W
R	ALERTING SYSTEM CEILING MOUNTED RED LED CLUSTER LIGHT
RB	ALERTING SYSTEM CEILING MOUNTED COLORED LED STROBE LIGHT
MCL	ALERTING SYSTEM CEILING MULTI-COLOR LIGHT
RB	ALERTING SYSTEM ABOVE CEILING RB RELAY
APS	ALERTING SYSTEM ALERTING CONTROLLER
I	ALERTING SYSTEM CEILING MOUNTED TROUBLE STROBE
I	ALERTING SYSTEM WALL MOUNTED EMERGENCY ALERT
AD	ALERTING SYSTEM WALL OR CEILING MOUNTED COMMERCIAL ALERTING DISPLAY
D	LED DISPLAY WALL OR CEILING MOUNTED
S_{VOL}	WALL MOUNTED VOLUME CONTROL, 10W, 48" MH
S_{VOL}	WALL MOUNTED VOLUME CONTROL, 36W, 48" MH
S_{48}	WALL MOUNTED 4 BUTTON ALERT SELECTOR, 48" MH
S_{3B}	WALL MOUNTED 3 BUTTON ALERT SELECTOR, 48" MH
S_2	WALL MOUNTED 2 BUTTON MANUAL ALERT, 48" MH
S_{MC}	WALL MOUNTED MEDICAL EMERGENCY BUTTON, 48" MH
S_{RR}	WALL MOUNTED RESET BUTTON, 48" MH
S_{SR}	WALL MOUNTED STOVE RESET BUTTON, 48" MH
S_{SAD}	WALL MOUNTED SPEAKER/AUDIO DISCONNECT
S_{SD}	WALL MOUNTED STOVE DISCONNECT
S_{PS}	FLUSH OR SURFACE MOUNTED APS DOORBELL
DS	STAINLESS STEEL WEATHER RESISTANT DOOR STATION LOCATION WITH VIDEO CAMERA.
MS	WALL MOUNTED VIDEO DOORBELL MASTER STATION LOCATION.
	WALL MOUNTED SPEAKER
	WALL MOUNTED DIGITAL NETWORK CLOCK - PYRAMID #90448R

GENERAL

SYMBOL	DESCRIPTION
#	KEYED NOTE (SEE KEYNOTE ON PLAN)
XX-1	MECHANICAL EQUIPMENT TAG
ROOM NAME XX	ROOM TAG
X.#	TYPICAL BRANCH CIRCUITING HOME RUN SYMBOL. GENERALLY, 15A AND 20A BRANCH CIRCUITS CONSISTS OF (2) #12 AWG CU. AND (1) #12 AWG CU. GND. IN 3/4" CONDUIT, UNLESS OTHERWISE NOTED. "X" IDENTIFIES PANELBOARD DESIGNATION, "#" IDENTIFIES PANELBOARD CIRCUIT NUMBER.
	LIGHT AND SOLID SYMBOL INDICATES EXISTING TO REMAIN
	DARK AND SOLID SYMBOL INDICATES NEW WORK
	DARK AND DASHED SYMBOL INDICATES DEMOLISHED.

* NOTE *
ALL OF GENERAL NOTES ON THIS SHEET ARE TO BE APPLIED TO ALL OTHER DRAWINGS IN THIS SET.THE SYMBOLS AND ABBREVIATIONS SHOWN ON THIS SHEET MAY OR MAY NOT BE USED IN THIS SET OF DRAWINGS.

SYMBOL LEGEND NOTES

POWER DEVICES

WALL MOUNTED WIRING DEVICE NOTES:
- MH = 18" A.F.F. AS MEASURED TO CENTER OF DEVICE BOX U.O.N. (COORDINATE WITH MILLWORK).
- GFI = GFCI TYPE
- U = USB-A &USB-C CHARGING PORT TYPE
- WP = IN USE WEATHERPROOF COVER

ELECTRICAL EQUIPMENT NOTES:
- "NEMA 9" IDENTIFIES NEMA ENCLOSURE TYPE. "9A" IDENTIFIES DISCONNECT SWITCH AMPACITY RATING. "9AF". IF PRESENT, IDENTIFIES APPROXIMATE FUSE RATING.
- UNLESS OTHERWISE NOTED, ALL FUSIBLE DISCONNECT SWITCHES SHALL BE COMPLETE WITH APPROPRIATELY SIZED DE, TD, CL, CLASS RK5 FUSES.
- ALL COMBINATION MOTOR STARTERS SHOWN ON OVERHEAD DOOR MOTORS SHALL BE REVERSING TYPE.
- ALL "MM" DEVICES SHOWN INSTALLED IN DRYWALL SHALL BE INSTALLED IN A 4 GANG WALLBOX. PROVIDE 11"x7-3/ 4" DEEP WALL BOX, TILE RING, (DEPTH AS REQUIRED). STUB-UP (1) 1-1/4" CONDUIT FROM WALL BOX UP TO DATA OUTLET MOUNTED ABOVE BOX AT 72" A.F.F. MOUNTING HEIGHT TO BOTTOM OF BOX SHALL BE AS COORDINATED WITH ARCHITECTURAL DRAWINGS. WALLBOX MODEL SHALL BE #EFSB4 AS MANUFACTURED BY WIREMOLD LEGRANCE.

TELE/DATA DEVICES

WALL MOUNTED DEVICE NOTES:
- S = SURFACE MOUNTED WITH RACEWAY.
- MH = 18" A.F.F. AS MEASURED TO CENTER OF DEVICE BOX U.O.N. (COORDINATE WITH MILLWORK).

TELE/DATA DEVICE NOTES:
- CABLING AS LISTED, TERMINATED ON DEVICE AND INSTALLED BACK TO IT ROOM.
- ALL DATA DEVICES SHALL CONSIST OF 4" SQUARE BOX, TILE RING (DEPTH AS REQUIRED), 1-1/4" CONDUIT STUBBED UP INTO THE NEAREST EASILY ACCESSIBLE CEILING SPACE.
- UNLESS OTHERWISE NOTED, ALL ETHERNET CABLING SHALL BE CAT-6A.
- E.C. SHALL FURNISH AND INSTALL ALL PATHWAYS, BACK BOXES, CONDUIT, CABLE TRAY, J-HOOKS, ETC.
- LOW-VOLTAGE VENDOR SHALL FURNISH AND INSTALL ALL LOW-VOLTAGE CABLING, JACKS, PATCH PANELS, WIRING DEVICES, AND WALLPLATES. 4

SECURITY DEVICES

SECURITY DEVICE NOTES:
- CABLING AS LISTED, TERMINATED ON DEVICE AND INSTALLED BACK TO SECURITY HEAD END EQUIPMENT.
- E.C. SHALL FURNISH AND INSTALL 1-1/4" CONDUIT STUBBED UP INTO EASILY ACCESSIBLE CEILING SPACE FROM JUNCTION BOX, TRANSFORMERS, TILE RINGS, JUNCTION BOXES, CONDUIT, AND LINE VOLTAGE WIRE.
- SECURITY VENDOR TO FURNISH AND INSTALL DEVICES, DEVICE PLATES, TERMINATIONS, PERFORM ALL PROGRAMMING, AND LOW VOLTAGE CABLING..

SECURITY CAMERA NOTES:
- CABLING AS LISTED, TERMINATED ON DEVICE AND INSTALLED BACK TO IT ROOM.
- E.C. SHALL PROVIDE 4" SQUARE DEVICE BOX, TILE RING (DEPTH AS REQUIRED), AND 1" CONDUIT STUBBED UP TO EASILY ACCESSIBLE CEILING SPACE WHEN WALL MOUNTED.
- ALL HEAD-END EQUIPMENT, DEVICES, DEVICE PLATES, TERMINATIONS AND PROGRAMING TO BE FURNISHED AND INSTALLED BY SECURITY VENDOR.
- ALL MOUNTING SHALL BE COORDINATED WITH SECURITY VENDOR AND ARCHITECTURAL DRAWINGS.

FIRE ALARM DEVICES

FIRE ALARM DEVICE NOTES:
- E.C. SHALL PROVIDE 4" SQUARE DEVICE BOX, TILE RING (DEPTH AS REQUIRED).
- E.C. SHALL FURNISH AND INSTALL ALL WIRING, CONDUITS, RELAYS, AND FIRE ALARM PROGRAMING FOR SMOKE DETECTOR INSTALLATION.
- LF = LOW FREQUENCY

LIGHTING DEVICES

LIGHTING CONTROL DEVICE NOTES:
- WALL-MOUNTED LIGHTING SWITCHES, MH = 48" A.F.F. AS MEASURED TO BOTTOM OF DEVICE BOX U.O.N.
- CABLING BETWEEN DIGITAL ROOM CONTROLLER AND DIGITAL WALL SWITCHES SHALL BE CAT-6A CABLE WITH RJ45 CONNECTORS.
- CABLING BETWEEN OCCUPANCY SENSOR/CONTROLLER AND ANALOG WALL SWITCHES SHALL BE LOW VOLTAGE CLASS 2 WIRING.
- E.C. TO INSTALL PER MANUFACTURER'S WRITTEN INSTRUCTIONS.
- ALL COLORS AS SELECTED BY ARCHITECT.
- E.C. SHALL MOUNT DIGITAL ROOM CONTROLLER SECURELY ABOVE DROP CEILING IN ACCESSIBLE SPACE.
- ROOM CONTROLLER'S CONTROLLING LIGHTING FED FROM EMERGENCY CIRCUITS SHALL BE PROVIDED WITH AN EMERGENCY BYPASS CONTROLLER AS MANUFACTURED BY LEVITON MODEL #DRD0T-ED0.
- GREENMAX DIGITAL CONFIGURATION APP SHALL BE USED TO PROGRAM THE DIGITAL ROOM CONTROLLERS.

RADIO SYSTEM NOTES

RADIO SYSTEM NOTES:
- E.C. SHALL FURNISH AND INSTALL ALL CONDUIT/CABLE TRAY/PATHWAYS FROM DEVICES TO THE IT ROOM, INCLUDING ALL EXTERIOR WALL-MOUNTED CABLE TRAY/CONDUIT PATHWAYS, CABLE ENTRY PORT PANELS, AND ALL SYSTEM GROUNDING.
- LOW-VOLTAGE VENDOR SHALL FURNISH AND INSTALL ALL ASSOCIATED LOW VOLTAGE WIRING.
- RADIO SYSTEM VENDOR SHALL FURNISH AND INSTALL ALL ASSOCIATED DEVICES AND ANTENNA WIRING AND CABLING.

COMMUNICATION DEVICES

WALL MOUNTED BUTTON NOTES:
- S = SURFACE MOUNTED WITH RACEWAY.
- MH = 48" A.F.F. AS MEASURED TO CENTER OF DEVICE BOX U.O.N. (COORDINATE WITH MILLWORK).

ALERTING SYSTEM DEVICE NOTES:
- E.C. SHALL FURNISH AND INSTALL J-BOXES AND 3/4" CONDUIT INSTALLED BACK TO IT ROOM WITH PULLSTRINGS.
- E.C. SHALL INSTALL ALL DEVICES, DEVICE PLATES, CONDUITS, PATHWAYS, PULLSTRINGS AND ALL UNLESS OTHERWISE NOTED.
- APS VENDOR SHALL FURNISH ALL DEVICES, INCLUDING MONITORS, AND COMPLETE ALL HEAD-END SYSTEM TIE-INS AND SYSTEM TESTING.
- LOW VOLTAGE VENDOR SHALL FURNISH AND INSTALL ALL ASSOCIATED LOW VOLTAGE WIRING.
- REFER TO ARCHITECTURAL DRAWINGS SET FOR SYSTEM SPECIFICATIONS.

GENERAL DEVICE NOTES

DEVICE KEY:
- XX" = MOUNTING HEIGHT A.F.F.
- S = SURFACE MOUNTED WITH WIREMOLD RACEWAY
- T = TAMPER PROOF
- WP = WEATHERPROOF
- ISO = GASKETED STAINLESS STEEL COVERPLATE

ELECTRICAL ABBREVIATIONS LIST

1P	1 POLE (2P, 3P, 4P, ETC.)	DCP	DOMESTIC WATER CIRCULATING PUMP	HT	HEIGHT	NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
A	AMPERE	DEPT	DEPARTMENT	HTG	HEATING	SYM	SYMMETRICAL
AC	ABOVE COUNTER OR AIR CONDITIONER	DET	DETAIL	HTR	HEATER	NFDS	NON-FUSED SAFETY DISCONNECT SWITCH
ACLG	ABOVE CEILING	DIA	DIAMETER	HV	HIGH VOLTAGE	NIC	NOT IN CONTRACT
ADO	AUTOMATIC DOOR OPENER	DISC	DISCONNECT	HVAC	HEATING, VENTILATING AND AIR CONDITIONING	NL	NIGHT LIGHT
AF	AMP FRAME	DIST	DISTRIBUTION			NO	NORMALLY OPEN
AFF	ABOVE FINISHED FLOOR	DN	DOWN	HWP	HYDRONIC WATER PUMP	NPF	NORMAL POWER FACTOR
AFG	ABOVE FINISHED GRADE	DPR	DAMPER	IC	INTERRUPTING CAPACITY	NTS	NOT TO SCALE
AFI	ARC FAULT CIRCUIT INTERRUPTER	DS	SAFETY DISCONNECT SWITCH	IG	ISOLATED GROUND	OH	OVERHEAD
AHU	AIR HANDLING UNIT	DT	DOUBLE THROW	IMC	INTERMEDIATE METAL CONDUIT	OL	OVERLOADS
AL	ALUMINUM	DWG	DRAWING	INCAND	INCANDESCENT	PA	PUBLIC ADDRESS
ALT	ALTERNATE	EC	ELECTRICAL CONTRACTOR	IR	INFRARED	PB	PULL BOX OR PUSHBUTTON
AMP	AMPERE	ELEC	ELECTRIC, ELECTRICAL	IW	INTERLOCK WITH	PE	PNEUMATIC ELECTRIC
AMPL	AMPLIFIER	ELEV	ELEVATOR	J-BOX	JUNCTION BOX	PED	PEDESTAL
ANNUN	ANNUNCIATOR	EM	EMERGENCY	KV	KILOVOLT	PF	POWER FACTOR
APPROX	APPROXIMATELY	EMS	ENERGY MANAGEMENT SYSTEM	KVA	KILOVOLT-AMPERE	PH	PHASE
AQ-STAT	AQUASTAT	EMT	ELECTRICAL METALLIC TUBING	KVAR	KILOVOLT-AMPERE REACTIVE	PIV	POST INDICATING VALVE
ARCH	ARCHITECT, ARCHITECTURAL	EP	ELECTRIC PNEUMATIC	KW	KILOWATT	PNL	PANEL
AS	AMP SWITCH	E.P.	ELECTRICAL PRIME CONTRACTOR	KWH	KILOWATT HOUR	PP	POWER POLE
AT	AMP TRIP	EQUIP	EQUIPMENT	LOC	LOCATE OR LOCATION	PR	PAIR
ATS	AUTOMATIC TRANSFER SWITCH	EWC	ELECTRIC WATER COOLER	LT	LIGHT	PRI	PRIMARY
AUTO	AUTOMATIC	EXIST	EXISTING	LTG	LIGHTING	PROJ	PROJECTION
AUX	AUXILIARY	EXH	EXHAUST	LTNG	LIGHTNING	PRV	POWER ROOF VENTILATOR
AV	AUDIO VISUAL	EXP	EXPLOSION PROOF	LV	LOW VOLTAGE	PT	POTENTIAL TRANSFORMER
AWG	AMERICAN WIRE GAUGE	FA	FIRE ALARM	MAX	MAXIMUM	PVC	POLYVINYL CHLORIDE (CONDUIT)
BATT	BATTERY	FABP	FIRE ALARM BOOSTER POWER SUPPLY PANEL	MAGS	MAGNETIC STARTER	PWR	POWER
BD	BOARD			MC	MOMENTARY CONTACT	QUAN	QUANTITY
BLDG	BUILDING	FACP	FIRE ALARM CONTROL PANEL	MC	MECHANICAL CONTRACTOR	RCPT	RECEPTACLE
BMS	BUILDING MANAGEMENT SYSTEM	FCU	FAN COIL UNIT	MCB	MAIN CIRCUIT BREAKER	REQD	REQUIRED
C	CONDUIT	FIXT	FIXTURE	MCC	MOTOR CONTROL CENTER	RM	ROOM
CAB	CABINET	FLR	FLOOR	MDC	MAIN DISTRIBUTION CENTER	RSC	RIGID STEEL CONDUIT
CAT	CATALOG	FLUOR	FLUORESCENT	MDP	MAIN DISTRIBUTION PANEL	RTU	ROOF TOP UNIT
CATV	CABLE TELEVISION	FU	FUSE	MFR	MANUFACTURER	SC	SURFACE CONDUIT
CB	CIRCUIT BREAKER	FUDS	FUSED SAFETY DISCONNECT SWITCH	MFS	MANUFACTURED DISCONNECT SWITCH	SEC	SECONDARY
CCTV	CLOSED CIRCUIT TELEVISION	GA	GAUGE	MH	MANHOLE	SHT	SHEET
CKT	CIRCUIT	GAL	GALLON	MIC	MICROPHONE	SIM	SIMILAR
CLG	CEILING	GALV	GALVANIZED	MIN	MINIMUM	SN	SOLID NEUTRAL
COMB	COMBINATION	GC	GENERAL CONTRACTOR	MISC	MISCELLANEOUS	SPEC	SPECIFICATION
COMPR	COMPRESSOR	GEN	GENERATOR	MJO	MAIN LUGS ONLY	SPKR	SPEAKER
CONN	CONNECTION	GFI	GROUND FAULT CIRCUIT INTERRUPTER	MMS	MANUAL MOTOR STARTER	SP	SPARE
CONST	CONSTRUCTION	GFP	GROUND FAULT PROTECTOR	MOA	MULTIOUTLET ASSEMBLY	SR	SURFACE RACEWAY
CONT	CONTINUATION OR CONTINUOUS	GND	GROUND	MSP	MOTOR STARTER PANELBOARD	SS	STAINLESS STEEL
CONTR	CONTRACTOR	GRS	GALVANIZED RIGID STEEL (CONDUIT)	MSBD	MAIN SWITCHBOARD	SSW	SELECTOR SWITCH
CONV	CONVECTOR	GYP BD	GYPSUM BOARD	MT	MOUNT	SS	STOP/START PUSHBUTTONS
CP	CIRCULATING PUMP	HOA	HANDS-OFF-AUTOMATIC SWITCH	MTC	MOTOR CONTROLLER	STA	STATION
CRT	CATHODE-RAY TUBE	HORIZ	HORIZONTAL	MTS	MANUAL TRANSFER SWITCH	STD	STANDARD
CT	CURRENT TRANSFORMER	HP	HORSEPOWER	MTR	MOTOR, MOTORIZED	SURF	SURFACE MOUNTED
CTR	CENTER	HPF	HIGH POWER FACTOR	N.C.	NORMALLY CLOSED	SW	SWITCH
CU	COPPER			NEC	NATIONAL ELECTRICAL CODE	SWBD	SWITCHBOARD
						SYM	SYMMETRICAL
						SYS	SYSTEM
						TEL	TELEPHONE
						TERM	TERMINAL
						TL	TWIST LOCK
						TR	TAMPER RESISTANT
						T-STAT	THERMOSTAT
						TTC	TELEPHONE TERMINAL CABINET
						TV	TELEVISION
						TVTC	TELEVISION TERMINAL CABINET
						TYP	TYPICAL
						UC	UNDER COUNTER
						UE	UNDERGROUND ELECTRICAL
						UG	UNDERGROUND
						UH	UNIT HEATER
						UT	UNDERGROUND TELEPHONE
						UTIL	UTILITY
						UV	UNIT VENTILATOR OR ULTRAVIOLET
						V	VOLT
						VA	VOLT-AMPERES
						VDT	VIDEO DISPLAY TERMINAL
						VERT	VERTICAL
						VFD	VARIABLE FREQUENCY DRIVE
						VOL	VOLUME
						W	WATT
						W	WITH
						WG	WIRE GUARD
						WH	WATER HEATER
						W/O	WITHOUT
						WP	WEATHERPROOF
						XFMR	TRANSFORMER
						XFR	TRANSFER
						@	AT
						'	FEET
						"	INCHES
						#	NUMBER
						Ø	PHASE
						℄	CENTER LINE
						P	PLATE

GENERAL ELECTRICAL NOTES

1. IF THERE IS A DISCREPANCY BETWEEN THE DRAWINGS, SCHEDULES, AND/OR SPECIFICATIONS, THE CONTRACTOR IS REQUIRED TO PROVIDE THE MORE STRINGENT OR HIGHER-COST OPTION UNLESS THEY SEEK CLARIFICATION VIA AN RFI BEFORE PROCEEDING.
2. ALL CONDUCTORS OPERATING AT 50 VOLTS OR GREATER SHALL BE IN RACEWAY. ALL RACEWAY WITHIN THE STRUCTURE ABOVE THE FLOOR SLAB SHALL BE METAL. RACEWAY BELOW THE FLOOR SLAB AND UNDERGROUND RACEWAY OUTSIDE THE STRUCTURE SHALL BE PVC.
3. ALL LOW VOLTAGE CABLES OR CONDUCTORS OPERATING AT LESS THAN 50 VOLTS SHALL BE IN METAL RACEWAY WHERE INSTALLED WITHIN WALLS OR INACCESSIBLE SPACES. LOW VOLTAGE CABLES MAY BE RUN IN CABLE TRAY, WHERE NOTED. LOW VOLTAGE CABLES MAY BE RUN IN PLENUM RATED CABLE.
4. HOOKS ABOVE ACCESSIBLE CEILINGS. ALL LOW-VOLTAGE CABLES TO BE RUN IN EXPOSED LOCATIONS SHALL BE BUNDLED NEATLY IN J-HOOKS AND INSTALLED PARALLEL AND STRAIGHT IN EXPOSED SPACE TO PROVIDE A CLEAN LOOK.
5. COORDINATE LOCATIONS OF DEVICES WITH ARCHITEC

KEYNOTES

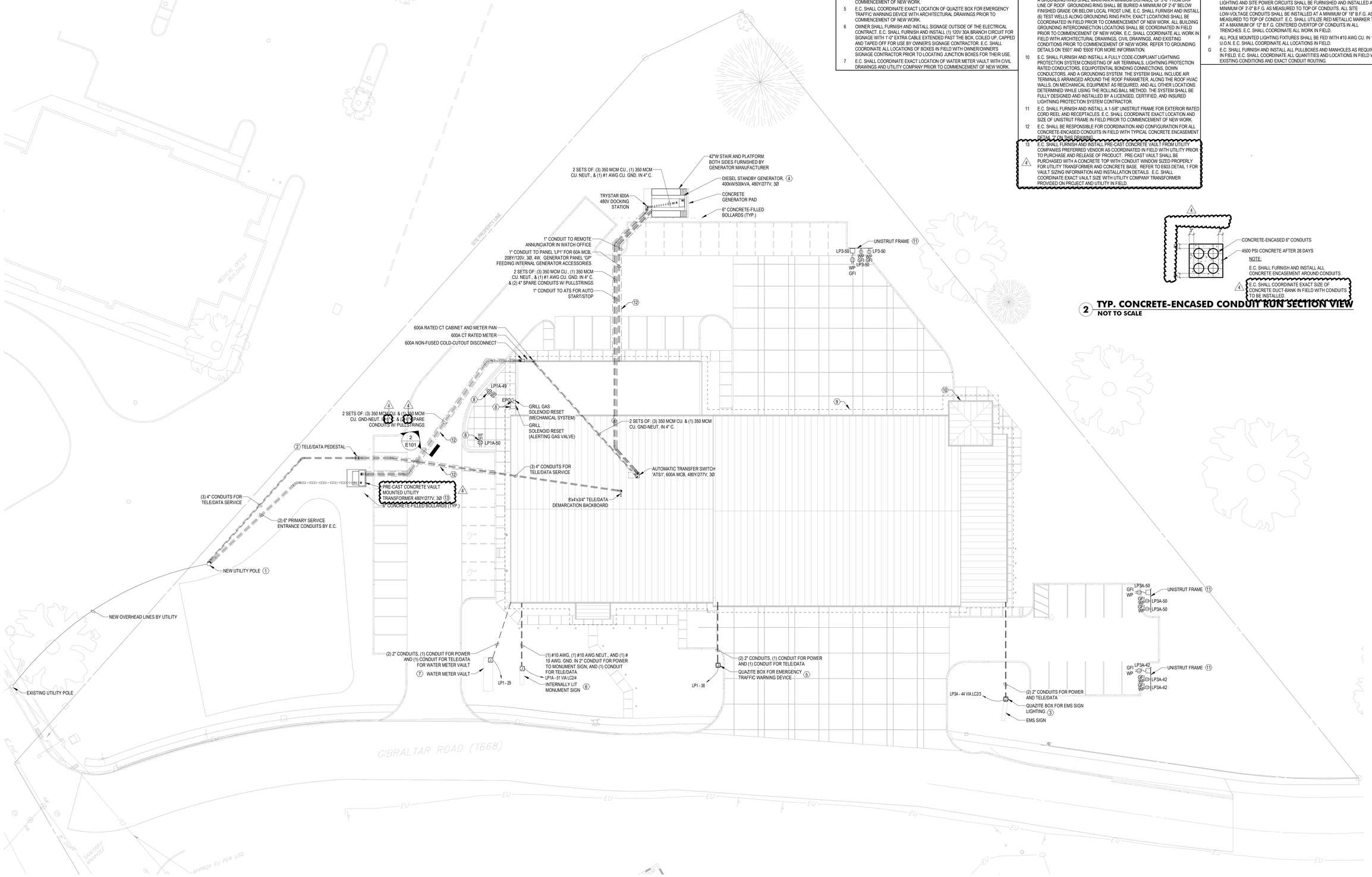
1. E.C. SHALL FURNISH AND INSTALL (1) UTILITY POLE AND ALL U-GUARD AS REQUIRED FOR CONDUIT RUNS. E.C. SHALL COORDINATE EXACT LOCATION OF UTILITY POLE IN FIELD WITH EXISTING CONDITIONS AND UTILITY PRIOR TO COMMENCEMENT OF NEW WORK.
2. E.C. SHALL COORDINATE ALL INCOMING UTILITY SERVICE WORK AND EXACT LOCATION OF TELE/DATA PEDESTAL IN FIELD WITH EXISTING CONDITIONS AND UTILITY PRIOR TO COMMENCEMENT OF NEW WORK.
3. E.C. SHALL COORDINATE EXACT LOCATION OF QUAZITE BOX AND LIGHT FIXTURES WITH ARCHITECTURAL DRAWINGS PRIOR TO COMMENCEMENT OF NEW WORK.
4. E.C. SHALL COORDINATE EXACT LOCATION OF INTERNAL GENERATOR FUEL TANK IN FIELD WITH ARCHITECTURAL DRAWINGS AND OWNER'S APPROVAL PRIOR TO COMMENCEMENT OF NEW WORK.
5. E.C. SHALL COORDINATE EXACT LOCATION OF QUAZITE BOX FOR EMERGENCY TRAFFIC WARNING DEVICE WITH ARCHITECTURAL DRAWINGS PRIOR TO COMMENCEMENT OF NEW WORK.
6. OWNER SHALL FURNISH AND INSTALL SIGNAGE OUTSIDE OF THE ELECTRICAL CONTRACT. E.C. SHALL FURNISH AND INSTALL (1) 120V 30A BRANCH CIRCUIT FOR SIGNAGE WITH 1'-0" EXTRA CABLE EXTENDED PAST THE BOX, COILED UP, CAPPED AND TAPED OFF FOR USE BY OWNER'S SIGNAGE CONTRACTOR. E.C. SHALL COORDINATE ALL LOCATIONS OF BOXES IN FIELD WITH OWNER/OWNER'S SIGNAGE CONTRACTOR PRIOR TO LOCATING JUNCTION BOXES FOR THEIR USE.
7. E.C. SHALL COORDINATE EXACT LOCATION OF WATER METER VAULT WITH CIVIL DRAWINGS AND UTILITY COMPANY PRIOR TO COMMENCEMENT OF NEW WORK.

KEYNOTES

8. E.C. SHALL FURNISH AND INSTALL (1) OUTDOOR-RATED QUAD RECEPTACLE WITH WEATHERPROOF COVER PER GRILL FOR SHUTOFF. E.C. SHALL RUN UG CONDUIT WITH WIRING TO BOTH LOCATIONS OF GRILLS FROM ON/OFF SWITCH. E.C. SHALL COORDINATE ALL LOCATIONS IN FIELD WITH MECHANICAL CONTRACTOR AND OWNER'S REPRESENTATIVE PRIOR TO COMMENCEMENT OF NEW WORK. E.C. SHALL FURNISH AND INSTALL ALL ACCESSORIES REQUIRED TO MAKE EXTERIOR GRILL SHUTOFF SYSTEM 100% OPERATIONAL AND TO THE SATISFACTION OF THE OWNER.
9. E.C. SHALL FURNISH AND INSTALL BUILDING GROUNDING RING IN COMPLIANCE WITH R56 GROUNDING STANDARDS. GROUNDING RING SHALL BE A MINIMUM OF #2 AWG CU. FOR ALL INTERSYSTEM/RING CONNECTIONS. GROUNDING RING SHALL BE A GROUNDING RING SHALL MAINTAIN A MINIMUM DISTANCE OF 3'-0" FROM DRIP LINE OF ROOF. GROUNDING RING SHALL BE BURIED A MINIMUM OF 2'-6" BELOW FINISHED GRADE OR BELOW LOCAL FROST LINE. E.C. SHALL FURNISH AND INSTALL (6) TEST WELLS ALONG GROUNDING RING PATH; EXACT LOATIONS SHALL BE COORDINATED IN FIELD PRIOR TO COMMENCEMENT OF NEW WORK. ALL BUILDING GROUNDING INTERCONNECTION LOCATIONS SHALL BE COORDINATED IN FIELD PRIOR TO COMMENCEMENT OF NEW WORK. E.C. SHALL COORDINATE ALL WORK IN FIELD WITH ARCHITECTURAL DRAWINGS, CIVIL DRAWINGS, AND EXISTING CONDITIONS PRIOR TO COMMENCEMENT OF NEW WORK. REFER TO GROUNDING DETAILS ON 'E601' AND 'E605' FOR MORE INFORMATION.
10. E.C. SHALL FURNISH AND INSTALL A FULLY CODE-COMPLIANT LIGHTNING PROTECTION SYSTEM CONSISTING OF AIR TERMINALS, LIGHTNING PROTECTION RATED CONDUCTORS, EQUIPOTENTIAL BONDING CONNECTIONS, DOWN CONDUCTORS, AND A GROUNDING SYSTEM. THE SYSTEM SHALL INCLUDE AIR TERMINALS ARRANGED AROUND THE ROOF PARAMETER, ALONG THE ROOF HVAC WALLS, ON MECHANICAL EQUIPMENT AS REQUIRED, AND ALL OTHER LOCATIONS DETERMINED WHILE USING THE ROLLING BALL METHOD. THE SYSTEM SHALL BE FULLY DESIGNED AND INSTALLED BY A LICENSED, CERTIFIED, AND INSURED LIGHTNING PROTECTION SYSTEM CONTRACTOR.
11. E.C. SHALL FURNISH AND INSTALL A 1-5/8" UNISTRUT FRAME FOR EXTERIOR RATED CORD REEL AND RECEPTACLES. E.C. SHALL COORDINATE EXACT LOCATION AND SIZE OF UNISTRUT FRAME IN FIELD PRIOR TO COMMENCEMENT OF NEW WORK.
12. E.C. SHALL BE RESPONSIBLE FOR COORDINATION AND CONFIGURATION FOR ALL CONCRETE-ENCASED CONDUITS IN FIELD WITH TYPICAL CONCRETE ENCASEMENT DETAIL '2' ON THIS DRAWING.
13. E.C. SHALL FURNISH AND INSTALL PRE-CAST CONCRETE VAULT FROM UTILITY COMPANIES PREFERRED VENDOR AS COORDINATED IN FIELD WITH UTILITY PRIOR TO PURCHASE AND RELEASE OF PRODUCT. PRE-CAST VAULT SHALL BE PURCHASED WITH A CONCRETE TOP WITH CONDUIT WINDOW SIZED PROPERLY FOR UTILITY TRANSFORMER AND CONCRETE BASE. REFER TO E603 DETAIL 1 FOR VAULT SIZING INFORMATION AND INSTALLATION DETAILS. E.C. SHALL COORDINATE EXACT VAULT SIZE WITH UTILITY COMPANY TRANSFORMER PROVIDED ON PROJECT AND UTILITY IN FIELD.

GENERAL SITE NOTES

- A. ALL ITEMS SHOWN DARK AND SOLID ARE NEW WORK. ALL ITEMS SHOWN LIGHT AND SOLID ARE EXISTING TO REMAIN.
- B. ALL ELECTRIC SERVICE WORK SHALL BE COORDINATED IN FIELD WITH ELECTRIC UTILITY COMPANY.
- C. ALL TRENCHING SHOWN ON PLANS IS DIAGRAMMATICAL. E.C. SHALL COORDINATE ALL TRENCHING IN FIELD.
- D. E.C. SHALL UTILIZE THE SERVIES OF SOFT-DIG OR EQUIVALENT TO SCAN UNDERGROUND FOR EXISTING UTILITIES BEFORE TRENCHING COMMENCES.
- E. ALL SITE PRIMARY AND SECONDARY SERVICE CONDUITS SHALL BE INSTALLED AT A MINIMUM OF 4'-0" B.F.G. AS MEASURED TO TOP OF CONDUIT. ALL SITE BRANCH LIGHTING AND SITE POWER CIRCUITS SHALL BE FURNISHED AND INSTALLED AT A MINIMUM OF 3'-0" B.F.G. AS MEASURED TO TOP OF CONDUITS. ALL SITE LOW-VOLTAGE CONDUITS SHALL BE INSTALLED AT A MINIMUM OF 18" B.F.G. AS MEASURED TO TOP OF CONDUIT. E.C. SHALL UTILIZE RED METALLIC MARKER TAPE AT A MAXIMUM OF 12" B.F.G. CENTERED OVERTOP OF CONDUITS IN ALL TRENCHES. E.C. SHALL COORDINATE ALL WORK IN FIELD.
- F. ALL POLE MOUNTED LIGHTING FIXTURES SHALL BE FED WITH #10 AWG CU. IN 1" C. U.O.N. E.C. SHALL COORDINATE ALL LOCATIONS IN FIELD.
- G. E.C. SHALL FURNISH AND INSTALL ALL PULLBOXES AND MANHOLES AS REQUIRED IN FIELD. E.C. SHALL COORDINATE ALL QUANTITIES AND LOCATIONS IN FIELD WITH EXISTING CONDITIONS AND EXACT CONDUIT ROUTING.



1 ELECTRICAL SITE POWER PLAN
1" = 20'-0"

2 TYP. CONCRETE-ENCASED CONDUIT RUN SECTION VIEW
NOT TO SCALE

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EXETER TOWNSHIP
EMERGENCY SERVICES FACILITY
70 GIBRALTAR ROAD
READING PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
2	10/22/26
3	10/29/26
4	11/06/26

LAST PROJECT REVISION: No 4 | 11/06/26

ELECTRICAL SITE POWER PLAN

SHEET NUMBER:
E101

11/5/2026 11:44:05 AM

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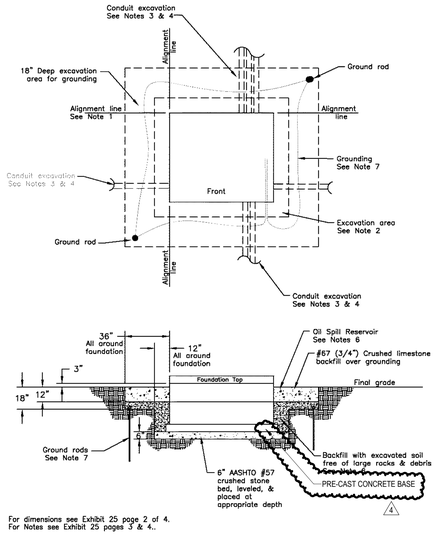
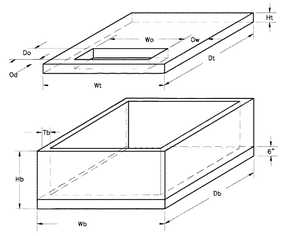


For dimensions see Exhibit 25 page 2 of 4.
For Notes see Exhibit 25 pages 3 & 4.

Three–Phase Transformer Pre–Cast Concrete Foundation / Vault (Installation Details)	FirstEnergy	
Page 1 of 4	Service Guide	REV. 1
	EXHIBIT 25	DATE 7/21



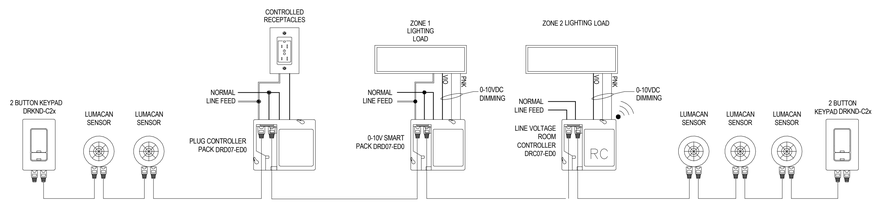
Pre–Cast Concrete Transformer Foundation Dimensions														
Transformer Size (kVA)	Found. Code	Base					Top				Opening in Top			
		Wb	Db	Hb	Tb	WT.	Wi	Di	Hi	WT.	Wo	Do	Ow	Od
22,940 GrdY/14,400 Volt & Below														
45 – 150	J1	72"	54"	42"	4"	4,275#	72"	54"	6"	1,725#	55"	14"	8.5"	6"
225 – 1000	J2	78"	66"	42"	4"	5,000#	78"	66"	6"	2,400#	60"	19"	9"	6"
1500 – 2500	J3	96"	96"	42"	6"	12,000#	96"	96"	9"	6,400#	60"	19"	18"	9"
1500 – 2500 (Note 7)	J4	96"	96"	54"	6"	14,000#	96"	96"	9"	6,400#	60"	19"	18"	9"
34,500 GrdY/19,920 Volt														
1500 – 2500	J3	96"	96"	42"	6"	12,000#	96"	96"	9"	6,400#	60"	19"	18"	9"
1500 – 2500 (Note 7)	J4	96"	96"	54"	6"	14,000#	96"	96"	9"	6,400#	60"	19"	18"	9"
34,500 Delta Volt Live–Front (includes CEI 36 kV System)														
All Sizes (Note 8)	J5	138"	120"	54"	6"	24,655#	138"	120"	9"	10,270#	102"	36"	18"	18"

Pre–Cast Concrete Transformer Foundation – Excavation Dimensions					
Transformer Size (kVA)	Found. Code	Width	Depth	Height	Stone Base
22,940 GrdY/14,400 Volt & Below					
45 – 150	J1	96"	78"	45"	6"
225 – 1000	J2	102"	90"	45"	6"
1500 – 2500	J3	120"	120"	45"	6"
1500 – 2500 (Note 7)	J4	120"	120"	57"	6"
34,500 GrdY/19,920 Volt					
1500 – 2500	J3	120"	120"	45"	6"
1500 – 2500 (Note 7)	J4	120"	120"	57"	6"
34,500 Delta Volt Live–Front (includes CEI 36 kV System)					
All Sizes (Note 8)	J5	162"	144"	57"	6"

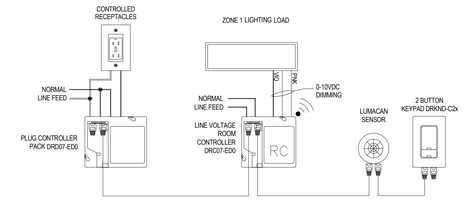
Three–Phase Transformer Pre–Cast Concrete Foundation / Vault (Fabrication Details)	FirstEnergy	
Page 2 of 4	Service Guide	REV. 1
	EXHIBIT 25	DATE 7/21

1 TRANSFORMER VAULT DETAIL
NOT TO SCALE

GreenMAX DRC Wired for Multi-Zone, Typical

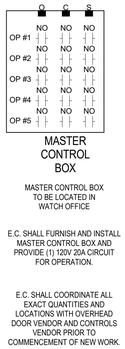


GreenMAX DRC Wired for Single-Zone, Typical



2 LEVITON ROOM CONTROLLER WIRING DIAGRAMS
NOT TO SCALE

MCB INTERIOR

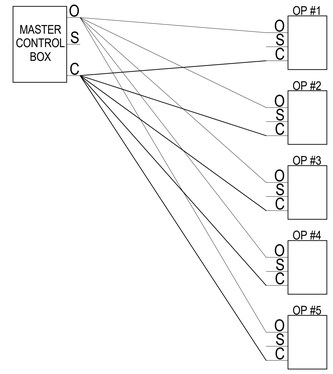


MASTER CONTROL BOX
TO BE LOCATED IN
WATCH OFFICE

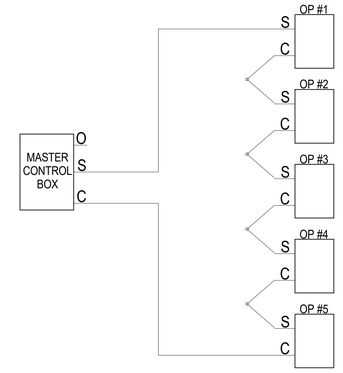
E.C. SHALL FURNISH AND INSTALL
MASTER CONTROL BOX AND
PROVIDE (1) 120V 20A CIRCUIT
FOR OPERATION.

E.C. SHALL COORDINATE ALL
EXACT QUANTITIES AND
LOCATIONS WITH OVERHEAD
DOOR VENDOR AND CONTROLS
VENDOR PRIOR TO
COMMENCEMENT OF NEW WORK.

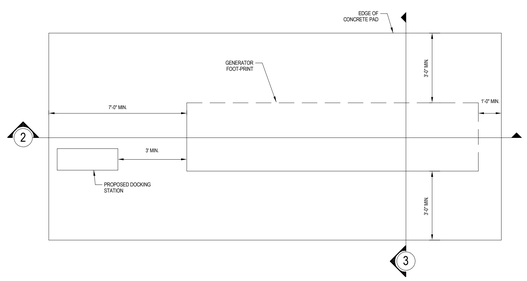
OPEN/CLOSE WIRING DIAGRAM



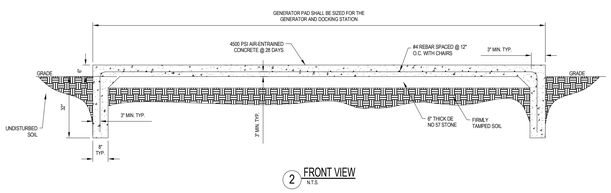
STOP BUTTON WIRING DIAGRAM



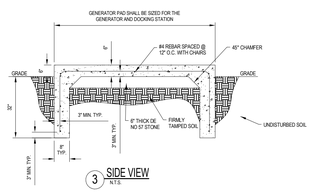
3 OVERHEAD DOOR CONTROL WIRING DIAGRAM (TYPICAL)
NOT TO SCALE



1 TOP VIEW
N.T.S.

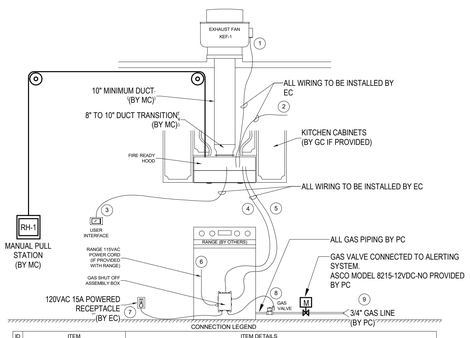


2 FRONT VIEW
N.T.S.



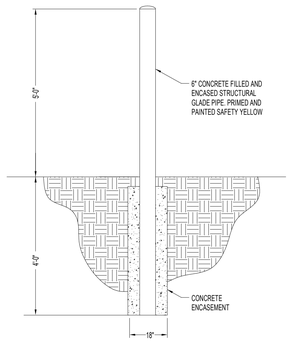
3 SIDE VIEW
N.T.S.

4 GENERATOR PAD DETAILS
NOT TO SCALE



ID	ITEM	ITEM DETAILS
1	FAN	FIELD TO CONNECT FAN KEF-1 TO QC2, PROVIDED WITH 0-10VDC SPEED REFERENCE AND 115VAC RUN COMMAND.
2	HOOD POWER	FIELD TO PROVIDE 115VAC POWER FROM 15A BREAKER TO TERMINAL BLOCKS H1 AND N1 INSIDE HOOD (GROUND TO GROUNDING TERMINAL).
3	SHIP LOOSE USER INTERFACE	8.5 FT PLUG AN PLAY CABLE WITH LIGHT BLUE LABEL COILED UP AND ATTACHED TO HOOD. FIELD TO CONNECT PLUG TO BACK OF USER INTERFACE INSIDE INTERFACE J-BOX.
4	GAS/ELECTRIC DISCONNECT CABLE 1	10 FT PLUG AND PLAY CABLE COILED UP AND ATTACHED TO 9PIN CONNECTION AT HOOD. FIELD TO PLUG THIS INTO GAS/ELECTRIC SHUT OFF ASSEMBLY BOX.
5	GAS/ELECTRIC DISCONNECT CABLE 2	10 FT PLUG AND PLAY CABLE COILED UP AND ATTACHED TO 4PIN CONNECTION AT HOOD. FIELD TO PLUG THIS INTO GAS/ELECTRIC SHUT OFF ASSEMBLY BOX.
6	RANGE POWER CORD	PLUG RANGE POWER CORD (IF PROVIDED WITH RANGE) INTO GAS SHUT OFF ASSEMBLY BOX.
7	SHUT OFF ASSEMBLY BOX POWER	PLUG GAS SHUT OFF ASSEMBLY BOX POWER CORD INTO NEARBY 115VAC RECEPTACLE.
8	SHUT OFF ASSEMBLY VALVE POWER	GAS VALVE TO CONNECT TO QUICK CONNECTOR, CONNECTS 5FT GAS VALVE POWER CORD TO 1.5FT CABLE ON GAS VALVE.
9	GAS LINE	PIPE GAS LINE INTO GAS VALVE INLET, THEN OUT OF GAS VALVE OUTLET TO RANGE.

5 KITCHEN HOOD/KEF-1 INSTALLATION DETAIL
NOT TO SCALE



6 BOLLARD DETAIL
NOT TO SCALE

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EXETER TOWNSHIP
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READING PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
4	11/06/26

LAST PROJECT REVISION: No 4 | 11/06/26

ELECTRICAL DETAILS

SHEET NUMBER:
E603

11/5/2026 11:44:07 AM

SYMBOL	DESCRIPTION	NOTE	MOUNTING/BACKBOX
(S)$_1$	CEILING SPEAKER (70V) QSC AD-C6T-WT		RECESSED IN CEILING GRID TIE TO STRUCTURE WITH SAFETY CABLE
MIC$_1$	CEILING MICROPHONE SHURE MXA920W-S		RECESSED IN CEILING GRID TIE TO STRUCTURE WITH SAFETY CABLE
CAM$_1$	CAMERA QSC NC-20X60		WALL MOUNT INCLUDED
CAM$_2$	CAMERA QSC NC-90-G2-BK		MOUNTED UNDER DISPLAY
TP$_1$	TABLE PANEL AND MIC QSC DISPLAY AND RS-CB-TM MIC		SITS ON CONFERENCE TABLE QSC RS-CBC-TMSK MOUNTING KIT
TP$_2$	TOUCH PANEL - 7" QSC TSC-70-G3		RECESSED WALL MOUNT @ 42" A.F.F. DUAL GANG BACKBOX BY E.C.
TP$_3$	TOUCH PANEL - 7" QSC TSC-70-G3		MOUNT ON LECTERN WITH QSC TSC-710K-G3 TABLE TOP MOUNT
BAR	MEETING BAR QSC RS-CB-MTRW-B		WALL MOUNT INCLUDED MOUNTED CENTERED BELOW DISPLAY
TV 65"	DISPLAY - 65" MAXHUB ND65CMB		CHIEF LTM1U WALL MOUNT
TV 98"	DISPLAY - 98" MAXHUB ND98CMB		CHIEF XSM1U WALL MOUNT

GENERAL NOTES:

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-ELECTRICAL, STRUCTURAL OR OTHER LICENSED PROFESSIONAL ENGINEERING STAMPS, CERTIFICATIONS, APPROVALS OR SIGNATURES BY OTHERS, UNLESS NOTED OTHERWISE.
-ALL PERMITTING BY OTHERS.
-VERIFY SITE CONDITIONS INDICATED BEFORE PERFORMING WORK PRESCRIBED OR PROCURING EQUIPMENT, INCLUDING ARCHITECTURAL, STRUCTURAL, MECHANICAL, ELECTRICAL, PLUMBING, FIRE PROTECTION AND OTHER TRADES. CROSS REFERENCE DOCUMENTATION AND COORDINATE WITH OTHER TRADES WHERE APPROPRIATE. NOTIFY DESIGN ENGINEER AND PROJECT MANAGER OF THIS SET OF ANY DISCREPANCIES, CONFLICTS OR TIMELINE DEPENDENCIES.
-EQUIPMENT SPECIFIED WITHIN IS THE BASIS OF THE DESIGN. EQUIPMENT SUBSTITUTIONS WILL NOT BE ACCEPTED WITHOUT FORMAL, WRITTEN SUBMISSION DEMONSTRATING EQUIVALENT OR SUPERIOR FUNCTIONALITY, CAPACITY AND QUALITY WITH COST SAVINGS TO CLIENT OR OWNER. ALL SUBSTITUTIONS REQUIRE WRITTEN APPROVAL FROM ILLUMINATED INTEGRATION PRIOR TO PROCUREMENT. SUBSTITUTION SUBMISSIONS TO BE IN ACCORDANCE WITH DIVISION 1 OF APPLICABLE PROJECTS.
-QUANTITIES NOTATED WITHIN SCHEDULES, LEGENDS OR EQUIPMENT LISTS ARE FOR QUICK REFERENCE. ANY DISCREPANCY WITH QUANTITIES SHOWN IN LAYOUT DRAWINGS SHOULD BE BROUGHT TO THE ATTENTION OF THE DESIGN DEPARTMENT AT ILLUMINATED INTEGRATION FOR RECONCILIATION.

TRADE COORDINATION:

-REPRESENTATION OF WORK PERFORMED BY OTHER TRADES IS FOR REFERENCE AND COORDINATION ONLY. REFER TO AUTHORITATIVE DOCUMENTATION FOR EACH TRADE FOR EXPECTED WORK BY OTHERS. THESE DRAWINGS ARE INSTRUCTIVE SOLELY FOR CONTRACTED WORK TO BE PERFORMED BY SYSTEMS INTEGRATOR OR ITS SUBCONTRACTORS.
-OTHER TRADES SHALL BE RESPONSIBLE FOR ADJUSTING TO EQUIPMENT LOCATIONS SHOWN IN THESE DOCUMENTS AND COORDINATING ANY ADJUSTMENTS REQUIRED BY THE SYSTEMS SHOWN HEREIN. SYSTEMS INTEGRATOR SHALL NOT BE RESPONSIBLE FOR REWORK RESULTING FROM UNCOORDINATED EQUIPMENT PLACEMENT, INCLUDING BUT NOT LIMITED TO FIXTURES, DUCTWORK, PLUMBING, FIRE PROTECTION AND ANY CEILING- OR WALL-MOUNTED EQUIPMENT.
-ILLUMINATED INTEGRATION IS NOT RESPONSIBLE FOR WORK DEPENDENT ON THIS DOCUMENTATION THAT HAS NOT BEEN PERFORMED ACCORDING TO ITS SPECIFICATIONS.
-SYSTEMS INTEGRATOR SHALL NOT BE RESPONSIBLE FOR EMERGENCY LIGHTING, FIRE ALARMS, EMERGENCY MESSAGING OR ANY OTHER LIFE SAFETY MECHANISMS EXCEPT WHERE EXPLICITLY CALLED OUT WITHIN SCOPE. SOURCE FOR FIRE ALARM MUTE, PANIC/EMERGENCY STATES OR OTHER SIMILAR TO BE PROVIDED BY OTHERS AND COORDINATED WITH ILLUMINATED INTEGRATION OR SYSTEMS INTEGRATOR WHERE REQUIRED BY CODE.

DIMENSIONS:

-WRITTEN DIMENSIONS TAKE PRECEDENCE OVER SCALED MEASUREMENTS. SYMBOLS MAY BE DIAGRAMMATIC AND SHIFTED IN REPRESENTATION FOR CLARITY. ALL DIMENSIONS TO BE VERIFIED IN FIELD.
-PROJECT ORIGIN (0,0) FOR AUDITORIUMS, THEATERS, CHURCHES, LECTURE HALLS OR SIMILAR SPACES SHALL BE SET AT THE INTERSECTION OF THE CENTER LINE (CENTER-MOST AXIS OF A STAGE OR PLATFORM BETWEEN THE PROSCENIUM ARCH OR STAGE STRUCTURE) AND 1) THE PLASTER LINE (UPSTAGE, ARCHITECTURALLY-UNOBSTRUCTED DATUM OF THE PROSCENIUM ARCH) IN PROSCENIUM SPACES OR 2) THE DOWNSTAGE EDGE OF THE STAGE OR PLATFORM. THIS GLOBAL ORIGIN FOR PERFORMANCE TECHNOLOGY SYSTEMS WITHIN SUCH SPACES SHALL APPLY UNLESS OTHER SPECIFIC ORIGIN POINTS ARE CALLED OUT.
-WHERE MEASUREMENTS TO THE ORIGIN OR ITS AXES ARE OBSTRUCTED FROM THE MEASUREMENT LOCATION OF EQUIPMENT, AN OFFSET SHALL BE IDENTIFIED AND USED. FOR CONSISTENT MEASUREMENT AGAINST STRUCTURAL OR ARCHITECTURAL FEATURES. CALCULATED DIMENSIONS (E.G. USING ANGLES TO CALCULATE SQUARE DIMENSIONS) SHALL ONLY BE USED IF DIRECT PERPENDICULAR MEASUREMENTS ARE INFEASIBLE.

EQUIPMENT MOUNTING:

-OVERHEAD RIGGING TO BE COMPLIANT WITH ANSI E1.4-2.
-GC TO PROVIDE ADDITIONAL MOUNTING STRUCTURE, BLOCKING OR BACKING AS CALLED OUT IN THESE DRAWINGS FOR EQUIPMENT WITHIN ILLUMINATED SCOPE.
-ALL RIGGING DESIGNED FOR LOADS WITHIN SCOPE FOR AVL SYSTEMS. NO OTHER TRADES TO SUSPEND EQUIPMENT OR CABLING FROM AVL RIGGING WITHOUT PRIOR COORDINATION.
-ALL TRADES SHALL AVOID ATTACHING TO OR CROSSING UNDERNEATH THE LIGHTING SUPPORT PIPES GRIDS OR TRUSSES WITHOUT COORDINATING WITH OR RECEIVING WRITTEN APPROVAL FROM ILLUMINATED INTEGRATION. AVL LOADS SHALL BE SUSPENDED DIRECTLY FROM BUILDING STRUCTURE UNLESS COORDINATED OTHERWISE WITH OTHER TRADES.
-ALL TRADES TO COORDINATE WORK OVER AVL MOUNTING STRUCTURES TO AVOID INTERACTION AND PERFORMANCE CONFLICT.
-MOUNTING HARDWARE TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
-MOUNTING HARDWARE TO BE PAINTED TO MATCH SURROUNDING FINISH, OTHERWISE BLACK IN PUBLICLY-VIEWABLE SPACES. MOUNTING HARDWARE IN LIMITED ACCESS SPACES WILL NOT BE REQUIRED TO BE ADDITIONALLY FINISHED WITH PAINT OR OTHER TREATMENT. THESE SPACES INCLUDE BUT ARE NOT LIMITED TO CRAWLSPACES, ATTICS, IDF OR MDF CLOSETS OR SIMILAR LOW-VOLTAGE OR LINE-VOLTAGE ELECTRICAL ROOMS, MECHANICAL SPACES, PLENUMS OR OTHER SPACES OF SIMILAR ACCESS OR GENERAL FINISH.

APPROVALS:

-COORDINATE DEVICE COLORS WITH ARCHITECT AND FINISH SCHEDULE OR MATCH TO EXISTING CONDITIONS. CUSTOM COLORS FOR ITEMS WITHOUT MANUFACTURER-SUPPLIED OPTIONS ONLY TO BE PROVIDED AT SPECIFIC OWNER REQUEST. ALL FINAL FINISHES TO BE APPROVED BY ARCHITECT, INTERIOR DESIGNER, AUTHORITY HAVING JURISDICTION AND/OR APPROPRIATE APPROVER PRIOR TO PROCUREMENT.
-DRAWINGS TO BE ACTIVELY APPROVED. RETURN OF REVIEWED DOCUMENTS WITHOUT NOTES OR ACTIVE ACTION TO REVISE AND RESUBMIT SHALL CONSTITUTE APPROVAL.
-APPROVAL TO BE BY OWNER, OWNER AGENT, CONSTRUCTION MANAGEMENT OR CONTRACTING ENTITY. APPROVAL OF THIS DOCUMENT BY THOSE PARTIES CONSTITUTES ALLOWANCE TO INSTALL AS INDICATED ON APPROVED DRAWINGS REGARDING QUANTITIES, COLORS, PLACEMENT INDICATED MEANS AND METHODS, AND OTHER HEREIN-SPECIFIED MATERIALS AND WORKMANSHIP.

GENERAL DRAWING STANDARDS:

DEVICE ID PREFIXES:

ALS- ASSISTED LISTENING SYSTEM
AMP- AMPLIFIER
ANT- ANTENNA
BCS- BATTERY CHARGING STATION
BS- BUTTON STATION
BT- BLUETOOTH RECEIVER
CAM- CAMERA
CBAR- CONFERENCING AV BAR
COMB- ANTENNA COMBINER
COM- INTERCOM
COMP- COMPUTER
CONS- LIGHTING CONSOLE
CONV- CONVERTER
CS- CONNECTOR STRIP
CTRL- CONTROL INTERFACE
DA- DISTRIBUTION AMPLIFIER
DEBC- DMX EMERGENCY BYPASS CONTROLLER
DIM- DIMMER
DISP- DISPLAY
DIST- DISTRIBUTOR
DSP- SYSTEMS PROCESSOR
EBDK- EMERGENCY BYPASS DETECTION KIT
ESTP- EMERGENCY STOP BUTTON STATION
FB- FLOOR BOX
GJB- GRID IRON JUNCTION BOX
GTWY- LIGHTING GATEWAY
IO- INPUT/OUTPUT INTERFACE
JB- JUNCTION BOX
LS- LIGHT SENSOR
MIX- AUDIO MIXER
MON- AUDIO/VIDEO MONITOR
MPB- MEDIA PLAYBACK
MTR- MOTOR
NPB- NETWORK PATCH BAY
OS- OCCUPANCY SENSOR
PB- PLUG BOX
PCD- POWER AND CONTROL DISTRIBUTION
PDU- PASSIVE POWER DISTRIBUTION UNIT
PMB- PIPE-MOUNT BOX
PNL- ELECTRICAL PANEL
PROJ- PROJECTOR
PSU- POWER SUPPLY UNIT
REC- AUDIO/VIDEO RECORDER
RK- EQUIPMENT RACK
RL- RUNNING LIGHT
RP- RACK PANEL
RTR- VIDEO ROUTER
RX- RECEIVER
SC- PROJECTION SCREEN/CONTROL
SEQ- POWER SEQUENCING
SNSR- SENSOR
SPKR- LOUDSPEAKER
SPLT- SIGNAL SPLITTER
SUB- SUBWOOFER
SW- NETWORK SWITCH
SWR- VIDEO SWITCHER
TP- TOUCH SCREEN CONTROL PANEL
TX- TRANSMITTER
UPS- UNINTERRUPTIBLE POWER SUPPLY
VC- VOLUME CONTROL
VW- VIDEO WALL
WAP- WIRELESS ACCESS POINT
WLS- WIRELESS MIC RECEIVER
WP- WALL PLATE
XCVR- TRANSCEIVER

N.B. NOT ALL DEVICE ID PREFIXES MAY BE USED IN ALL PROJECTS

DRAWING REFERENCE SYMBOL LEGEND:
SHT# -SHEET LOCATION OF REFERENCED DRAWING
-DETAIL DRAWING NUMBER

-SECTION VIEW REFERENCE MARKER
-ELEVATION VIEW REFERENCE MARKER
-ENLARGED PLAN VIEW REFERENCE MARKER
-PLASTER LINE
-CENTER LINE
-ELEVATION DATUM
-LINE BREAK
-HIDDEN LINE
-DEMO
-MATCH
-DETAIL CALLOUT
-DATUM
-REVIEWER ACTION NEEDED

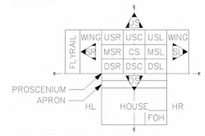
REVISION DELTA TAG LEGEND:
-REVISION NUMBER (E.G. CD100)
-REVISION LOG REFERENCE ID

COMMON ABBREVIATIONS:

ACT – ABOVE COUNTERTOP
AFF – ABOVE FINISHED FLOOR
AVoIP – AUDIO/VIDEO OVER INTERNET PROTOCOL
CKT – CIRCUIT
CL – CENTER LINE
CONT. – CONTINUED
COORD. – COORDINATE AMONG TRADES
DIM .- DIMENSION
ETR – EXISTING TO REMAIN
EQ. – EQUIDISTANT
EQPT – EQUIPMENT
FOH – FRONT OF HOUSE (CONTROL BOOTH)
I.D. – INNER DIAMETER
INCL. – INCLUDE(D)
LX – LIGHTING
MAX. – MAXIMUM
MFR – MANUFACTURER
MIN. – MINIMUM
MOD. – MODIFY
N.B. – NOTA BENE, TAKE SPECIAL NOTE
N.I.C – NOT IN CONTRACT
NOM. – NOMINAL
O.C. – ON CENTER
O.D. – OUTER DIAMETER
OFCI – OWNER-FURNISHED, CONTRACTOR INSTALLED
OFE – OWNER-FURNISHED EQUIPMENT
OPT. – OPTIONAL
PL – PLASTER LINE
PoE – POWER OVER ETHERNET
QTY – QUANTITY
RCPT – RECEPTACLE
REF. – REFERENCE
REQ. – REQUIRED
R&R – REMOVE AND REPLACE
RU – RACK UNIT SPACE (1.75")
TBD – TO BE DETERMINED
TYP. – TYPICAL
VIF – VERIFY IN FIELD

DEFINITIONS:

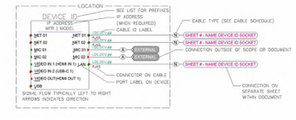
ABANDON: EXISTING TO REMAIN BUT NOT USED IN NEW SYSTEM. LOCKOUT OR CAP AS NECESSARY FOR SAFETY AND/OR AESTHETICS.
FURNISH: SUPPLY WITHOUT INSTALLATION.
MODIFY: SIGNIFICANT ELEMENTS OF A DEVICE WILL REMAIN INTACT WHILE SOME PIECES ARE ALTERED OR REPLACED.
PROVIDE: FURNISH AND INSTALL.
REMOVE: UNINSTALL TO NOT BE REUSED IN NEW SYSTEM. DISPOSE OF IN ACCORDANCE TO PROCEDURES REQUIRED BY CLIENT. MAKE BEST EFFORT TO RECYCLE MATERIALS WHERE POSSIBLE.



AUDITORIUM/STAGE LOCATION KEY

APRON – FRONT PART OF STAGE EXTENDING PAST PROSCENIUM
CL – CENTER LINE
CS – CENTER STAGE
DS – DOWN STAGE
DSC – DOWN STAGE CENTER
DSL – DOWN STAGE LEFT
DSR – DOWN STAGE RIGHT
FLYRAIL – WHERE RIGGING LINE SETS ARE OPERATED IN WINGS
FOH – FRONT OF HOUSE CONTROL BOOTH
HOUSE – AUDIENCE SEATING
HC – HOUSE CENTER
HL – HOUSE LEFT
HR – HOUSE RIGHT
MS – MID STAGE
MSC – MID STAGE CENTER
MSL – MID STAGE LEFT
MSR – MID STAGE RIGHT
OFF STAGE – AWAY FROM CENTER LINE
ON STAGE – TOWARD CENTER LINE
PL – PLASTER LINE, UNOBSTRUCTED UPSTAGE EDGE OF PROSCENIUM ARCH
PROSCENIUM – ARCH SEPARATING STAGE FROM HOUSE
SL – STAGE LEFT
SR – STAGE RIGHT
THRUST – STAGE EXTENDING INTO AUDIENCE
US – UP STAGE
USC – UP STAGE CENTER
USL – UP STAGE LEFT
USR – UP STAGE RIGHT
WING – SIDE OF STAGE NOT SEEN FROM HOUSE

RISER GRAPHIC LEGEND:



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CLIENT LOGO

CLIENT CONTACT
-

REVISIONS

Rev:	Date:	By:	Description:
4	11/05/2026	JJE	Addendum 5

PROJECT NAME
EXETER TWP ESF

FACILITY ADDRESS

DESIGNED BY	D&E CHECKED BY
MS	
DRAFTED BY	DATE
JE	09/11/2026
SCALE	ORIGINAL PAPER SIZE
N/A	N/A

SHEET TITLE
GENERAL INFO AND LEGEND

FILE NAME
5372_ExeterESF_CoverPage-Adde5

AV01

PROJECT ID	SHEET NO.
ii-5372	1 OF 2

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READING, PA 19606

PROJECT NUMBER: 25-049

SUBMISSION:
BID SET

ORIGINAL ISSUE DATE:
10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
4	2026-11-05

LAST PROJECT REVISION: No 4 | 2026-11-05

GENERAL INFO AND LEGEND

SHEET NUMBER:
AV01

11/4/2026 9:29:43 AM

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1 1ST FLOOR PLAN
3/32" = 1'-0"

2 MEZZANINE FLOOR PLAN
3/32" = 1'-0"

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CLIENT LOGO

CLIENT CONTACT
-

REVISIONS

Rev:	Date:	By:	Description:
4	11/05/2026	JJE	Addendum 5

PROJECT NAME
EXETER TWP ESF

FACILITY ADDRESS

DESIGNED BY	D&E CHECKED BY
MS	
DRAFTED BY	DATE
JE	09/11/2026
SCALE	ORIGINAL PAPER SIZE
N/A	N/A

SHEET TITLE
AV FLOORPLAN

FILE NAME
5372_ExeterESF_AV_Floorplan-Adde5

AV02

PROJECT ID	SHEET NO.
ii-5372	2 OF 2

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10/01/2026

SHEET REVISION SCHEDULE:

No.	DATE
4	2026-11-05

LAST PROJECT REVISION: No 4 | 2026-11-05

AV FLOOR PLAN

SHEET NUMBER:

AV02

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PROCUREMENT AND CONTRACTING REQUIREMENTS

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00 7000.1 – AIA A132-2019

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Attachment: Schedule of Alternates

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33 1416 - Site Water Utility Distribution Piping

33 3100 - Sanitary Sewerage Piping

33 3900 - Underground Protected Steel Gravity Based Oil-Sand Interceptor

33 4200 - Stormwater Conveyance

DIVISION 41 -- MATERIAL PROCESSING AND HANDLING EQUIPMENT

41 2200 - Cranes and Hoists

END OF SECTION 00 0010

SECTION 00 11 00 – INSTRUCTIONS TO BIDDERS

1. GENERAL

1.1 The drawings and specifications are complimentary via the Building Connected Program. Any labor and/or material not shown on the drawings but called for in the specifications or any labor and/or material not called for in the specifications but shown on the drawings, shall be furnished by the contractor as shown and called for in both.

1.2 DEFINED TERMS

1.2.1 Terms used in these Instructions to Bidders, which are defined in the General Conditions of the Contract for Construction (the “General Conditions”), have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to Owner, as distinct from a sub-Bidder, who submits a bid to a Bidder. The term "Successful Bidder" means the lowest, qualified, responsible, and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award. The term "Bidding Documents" includes the Advertisement for Bids, Instructions to Bidders, the Bid Form, and the Contract Documents (including all Addenda issued prior to receipt of Bids). The numbering system refers to Articles.

2. COPIES OF BIDDING DOCUMENTS

2.1 In order to Bid the Project, complete sets of PDF documents must be obtained.

2.2 Complete sets of Bidding Documents must be used in preparing Bids; neither Owner, Architect, or Construction Manager assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents. Bidding Documents consist of Contract Documents (and all reference standards), specifications, addenda, and drawings. Bidder is responsible to make sure that the set of Bidding Documents is complete and that any printed contract document is legible and represents properly all the information as represented in the PDF file.

2.3 Owner, Architect, and Construction Manager, in making copies of the Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

3. QUALIFICATIONS OF BIDDERS

3.1 **The following information must be completed and submitted when requested by the Construction Manager.**

3.1.1 The Contractors Qualification Statement A305-2020 found in Section 00 1940. Use additional pages to complete any of the sections if more space is needed. Bidder’s failure to fully and

accurately disclose all information requested in the Request for Qualifications questionnaire shall constitute grounds for Bidder's disqualification from being considered the lowest responsive, responsible Bidder.

3.2 To demonstrate qualifications to perform the Work, each Bidder must be prepared to submit with their bid proposal, written evidence such as financial data, insurance certificates, previous experience of the Bidder and its assigned personnel, present commitments, and any other information that may be requested by the Owner. Each Bid must contain evidence of Bidder's qualification to do business in the Commonwealth of Pennsylvania, or covenant to obtain such qualification prior to award of the Contract. Owner reserves the right to reject Bidder if he cannot satisfy all of the Qualification Requirements, including those listed in the Technical Specifications.

3.3 In determining the lowest responsible Bidder, the Owner will consider the integrity, efficiency, experience of the Bidder and its assigned personnel, promptness, current workload, financial capability, performance on recent projects, references from owners, architects, and engineers, list of potential sub-contractors, schedule of values, and ability to successfully and timely complete the Project**.** The apparent low Bidder must demonstrate competency and provide any or all of the above information requested within three (3) calendar days of request. Owner reserves the right to reject the Bidder as non-responsive if all the information is not received on time and/or does not reasonably satisfy the Owner's evaluation process.

3.4 In addition to all the requirements specified in Articles 3.1, 3.2 and 3.3 regarding qualifications of Bidders, the Owner will evaluate Bidders using the following additional criteria:

3.4.1 The Bidder and its assigned personnel must have successfully performed a minimum of 3 previous Pennsylvania public municipal projects within the last 5 years of similar type or a contract value of at least seventy-five percent (75%) of the amount of the Bidder's Base Bid. Provide references including telephone number and contact person.

3.4.2 The Bidder shall perform not less than ten percent (10%) of the actual construction Work with staff employed directly by the Bidder. Project Management and Office Staff shall NOT be included in this percentage.

3.4.3 The Bidder, or its assigned personnel, must have successfully performed at least 3 Pennsylvania public municipal projects within the last 5 years where they have managed multiple trades and coordinated and scheduled all the activities for projects as per Article 3.4.1. Provide references including telephone number and contact person.

3.4.4 An Agreement of Surety certifying that the Surety Company is committed to provide the Bidder with a Performance Bond and Payment Bond each in the amount of one hundred percent (100%) of the contract amount. The Surety Company must have an AM Best rating of A- or higher and a financial rating of Class X or higher.

3.4.5 The Bidder's performance on previous projects including claims, litigation, coordination of work, staffing, and timely completion. If it is determined that the Bidder has not fully performed previous projects in a coordinated, timely, and good and workmanlike manner, the Owner reserves the right to reject the Bid.

3.4.6 The Bidder shall also refer to Article 11.

3.5 Owner shall be entitled to recover attorneys' fees and costs incurred in defending any unsuccessful challenge brought by a Bidder in its own name or as proxy for a Municipality resident to Owner's award of a contract to another Bidder, from the Bidder who brought the unsuccessful challenge as more fully set forth in Section 13.8.1 of the General Conditions of Contract.

3.6 All Bidders should be aware that the Owner encourages and promotes MBE (Minority Business Enterprise) and WBE (Women's Business Enterprise) participation for this Project. Bidders are encouraged to do their own research on the qualifications, and other factors, in preparing a comprehensive and responsible bid.

4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE

4.1 It is the responsibility of each Bidder, before submitting a Bid, to:

1. Examine the Contract Documents thoroughly.
2. Visit the site to become familiar with local conditions that may affect the cost, progress, performance, or furnishing the Work.
3. Consider federal, state, and local laws and regulations that may affect cost, progress, performance, or furnishing of the Work.
4. Study and carefully correlate Bidder's observations with the Contract Documents.
5. Notify Architect and Construction Manager of any conflicts, errors, or discrepancies discovered in the Contract Documents.

4.1.1 REVIEW OF DRAWINGS AND SPECIFICATIONS

A. Bidders shall thoroughly examine and be familiar with the Specifications and Drawings. The failure or omission of any Bidder to receive or examine any form, instrument, document, or visit the site and acquaint himself with conditions there existing, shall in no way relieve any Bidder from obligation with respect to his or her Bid. By submitting a Bid, the Bidder agrees and warrants that he/she has examined the site and the Specifications and Drawings and, where Specifications and/or Drawings require in any part of the Work a given result to be produced, that the Specifications and Drawings are adequate, and the required result can be produced under the Specifications and Drawings. No claim for any additional costs will be allowed because of alleged impossibilities in the production of the results specified or because of inadequate or improper plans and specifications and whenever a result is required, the successful Bidder shall furnish any and all extras and make any changes needed to produce the required result for the sum stated in the form of proposal.

B. Should any Bidder find discrepancies, duplications, or omissions in the documents or have doubt as to the meaning expressed by the Contract Documents, he/she shall make inquiry at once in writing to the Architect and Construction Manager. Where changes, corrections, or clarifications to Contract Documents are deemed necessary by the Architect and/or Construction Manager, he will issue written Addenda

accordingly. Addenda shall be a part of the Contract Documents. No oral, telephone, email, or letter instructions will be considered as having effect upon the Contract Documents; Addenda only shall constitute change to them. Bidders and sub-Bidders are urged to make early examination of Contract Documents and make inquiries about them, if necessary, even though prices may not be determined until late in the bidding period.

4.2 The site may be made available for visits at the pre-bid conference and at the other specific designated dates and times determined at the pre-bid conference.

4.3 Information and data reflected in the Contract Documents with respect to underground facilities at or contiguous to the site is based upon information and data furnished to Owner and Architect and/or Construction Manager by owners of such underground facilities or others, and Owner and Architect and/or Construction Manager do not assume responsibility for the accuracy or completeness thereof. Successful Bidder shall verify the location of all underground utilities prior to any excavation.

4.4 Successful Bidder for the Site Contract is responsible, on behalf of the Owner, for providing the physical markings of all existing utilities including those on site as indicated on the drawings or that may be identified in the field. The locations shown on the drawings are approximate. The Bidder must include in his proposal the cost for hand-dug test holes, or other means, to ascertain the precise position of such underground facilities on the site owned by the Owner. This verification should be performed for any utilities to be relocated, removed, modified, or that may otherwise interfere with planned work. The utilities in the public right of way will be identified and marked by the appropriate facility owner as per the requirements of the PA One Call Act as amended. Physical layout is to be performed in full compliance with the PA One Call PA Act 287 of 1974 as amended by Act 18 of 1996 and Act 50 of 2017.

4.5 The Owner, Architect, and Construction Manager will not be responsible for the adequacy of data furnished to prospective Bidders on subsurface conditions, underground facilities, and other physical conditions. This information is provided based on information available. Bidder assumes responsibility for verifications, adjustments, and modifications that may be required since this is generally recognized as inherent to the work of the Contract Documents.

4.6 Before submitting a Bid, each Bidder will, at Bidder's expense, make or obtain any additional examinations, investigations, explorations, tests and studies, and obtain any additional information and data which pertain to the physical conditions (surface, subsurface, and underground facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance, or furnishing the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.

4.7 On request in advance, Owner will provide each Bidder access to the site to conduct such explorations and tests, as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes, clean up, and restore the site to its former condition upon completion of such explorations.

4.8 The lands upon which the Work is to be performed, rights-of-way, and easements for access thereto and other lands designated for use by the Bidder in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by Bidder. Easements for permanent structures

or permanent changes in existing structures are to be obtained and paid for by Owner unless otherwise provided in the Contract Documents.

4.9 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of the Bidding Documents and, that without exception, the Bid is premised upon performing and furnishing the Work required by the Contract Documents and such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

5. SCOPE

5.1 Contracts will be awarded in (6) prime contracts: Separate bids shall be submitted for: (BP-01) Site Construction, (BP-02) General Construction, (BP-03) Fire Protection Construction, (BP-04) Plumbing Construction, (BP-05) Mechanical Construction and (BP-06) Electrical Construction.

5.2 Each prime contractor shall furnish all labor, equipment, and materials necessary to complete the work called for and implied by the plans and specifications.

5.3 **Upon issuance of the Letter of Intent to Award to the Electrical and General Construction Prime Contractors, the Owner and Construction Manager request that the following submittals be provided for review due to anticipated lead times: Structural Steel, Pre-Engineered Metal Building System, Generator, and Automatic Transfer Switch (ATS). Submission of these items prior to contract execution shall be at the Prime Contractor's sole risk. Following issuance of the Notice to Proceed, the Prime Contractor may submit payment applications for reimbursement of approved costs associated with these submittals.**

6. TIME

6.1 The Contract Documents include potential assessment of Liquidated Damages. Refer to AIA Document A132 – 2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition.

7. INTERPRETATIONS OF CONTRACT DOCUMENTS PRIOR TO BIDDING

7.1 If any person submitting a bid for construction of the Work is in doubt as to the true meaning or intent of any part of the proposed Contract Documents, or find discrepancies or omissions, they shall submit a request for information to the Architect and Construction Manager no later than the date indicated in the Bid Schedule.

7.2 Interpretation or correction of proposed Contract Documents will be made only by Addendum and will be released to all prime contract bidders of record. The Owner, Architect, and Construction Manager will not be responsible for any other explanations or interpretations of the proposed Contract Documents.

7.3 During the bidding period, Bidders may be furnished these Bid Addenda modifying the Bid Documents. Any such Addenda shall be taken into account in submitting a Bid and shall form a part of the Contract Documents. Receipt of Bid Addenda must be identified on Bid Form.

7.4 When mistakes or omissions occur in the drawings and/or specifications, they shall be brought to the Construction Manager's attention before proceeding with the work.

7.5 All construction shall be in accordance with all federal, state, and local building codes and ordinances, which shall take precedence over these drawings and specifications.

7.6 Manufacturer's directions – All manufacturer's articles, materials and equipment shall be supplied, installed, connected, cleaned or conditioned in strict accordance with the manufacturer's printed directions.

7.7 If there is a discrepancy between the contract documents and the information on Building Connected the contract document requirements shall prevail in all cases.

8. REQUESTS FOR INFORMATION

8.1 If additional information is required concerning the meaning or intent of the Bid Documents, all questions and requests for information must be submitted electronically via Building Connected.

9. SUBMISSION OF PROPOSALS

9.1 Bids shall be submitted at the time and place indicated in the Advertisement for Bids and shall be enclosed in an opaque, sealed envelope, marked with the Project title, Contract No., and, if applicable, the designated portion of the Project for which the Bid is submitted. Envelopes shall contain the name and address of the Bidder and accompanied by the documents listed below. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in another envelope with the notation "BID ENCLOSED" on the face of it. Receipt of Bid is acknowledged when delivered to the Owner and not when mailed.

9.2 **Each Bidder shall submit two (2) hard copies of the complete bid submission.**

The following shall be included in the bid submission:

1. Form of Proposal, fully executed and notarized
2. Bid Bond or Certified Check or Cashier's check in the amount of 10% of the Bid total and shall include Consent of Surety and Power of Attorney
3. Non-Collusion Affidavit, Signed and Sealed
4. Non-Discrimination Clause, Signed and Sealed
5. PA Public Works Employment Verification Form (E-Verify)
6. **Letter of Insurer**

Note that the following will be required to be submitted by ALL Bidders at the request of the Construction Manager within 48 hours of bid submission:

1. Bidder's Qualifications, AIA A305, completed
2. Schedule of Values
3. List of Subcontractors
4. Safety Questionnaire

Note that the successful bidder will be required to submit the following documents and any other documents deemed necessary by the Construction Manager upon issuance of Letter of Intent to Award:

1. Certificate of Insurance
2. Performance Bond in the amount of 100%
3. Payment Bond in the amount of 100%
4. No Lien Agreement

10. BIDDERS RESPONSIBILITIES

10.1 Bidders will be given permission to withdraw any proposal after it has been received by the Owner, provided the Bidder or his agent duly authorized to act for him, personally appears at the Owner's Business Office with a written request signed by the Bidder prior to the time set forth for the opening of the Bids. At the time set for the opening of Bids, the withdrawn proposal will be returned to the Bidder. Such withdrawn proposals will not be opened or read at the Bid opening. Bids may not be modified after submittal.

10.2 Bids shall be irrevocable for ninety (90) days after the actual day of opening thereof unless the Owner is delayed in awarding the Contract due to the failure to receive a required approval/permit from one or more reviewing bodies/governmental agencies having jurisdiction over the Project, the sale of bonds or the award of a grant, in which case, Bids shall be irrevocable for (120) calendar days after Bid opening. Absent an exception for extending time for the award of the Contract, the Owner and the lowest responsible and responsive Bidder may mutually agree in writing to extend the time for the Owner to award the Contract.

10.3 Neither the designation of the apparent lowest responsible Bidder, nor the issuance of a Notice of Intent to Award to the Bidder so designated shall operate to release any other Bidder from its Bid. Each such other Bidder, unless earlier released from its Bid by specific action of the Owner, shall remain bound by its Bid until the earlier of (1) the date of actual execution by Owner of the Agreement Between Owner and Contractor with the Bidder whom the Award of Contract has been made, or (2) the expiration of the firm Bid period stipulated above.

10.4 Negligence by the Bidder in preparing his Bid confers no right of withdrawal or modification of his proposal after such proposal has been opened. No claims on account of mistakes or omissions of any proposal will be considered. Notwithstanding the above, a Bidder may withdraw his Bid within two (2) business days after the Bid opening time in accordance with the Public Contracts – Withdrawal of Bids

Law, Act of January 23, 1974, P.L. 9, No. 4, 73 P.S. §1601 et seq., as amended. A Bid which has been opened may be withdrawn only in accordance with the causes set forth in said Act and for no other reasons. Strict compliance with said Act is required to withdraw a Bid after opening.

10.5 By submitting a bid, the bidder covenants and agrees that he has carefully examined the site, the existing building and details, the documents and the Contract and that, from his own investigations, he has satisfied himself as to the nature and location of the work, the general and local conditions and all matters which may in any way affect the work or its performance and that as a result of such examination, he fully understands the intent and purpose thereof and his obligations thereunder, and that he will not make any claim for, or have any right to, damages because of any lack of information.

10.6 Each bidder is highly encouraged to visit the site to familiarize themselves with the existing conditions thereon pertaining to the work. The bidder shall examine all the documents relating to the Contract on which he is bidding before submitting a Bid. Each Contractor shall obtain the full knowledge by personal and careful inspection of all existing conditions at the site and of all requirements of the Bid Documents that affect the work. The Contractor accepts all such conditions and requirements and hereby assumes all responsibilities and costs resulting from their failure to obtain full knowledge of them.

10.7 The Bids are to include all work as shown or specified, including but not limited to Unit Prices, Alternates and Allowances as may be requested or noted. These prices are important and should be carefully considered when Bids are submitted, and in the form, as quoted, on the Bid forms, attached to these specifications. It is requested upon any bidder, to include all Alternate Bids or Unit Prices. Should any bidder fail to submit requested Alternate Bids or Unit Prices the bidder will be responsible for his omission and shall have no claim against the Owner, should the Owner award the Contract to a bidder who has submitted a more satisfactory and complete bid.

10.8 Any Unit Prices furnished by the Bidder as part of his Proposal Form shall be made a part of the Agreement and shall be the basis of compensation for any Unit Price work required on the Project.

10.9 The Bidder shall identify and list Prior to Award of Contract each Subcontractor or material supplier, with their respective prices, to be used on this Project in accordance with the General Conditions of the Contract.

10.10 Bidders shall also secure and submit Contractors Qualification Statements accordingly as noted below.

10.11 Bidder warrants to execute the Contract, furnish required Bonds in form as incorporated in the contract documents and furnish required insurance certificates and other items, in amounts specified or required, by the owner. Bidder shall also warrant beginning work in accordance with the Project Contract agreement.

10.12 All permits and inspections shall be obtained by each prime contractor and paid for by the owner. The contractors will be required to pay all license and/ or registration fees by the local community.

10.13 A Waiver of Liens shall be signed by The Contractor as requested by the CM or prior to the beginning of the ordering of material and before any work is performed on the property. The Waiver of Lien to be filed and indexed in the Berks County Prothonotary's Office is found as an attachment at the end of these

specifications. The Contractor shall provide a Release of Liens for themselves and all suppliers prior to application of final payment.

10.14 All work to be in accordance with applicable codes and ordinances adopted and/or as amended by the local Municipality, and the Commonwealth of Pennsylvania, Pennsylvania Uniform Construction Code, Act 45, The International Code Council, International Building Code – 2021 and Chapter 11 of the IBC 2018.

10.15 This Project falls under the Commonwealth of Pennsylvania Public Works Employment Verification Act, Act 127 of 2012, 43 P.S. § 167.1, which requires all public work contractors and subcontractors to utilize the Federal Government's E-Verify system to ensure that all employees performing work on public work projects are authorized to work in the United States. All Bidders are required to submit a Public Works Employment Verification Form as a precondition for the Contract Award.

10.16 The "Bid Bond," A.I.A. Document No. A310, of the American Institute of Architects, 2010 Edition, is hereby made a part of the Specifications as bound herein. The Bond is subject to all modifications as set forth hereinafter.

10.16.1 A bank cashier's, bank treasurer's certified check or bid bond in favor of Berks County in the amount of 10% of all base bids plus the amount of all add alternates, is required from each bidder and must be submitted electronically with the bid. It is understood the Bid Deposit will be forfeited to and retained by the owner as liquidated damages if the Proposal, or any part thereof, is accepted by the Owner and the Bidder fails to execute the contract and furnish Bonds within ten (10) days from the date of "Notice of Award". Should the owner fail to make any awards through no fault or failures on the part of the bidders, the Owner shall return said Bid Deposits.

10.16.2 Agreement of Surety: The "Agreement of Surety" form is to be provided to the Owner along with the bid proposal should the bid deposit submitted be other than a "Bid Bond". Attached is a 1-page sample letter to be signed and sealed from a corporate surety agreeing to provide a Performance Bond and Payment Bond in favor of the Owner as required for faithful performance and proper fulfillment of the contract. The Agreement is subject to all modifications as set forth hereinafter.

10.16.3 Non-Collusion Affidavit: The "Non-Collusion Affidavit" form is to be provided to the Owner along with the bid proposal by all prospective bidders. Attached is a document to be signed by all prospective bidders and sealed by notary, assuring the owner that the proposal for work is being submitted in good faith and without collusion with any other contractors or sub-contractors. The Affidavit is subject to all modifications as set forth hereinafter.

10.17 Non-Discrimination Clause: The "Non-Discrimination Clause" form is to be provided to the Owner along with the bid proposal by all prospective bidders. Attached is a document to be signed by all prospective bidders, assuring the owner that the proposal for work is being submitted in good faith and without collusion with any other contractors or subcontractors. The Clause is subject to all modifications as set forth hereinafter.

10.18 Performance and Payment Bonds: The "Performance Bond" and the "Payment Bond," A.I.A. Documents No. A312-2010, of the American Institute of Architects, are hereby made a part of the Specifications as bound herein. The Bonds are subject to all modifications as set forth hereinafter.

10.19 Maintenance Bond – the execution of a maintenance bond is required, per **Section 00 1930.**

10.20 CONTRACTOR'S QUALIFICATION STATEMENT

10.20.1 Each Bidder is required to submit a Contractor's Qualification Statement (AIA A305-2020) with a sworn statement of his financial responsibility, technical qualifications and evidence that he has completed at least Five similar construction contracts within the last five (5) years, each with a minimum value of 75% of the total amount of the proposal submitted. In addition, the designated Project Manager and Superintendent must have at least ten (10) years' experience in similar projects with similar values and phased construction. The Owner /CM has the right to reject a Project Manager or Superintendent if they do not specifically meet the qualifications.

10.21 REJECTION OR WITHDRAWAL OF PROPOSALS

10.21.1 A bidder on any Prime Contract may withdraw his bid from consideration within forty-eight (48) hours of the bid opening without forfeiture of the certified check, bank cashier's check, surety bid bond or other security filed with the bid if the price bid was submitted in good faith, and the bidder submits credible evidence that the reason for the price bid being substantially lower was a clerical mistake as opposed to a judgment mistake, and was actually due to an unintentional and substantial arithmetical error or an unintentional omission of a substantial quantity of work, labor, material or services made directly in compilation of the bid; provided, 1.) the mistake or error must be proven and submitted to the Owner / CM for review and approval: 2.) notice of a claim of the right to withdraw such bid is made in writing with the contracting body within two business days after the opening of bids; and 3.) the withdrawal of the bid would not result in the awarding of the contract on another bid of the same bidder, his partner, or to a corporation or business venture owned by or in which he has a substantial interest.. No bidder who is permitted to withdraw a bid shall supply any material or labor or perform any subcontract or other work on the project without written approval of the contracting body. No accepted bid may be withdrawn for ninety (90) calendar days after the Bid Opening. Initial determination as to whether there was a clerical mistake or arithmetical error or unintentional omission of substantial quantity of work, labor, material, or services will be within the discretion of the Architect, a representative of the Owner, with the assistance of the Construction Manager, and such decision shall be considered final and determinative.

10.21.2 The Township reserves the right to reject any bid received if the bidder's responses to the Contractor's Qualification Statement (AIA Document A305) fail to satisfy the Township that such bidder is qualified to carry out the obligations of the Contract and to complete work, as specified. By way of specific example, a default in a contract in the last five years will, absent extraordinary justification, disqualify a bidder, as will litigation on a construction

contract which, in the past five years, resulted in an award against the interest of the bidder.

10.22 PA PREVAILING WAGE

10.22.1 The Schedule of Minimum Wages as determined by the Department of Labor and Industry, Commonwealth of Pennsylvania, is hereby made a part of this Specification. A copy of these rates is attached in Section 007343 Prevailing Wage Requirements.

10.22.2 Copies of these forms may be obtained from the Prevailing Wage Division. The Project is subject to the Pennsylvania Prevailing Wage Act (Act of 1961, P.L. 987 No. 442) as amended. The pages titled, "Duties of Awarding Agencies Under Pennsylvania Prevailing Wage Act" may be obtained from the Prevailing Wage Division. These duties include requirements of both the awarding agency (Owner), the Contractor(s) and Subcontractors. It is understood that the Owner will comply with its required duties. The Contractor(s) and Subcontractors shall comply with all duties and instructions required of them. All items mentioned as "contract requirements" in the documents are hereby made a part of the contract to the same extent as if included in the Owner-Contractor Agreement.

10.22.3 "Payroll Certification for Public Works Projects". All Contractors and Subcontractors shall complete this form for each week worked on this project. Each Weekly Payroll Certification form shall be Notarized and forwarded to the Construction Manager for inclusion in the Owner's records. Payroll Certification Forms covering work periods included in an application for payment shall be submitted before or with the respective Application For Payment. If the certifications Forms are not submitted with the Application for Payments, the Owner will withhold payment until received.

10.22.4 US Steel Act 132. The Steel Products Procurement Act, 73 P.S. §§1881-1887, and the Trade Practices Act, 71 P.S. §773.101 et seq.

10.22.4.1 If any steel products are to be used or supplied in the performance of the Contract, only steel products produced in the United States shall be used or supplied in the performance of the Contract or any subcontract thereunder. This provision shall not apply in any case where the head of the public agency, in writing, determines that the type of steel products necessary to the performance of the Contract are not produced in the United States in sufficient quantities to meet the requirement of the Contract.

10.22.4.2 Contractors must ensure compliance with all provisions of the above which place restrictions upon the source of certain steel, cast iron and aluminum products allowed to be used in the performance of public agency contracts. The provisions of the above sited statutes are incorporated herein as if the same were set out at length herein.

10.22.4.3 Bidding will be public and utilize Pennsylvania State Prevailing Wage Rates established by the Commonwealth of PA Department of Labor and Industry.

11. INDEMNITY

11.1 The undersigned shall indemnify and hold harmless Exeter Township, Boyle Construction, Inc., Manns Woodward Studios and Herbert, Rowland & Grubic, Inc., all consultants and each officer and employees, with respect to any claims, losses, expenses, costs and reasonable attorney's fees incurred by Exeter Township, Boyle Construction, Inc., Manns Woodward Studios and Herbert, Rowland & Grubic, Inc., all consultants and each officer and employees, with regard to the undersigned's failure to comply with these Bid Documents and procedures.

11.2. Additional Insureds: All shall be named as "Additional Insureds" under all policies of insurances. Coverage shall be primary and non-contributory.
1. Exeter Township - its members, officers, employees and consultants.
2. Boyle Construction, Inc., Manns Woodward Studios, and Herbert, Rowland & Grubic, Inc. - and their members, officers, employees and consultants.
3. The Commonwealth of Pennsylvania.

12. Extra Work – No extra work will be considered unless the Exeter Township authorizes such work, in advance, in writing.

13. Safety and Health Regulations – The Bidder further agrees that should he enter into a Contract with the Exeter Township to perform all or any portion of the work included herein, he will comply with all the provisions of the Department of Labor, Occupational Safety and Health Administration, Safety and Health Regulations for Construction, contained in the Federal Register Volume 37, Number 243, Part II, dated Saturday, December 16, 1972.

14. SPECIFICATION AND PRODUCT DESCRIPTION

14.1 Substitute Material and Equipment – Proposal shall include furnishing and installing material in strict accordance with Contract Documents. No substitutions or deviations will be considered except as provided for in Contract Documents

14.2 Any product substitution requests must be made in writing including all product literature and specification at least ten (10) calendar days prior to the bid due date.

15. This project is financed by Exeter Township.

16. OPENING OF PROPOSALS

16.1 The Owner will, as soon as practical, award the Contracts to the Bidders, and shall have the right to reject any or all Bids, to waive technical defects, and to accept or reject any part of any Bid if in the judgment of the Owner its best interest shall be served by such action; and the Bidder, in submitting a Bid accepts these conditions. No rights shall accrue to any person submitting a Bid or Proposal until such Bid has been accepted, and a

contract awarded, and such contract completely executed in writing by both parties.

17. AWARD OF CONTRACT

17.1 The Owner's intent is to enter into Contracts with the lowest responsible and qualified Bidders.

17.2 The Owner reserves the right to reject any and all bids. The Owner reserves the right to waive non-material defects, informalities or technicalities in any Bid in accordance with law. The Owner reserves the right to disregard all nonconforming, non-responsive, unbalanced, or conditional bids. Also, Owner reserves the right to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive, or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the Bidding Documents.

17.3 In evaluating Bids, Owner will consider the qualifications of such Bidders (see Article 3), whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

17.4 Owner may consider the qualifications and experience of Subcontractors, suppliers, and other persons or organizations proposed for any portions of the Work requested by Owner. Owner also may consider the operating costs, maintenance requirements, performance data, and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

17.5 Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualification, and financial ability of Bidders, subcontractors, suppliers, and other persons or organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

17.6 If the Contract is to be awarded, Owner will give the Successful Bidder a Notice of Intent to Award within sixty (60) days after the day of Bid opening unless extended as set forth in these Instructions to Bidders.

17.7 The Owner reserves the right to waive non-material defects, informalities, or technicalities in any Bid in accordance with the law.

18. CONTRACT SECURITY & INSURANCE

18.1 The General Conditions set forth the Owner's requirements as to Performance Bonds, Payment Bonds, and insurance requirements.

18.2 The apparent low Bidder must provide Payment and Performance Bonds in the forms included in the Contract Documents and all Certificates of Insurance or other insurance information as required pursuant to the General Conditions of the Contract within ten (10) days of the issuance of Notice of Intent to Award. **Other bond forms will not be accepted**. Failure of the apparent low Bidder to provide original executed Payment and Performance Bonds in the required form within the required time will result in forfeiture of the Bid Security.

19. SIGNING OF AGREEMENT

When Owner/Construction Manager issues a Notice of Intent to Award to the Successful Bidder, the Successful Bidder shall within ten (10) days thereafter, deliver to the Owner/Construction Manager, One (1) original copy of the required bonds, insurance certificates, and any other documents that may be requested with the Notice of Intent to Award. Within ten (10) days thereafter, the Construction Manager will send contract agreements via DocuSign to Successful Bidder. The Successful Bidder shall sign the agreements and DocuSign will automatically send the agreements to the Owner for signature. Once signed by the Owner DocuSign will automatically return an executed agreement to all parties.

20. RETAINAGE

See Section 5.1.7 of the Agreement (AIA A132-2019) and Article 9 of the General Conditions.

21. PREVAILING WAGES

Pennsylvania Prevailing wage rates will apply to this project. The Contractor and its subcontractors shall comply with the provisions, duties, obligations, remedies, and penalties of the Pennsylvania Prevailing Wage Act, 43 P.S. § 165-1 et seq. which is incorporated herein by reference as if fully set forth herein. The general prevailing minimum wage rates, as determined by the Secretary of Labor and Industry shall be paid for each craft or classification of all workmen needed to perform work on the Project during the term hereof for the locality in which the work is to be performed.

22. COMPETENT WORKMEN

No person shall be employed to perform any work under the Contract if they are not legally eligible to be employed under applicable state and federal law or if they are not a trained, competent workman, or mechanic, as applicable. For purposes of this Section, no workman or mechanic, as applicable, shall be regarded as competent unless he shall be duly skilled in the applicable branch of labor, and paid the applicable prevailing wage.

22.1 The Commonwealth of Pennsylvania enacted Act 127 of 2012, known as the Public Works Employment Verification Act ('the Act') which requires all public work contractors and subcontractors to utilize the Federal Government's E-Verify system to ensure that all

employees performing work on public work projects are authorized to work in the United States. The Contractor and its Subcontractor (as such term is defined in the Act) are required to comply with the Act and the Statement of Policy as published in the Pennsylvania Bulletin, December 29, 2012, and effective January 1, 2013.

23. EROSION CONTROL

The Successful Bidders shall comply with all rules and regulations of Chapter 102, Title 25 of Pennsylvania Code, relating to Soil Erosion and Sedimentation Control.

24. PUBLIC WORKS CONSTRUCTION CONTRACTS

In consideration of the funds awarded and activities funded under the Contract which involves construction, reconstruction, alteration, repair, improvement, or maintenance of a building, structure, or improvement ("The Work"), the Successful Bidder agrees to perform in accordance with the following:

24.1 Steel Products Procurement Act.

24.2 Trade Practices Act.

24.3 Public Works Contractor's Bond Law of 1967. Prior to the award of any Contract for any Work on the Project, the contractor to whom the contract is to be awarded must furnish the following bonds which shall become binding upon the award of such Contract:

24.3.1 A performance bond at 100 percent of the Contract Sum, conditioned upon the faithful performance of the Contract in accordance with the plans, specifications, and conditions of the Contract. Such bond shall solely for the protection of the Owner which awarded said contract.

24.3.2 A payment bond at 100 percent of the Contract Sum. Such bond shall be solely for the protection of claimants supplying labor or materials to the Successful Bidder, its contractor(s) or to any of its Subcontractors, in the prosecution of the work provided for in such Contract and shall be conditioned for the prompt payment of all such material furnished or labor supplied or performed in the prosecution of the Work. "Labor or materials" shall include public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the site.

24.3.3 Reference Article 11.1.2 of the General Conditions for additional requirements.

25. SEVERABILITY

25.1 Should any section or any part of any section of the Contract be rendered void, invalid, or unenforceable by any court of law, for any reason, such a determination shall not render void, invalid, or unenforceable any other section or part of any section of the Contract.

26. AMERICANS WITH DISABILITIES ACT

During the term of this Contract, the Successful Bidder agrees as follows:

26.1 Pursuant to federal regulations promulgated under the authority of The Americans with Disabilities Act, 28 C.F.R. § 35.101 et. Seq., the Successful Bidder understands and agrees that no individual with a disability shall, on the basis of the disability, be excluded from participation in this Contract or from activities provided for under this Contract. As a condition of accepting and executing the Contract, the Successful Bidder agrees to comply with the General Prohibitions Against Discrimination, 28 C.F.R. § 35.130, and all other regulations promulgated under Title II of The Americans with Disabilities Act which are applicable to all benefits, services, programs, and activities provided by the Commonwealth of Pennsylvania through contracts.

27. HEALTH AND SAFETY

27.1 Reference Article 10 of the General Conditions.

28. BONDS & INSURANCE

28.1 The Bidder will be required to furnish a Bid Bond, Performance Bond, and Labor and Material Payment Bonds in the amount of one hundred percent (100%) of the Contract Price in the form provided in the Contract Documents. Said Sureties shall be listed on the current Federal Register and have an AM Best rating of 'A-' or better and a financial rating of Class X or higher.

28.2 Insurance companies must be rated 'A-' or better in A.M. Best.

28.3 Bidder shall include the cost of the Bonds & Insurance in their Bid.

28.4 Bidder shall provide the insurance required in the General Conditions.

29. PRE-BID CONFERENCE

29.1 The Mandatory Pre-bid Conference will be held on the date and time listed in the Advertisement for Bids. Representatives of Owner, Construction Manager (CM), Architect and Civil Engineer will be present to discuss the Project. CM will transmit to all prospective Bidders of record such Addenda, as CM considers necessary in response to questions arising at the Conference. **Non-attendees will <u>no</u>t be permitted to bid.**

30. PROJECT FINANCING

The Work to be done under the Contract is public work and may be financed in whole or part by the Owner (a public body) by issuance of bonds, which are subject to various qualifications and restrictions. The Owner, in such case and in good faith, intends to consummate such financing, but its ability to do so is subject to many factors beyond its control. It is therefore expressly understood and agreed to by each Bidder that, notwithstanding any other provision of the Contract Documents, the Owner may at any time cancel any award made by it, or cancel any contract entered into with any Bidder, without liability to the Bidder, at any time before the Bidder has been given written notice to proceed and has actually begun Work under the Contract if financing satisfactory to the Owner cannot reasonably be consummated as contemplated, or if any court of competent jurisdiction shall enjoin or otherwise prohibit the Owner from proceeding with the Work.

30.1 The Work to be done under the Contract is funded in part by a Redevelopment Assistance Capital Program (RACP) Grant from the Commonwealth of Pennsylvania, Office of the Budget. Bidders are notified that Projects funded by state funds are subject to various qualifications, restrictions, and special requirements.

31. FAILURE TO EXECUTE CONTRACT

Failure of the Successful Bidder to whom Notice of Intent to Award has been given to deliver appropriate Payment and Performance Bonds, Certificates of Insurance, or execute the Contract within the time specified, shall constitute a default by such Bidder and the Owner may, at its sole discretion, award the contract to the next lowest responsive and responsible Bidder or re-advertise for Bids, and the defaulting Bidder shall pay to the Owner the difference between the amounts of his Bid and any higher amount for which the Owner may contract for the required work, plus any advertising, consulting, legal or other expenses incurred by reason of the default. The Bid Security of such defaulting Bidder shall be applied on account of said damages, and if the amount of said damages exceeds the amount of the Bid Security, the defaulting Bidder shall pay to the Owner the full amount of the excess.

END OF SECTION 00 1100

SECTION 00 7343 PREVAILING WAGE RATE REQUIREMENTS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Prevailing Wage Act.
2. Pennsylvania Prevailing Wage Determination Schedule follows as Section **007343.1**.
3. Pennsylvania Department of Labor and Industry "Weekly Payroll Certification for Public Works Projects" Form LLC-25 follows as Section **007343.2**

1.3 Prevailing Wage Rates

A. The provisions of the Pennsylvania Prevailing Wage Act, Act. No. 442, approved August 15, 1961 (P.L. 987) as amended are hereby incorporated herein and the Contractor and all Subcontractors shall comply with the requirements of the applicable portions thereof and the Regulations issued in connection therewith.

B. The Contractor assumes full and exclusive responsibility for compliance with the Prevailing Wage Act and all applicable laws, regulations, amendments, and supplemental acts, including, without limitation, Act 101 of 2026. Any costs, expenses, delays, disruptions, inefficiencies, or other impacts resulting from compliance with, interpretation of, or failure to comply with such requirements shall be borne solely by the Contractor. Under no circumstances shall the Owner be liable for, nor shall the Contractor be entitled to, any adjustment in the Contract Sum, additional compensation, extension of time, change order, claim, or other remedy arising out of or related to prevailing wage requirements.

C.. Pursuant to the requirements of the above Act, the Prevailing Minimum Wage Predetermination is attached hereto and hereby made part of the Contract Documents.

D. The general prevailing minimum wage rates including contributions for employee benefits as shall have been determined by the Secretary of Labor and Industry (hereinafter "Secretary"), which must be paid to the workmen, employed in the performance of the Contract.

E. All Prime Contractors shall submit electronic copies of weekly certification forms with their payment requisitions. The form to be used is the latest edition of the Department of Labor and Industry form "Contractor's or Subcontractor's Weekly Payroll Certification for Public Works Projects" form LLC-25 (2 pages).

F. There shall be paid each laborer or mechanic of the Contractor or Subcontractor engaged in the Work on this Project, in the trade or occupation listed on the attached Prevailing Minimum Wage Predetermination, not less than the hourly wage rate set opposite the same, regardless of any contractual relationship which may be alleged to exist between the Contractor, or any Subcontractor, and such laborers and mechanics.

G. These Contract provisions shall apply to all work performed on the Contract by the Contractor and to all work performed on the Contract by all subcontractors.

H. The Contractor shall insert in each of his subcontracts all of the stipulations contained in these required provisions.

I. No workmen may be employed on the Work except in accordance with the classifications set forth in the decision of the Secretary. In the event that additional or different classifications are necessary, the procedure set forth in the Regulations shall be followed.

J. All workmen employed or working on the Work shall be paid unconditionally, regardless of whether any contractual relationship exists or the contractual relationship which may be alleged to exist between any contractor, subcontractor, and workmen, not less than once a week without deductions or rebate, on any account, either directly or indirectly, except authorized deductions, the full amount due at the time of payment, computed at the rates applicable to the time worked in the appropriate classification. Nothing in this Contract, the Act or the Regulations shall prohibit the payment of more than the general prevailing minimum wage rates as determined by the Secretary to the workmen on the Work.

K. Each Prime Contractor or Subcontractor shall post the general prevailing minimum wage rates for each craft and classification involved, as determined by the Secretary of the Department of Labor and Industry, including the effective date of any changes thereof, in prominent and easily accessible places at the site of the work, or at such place or places as are used by them to pay the workmen their wages. The posted notice of wage rates must contain the following information:

1. Name of project.
2. Name of public body of which it is constructed.
3. The crafts and classifications of workmen listed in the Secretary's general prevailing minimum wage rate determination for the particular project.
4. The general prevailing minimum wage rates determined for each craft and classification and the effective date of any changes.
5. A statement advising workmen that if they have been paid less than the general prevailing minimum wage rate for their job classification or that the Contractor and/or subcontractor are not complying with the Act or the Regulations in any manner whatsoever, they may file a protest with the Secretary within three (3) months of the date of the occurrence, objecting to the payment to the Contractor to the extent of the amount or amounts due or to become due to them as wages for work performed on the Project. Any workmen paid less than the rate specified in the Contract shall have a civil right of action for the difference between the wage paid and wages stipulated in the Contract, which right of action must be exercised within six (6) months from the occurrence of the event creating such right.

L. The Contractor and all subcontractors shall keep an accurate record **showing the name, craft and/or classification, number of hours worked per day, and the actual hourly rate of wage paid (including**

employee benefits) to each workman employed by him in connection with the Work and such record must include any deductions from each workman. The record shall be preserved for two (2) years from the date of payment and shall open at all reasonable hours to the inspection of the Owner and to the Secretary or his duly authorized representative.

1. Apprentices shall be limited to such numbers as shall be in accordance with a bona fide apprenticeship program registered with and approved by the Pennsylvania Apprenticeship and Training Council and only apprentices whose training and employment are in full compliance with the provisions of the Apprenticeship and Training Act approved July 14, 1961 (Act No. 304) and the Rules and Regulation issued pursuant thereto shall be employed on the Work. Any workmen using the tools of a craft that does not qualify as an apprentice within the provisions of this submission shall be paid the rate predetermined for journeyman in that particular craft and/or classification.

M. Wages shall be paid without any deductions except authorized deductions. Employers not party to a contract requiring contributions for employee benefits which the Secretary has determined to be included in the general prevailing minimum wage rate shall pay the monetary equivalent thereof directly to the workman.

N. Payment of compensation to workmen for work performed on public work on a lump sum basis, or apiece work system, or a price certain for the completion of a certain amount of work, or the production of a certain result shall be deemed a violation of the Act and the Regulations, regardless of the average hourly earnings resulting therefrom.

O. Each Contractor and each subcontractor shall file a statement each week and a final statement at the conclusion of the Work on the Contract with Owner, under oath, and in form satisfactory to the Secretary, certifying that all workmen have been paid wages in strict conformity with the provisions of the Contract as prescribed by the Regulations, or if any wages remain unpaid, to the amount of wages due and owing to each workman respectively.

P. The provision of the Act and the Regulations are incorporated by reference in the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

A. Prevailing wage certification forms are to be produced weekly and are to be submitted monthly. Prevailing wage certificates are to be sent to CM with a pencil copy of the Application for Payment. No Applications for Payment will be processed without the proper prevailing wage certificates. Contractor may be requested to submit the prevailing wage certification forms in any of the following manners:

1. If hard paper copies are submitted, Contractor shall submit one (1) copy of each prevailing wage certification form.
2. If digital copies are submitted, Contractor shall submit to Architect and CM in PDF form.
3. Redacted certified payroll:

    a. Prevailing wage certification forms submitted to the Owner may not be redacted by law;

however, if there is a Project Right-to-Know request, the Contractor will be required to submit redacted prevailing wage certification forms **in addition** to the required unredacted forms. The following information may be redacted:

1) Employee Name
2) Employee Address
3) Employee Social Security Number

B. Contractor shall use the Commonwealth of Pennsylvania Department of Labor and Industry Form LLC-25 (2 pages) Form can be accessed at: http://www.dli.pa.gov/Individuals/Labor-Management-Relations/Documents/llc-25.pdf, as revised from time to time, and ensure proper classification of workmen are assigned to each person. Certificates must be filled out in their entirety. Form is included as Specification Section **007343.2.** Certified Payroll submitted on U.S. Wage and Hour Division forms are NOT accepted and will be returned to the Contractor.

C. Regardless of the submission type, the first and the final certification forms must be notarized, signed, and dated.

JBM MECHANICAL, INC. Mechanical Contractors
3273 Gun Club Road, Nazareth, PA 18064

To:	Boyle Construction	From:	Todd Shook
		Email:	tshook@jbmmechanical.com
Attn:	Chris Haller	Date:	
Email:	challer@boyleconstruction.com		
RFI #:		Pages:	2
Project:	Exeter Twsp Emergency	Cc:	

JBM Mechanical, Inc. requests clarification regarding the applicability of Pennsylvania Act 101 of 2026, formerly Senate Bill 908, which amends the Pennsylvania Prevailing Wage Act and is scheduled to become effective December 21, 2026. Act 101 expands Pennsylvania prevailing-wage requirements to certain off-site custom fabrication of nonstandard goods, materials, components, fixtures, assemblies and other items produced specifically for a public works project. This project is presently being bid prior to the December 21, 2026 effective date; however, contract award, contract execution, Notice to Proceed, procurement and/or actual fabrication of materials may occur after December 21, 2026. The current bid documents and prevailing-wage determination do not appear to clearly address how Act 101 is to be applied to projects bid prior to its effective date but awarded or performed after its effective date. This creates a significant bidding concern because subcontractors, fabricators and suppliers may incur substantial additional labor, payroll, administrative and compliance costs if Act 101 is determined to apply after bids have already been submitted.

Please clarify the following:

1. **Does the Owner/Design Team consider Act 101 of 2026 applicable to this project?**
2. If so, please identify the event or date that determines applicability, including whether applicability will be based upon:
    1. Project advertisement date
    2. Prevailing-wage determination date
    3. Bid date
    4. Contract award date
    5. Contract execution date
    6. Notice to Proceed date

7. Date the custom-fabrication subcontract or purchase order is issued
8. Date fabrication is performed
9. Another date established by the Pennsylvania Department of Labor & Industry.

3. If bids are received before December 21, 2026, but the contract is awarded or executed after December 21, 2026, are bidders required to include the additional costs associated with Act 101 in their base bids?
4. If Act 101 applies to this project, please provide through addendum the applicable revised Pennsylvania prevailing-wage determination and identify the classifications and wage/fringe rates that bidders are required to use for covered off-site custom fabrication.
5. Please identify which project materials, equipment, systems and assemblies the Owner/Design Professional considers subject to the new custom-fabrication requirements.
6. Please confirm that structural steel members and precast concrete remain excluded from the Act 101 custom-fabrication requirements.
7. If bidders are required to include Act 101 costs in the current bid, please issue this requirement by formal addendum and provide sufficient time prior to bid to allow subcontractors, suppliers and fabricators to obtain revised labor pricing and incorporate the new prevailing-wage, certified-payroll and administrative requirements into their quotations.
8. If the Owner determines after receipt of bids or after award that Act 101 applies to this project when such requirements were not included in the bid documents, please confirm that any resulting additional labor, fringe-benefit, payroll, administrative, subcontractor, supplier, fabrication, schedule or compliance costs will be treated as a change in the Contract requirements and an appropriate adjustment to the Contract Sum and Contract Time will be made.

JBM Mechanical, Inc. requests this clarification prior to bid so that all bidders may price the project on an equal basis and so that the bid accurately reflects the prevailing-wage requirements that will govern the Work.

Please provide clarification by Addendum prior to the bid date.

EXETER TOWNSHIP
NEW EMERGENCY SERVICES CENTER
PROPOSED ALTERNATES LIST
BOYLE PROJECT NO. 25051.01

11/2/2026

ALT #	DESCRIPTION	Site Contractor	General Construction	Mechanical Contractor	Electrical Contractor	Plumbing Contractor	Fire Protection Contractor
1	Increase warranties from one year to two years from the date of substantial completion (excludes landscaping)	X	X	X	X	X	X
2	Base bid Site is Classified. Alternate Bid Site is Unclassified	X	X				
3	Provide engineered structural fill or 2A modified stone in lieu of using on-site materials for all fills required below the bottom of subgrade stone for the entire building pad and up to 10' outside the new buildings exterior wall line as identified on the Special Excavation Plan. Under this alternate, the resulting excess soils are to be disposed of legally by the contractor off-site.	X	X	X	X	X	
4	Provide heavy duty PennDOT spec asphalt drive in lieu of concrete.	X					
5	Provide concrete filled permanent bollards in lieu of removable bollards	X					
6	Provide sod in lieu of seeded lawn in the areas shown on the drawings.	X					
7	Deduct the landscaping from the project. Plantings & Mulch.	X					
8A	Provide Four-Fold doors in lieu of Fully Glazed Sectional overhead doors of Apparatus Bay doors OHD1, OHD2, OHD3, OHD4, OHD5, OHD6, and OHD7.		X		X		
8B	Provide Fully Glazed Sectional overhead doors in lieu of Four-Fold doors of Apparatus Bay doors FFD1, FFD2, FFD3, FFD4, FFD5, FFD6, and FFD7.		X		X		
9	Provide Resinous floor finish and wall base in Corridor 106, Watch Office 111, Janitor 121, Kitchen & Day Room 122, and Laundry 125 in lieu of Base Bid Terrazzo floor and wall base.		X				
10	Provide Resinous floor finish and wall base in Corridor 145 and EMS Dayroom 146 in lieu of Base Bid Terrazzo floor finish and wall base.		X				
11	Provide 3" river stone in five (5) beds adjacent to the building in lieu of landscape and mulch. This includes soil sterilant and geotextile (class 2, Type B) fabric as specified.	X					
12	Provide Alternate Masonry and Metal Gate Dumpster Enclosure in liue of privacy slat style fence dumpster enclosure.		X				
13	Provide standard (91dBA) weather enclosure for the generatore in lieu of BOD Level 2 (74dBA) sound enclosure for the generator.				X		

SECTION 01 4533 - CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Code-required special inspections.

B. Testing services incidental to special inspections.

C. Submittals.

D. Manufacturers' field services.

E. Fabricators' field services.

1.2 DEFINITIONS

A. Code or Building Code: ICC (IBC), International Building Code, edition adopted by authority having jurisdiction at the time the Project was permitted, including applicable amendments and supplements without limitation, and specifically Chapter 17 - Special Inspections and Tests.

B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce site development, zoning, environmental, material, occupational, health, building, fire, and life safety code requirements of the permitting jurisdiction in which the Project is located.

C. NIST: National Institute of Standards and Technology.

D. Special Inspections and Tests: Inspections and testing of materials, installation, fabrication, erection, or placement of components and connections mandated by Building Code to safeguard public welfare.
   1. Special inspections and tests are separate from and independent of tests and inspections conducted by Owner or Contractor for purposes of quality assurance and contract administration.

1.3 REFERENCE STANDARDS

A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

B. IAS AC89 - Accreditation Criteria for Testing Laboratories.

C. IAS AC291 - Accreditation Criteria for Special Inspection Agencies AC291.

D. ICC (IBC) - International Building Code.

1.4 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
   1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
   2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

B. Special Inspection Agency Qualifications: Prior to start of work, Special Inspection Agency is required to:
   1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of deficiencies reported by the inspection.
   3. Submit certification that Special Inspection Agency is acceptable to AHJ.
   4. Submit documentation that Special Inspection Agency is accredited by IAS according to IAS AC291.

C. Testing Agency Qualifications: Prior to start of work, Testing Agency is required to:
   1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of deficiencies reported by the inspection.
   3. Submit certification that Testing Agency is acceptable to AHJ.
   4. Submit documentation that Testing Agency is accredited by IAS according to IAS AC89.

D. Smoke Control Testing Agency Qualifications: Submit prior to the start of work.
   1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit documentary evidence that agency has appropriate credentials and documented experience in fire protection engineering, mechanical engineering and HVAC air balancing.
   3. Submit certification that Testing Agency is acceptable to AHJ.
   4. Submit documentation that Testing Agency is accredited by IAS according to IAS AC89.

E. Manufacturer's Qualification Statement: When required by AHJ, submit documentation of manufacturing capability and quality control procedures. Include documentation of AHJ approval.

F. Fabricator's Qualification Statement: When required by AHJ, submit documentation of fabrication facilities and methods and quality control procedures. Include documentation of AHJ approval.

G. Special Inspection Reports: After each special inspection, Special Inspector is required to submit at least two copies of report; one to Architect and one to AHJ.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of Special Inspector.
      d. Date and time of special inspection.
      e. Identification of product and specifications section.

f. Location in the Project.
g. Type of special inspection.
h. Date of special inspection.
i. Results of special inspection.
j. Compliance with contract documents.

2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.

H. Fabricator Special Inspection Reports: After each special inspection of fabricated items at fabricator's facility, Special Inspector is required to submit report to Architect and to AHJ.
1. Include:
a. Date issued.
b. Project title and number.
c. Name of Special Inspector.
d. Date and time of special inspection.
e. Identification of fabricated item and specification section.
f. Location in the Project.
g. Results of special inspection.
h. Verification of fabrication and quality control procedures.
i. Compliance with contract documents.
j. Compliance with referenced standards.

I. Test Reports: After each test or inspection, Testing Agency is required to submit report to Architect and to AHJ.
1. Include:
a. Date issued.
b. Project title and number.
c. Name of inspector.
d. Date and time of sampling or inspection.
e. Identification of product and specifications section.
f. Location in the Project.
g. Type of test or inspection.
h. Date of test or inspection.
i. Results of test or inspection.
j. Compliance with contract documents.

J. Certificates: When required by AHJ, Special Inspector will submit certification by manufacturer, fabricator, and installation subcontractor to Architect and AHJ.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect and AHJ.

K. Fabricator's Inspection Reports: When required by AHJ, submit reports to Architect and AHJ.
1. Submit report in duplicate within 30 days of observation to Architect for information.

1.5 SPECIAL INSPECTION AND TESTING AGENCY

A. Contractor to employ services of Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by building code.

B. Special Inspection Agency may delegate to independent testing agency to perform testing and sampling associated with special inspections and required by building code.

C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of contract documents.

1.6 QUALITY ASSURANCE

A. Special Inspection Agency Qualifications:
1. Independent firm specializing in performing testing and inspections of the type specified in this section.
2. Accredited by IAS according to IAS AC291.

B. Testing Agency Qualifications:
1. Independent firm specializing in performing testing and inspections of the type specified in this section.
2. Accredited by IAS according to IAS AC89.

C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SPECIAL INSPECTIONS AND TESTING

A. The Code requires special inspections and testing of certain materials, components, assemblies, and connections used in constructing the project. Special inspections and testing will be performed in accordance with the Code.

B. Special inspections and testing will be performed in accordance with the Code for the following materials and project components:
1. Steel.
2. Concrete.
3. Masonry.
~~4. Wood.~~
~~5.~~4. Soils.
~~6. Driven deep foundations.~~
~~7. Cast-in-place deep foundations.~~
~~8. Helical pile foundations.~~
~~9.~~5. Vertical masonry foundation elements.
~~10.~~6. Fabricated items.
~~11.~~7. Mastic and intumescent fire-resistant coatings.

~~12. Exterior insulation and finish systems (EIFS).~~
~~13.~~8. Fire-resistant penetrations and joints.
~~14.~~9. Smoke control testing.
~~15.~~10. Seismic resistance.
~~16.~~11. Wind resistance.
~~17.~~12. Structural observations required by ICC (IBC) section 1704.6.
13. Special cases as determined by building official and required by ICC (IBC) section 1705.1.

~~18.~~C. Submit PA UCC-6 Special Inspections and Observations Statement form for each special inspection and test performed.

3.2 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

A. Special Inspection Agency shall:
1. Verify samples submitted by Contractor comply with the referenced standards and the approved Contract Documents.
2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
3. Perform specified sampling and testing of products in accordance with specified reference standards.
4. Ascertain compliance of materials and products with requirements of Contract Documents.
5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
6. Perform additional tests and inspections required by Architect.
7. Attend preconstruction meetings and progress meetings.
8. Submit reports of tests or inspections specified.

B. Limits on Special 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 duties of Contractor.
4. Agency has no authority to stop the work.

C. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

D. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.3 TESTING AGENCY DUTIES AND RESPONSIBILITIES

A. Testing Agency Duties:
1. Test samples submitted by Contractor.
2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
3. Perform specified sampling and testing of products in accordance with specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.

6. Perform additional tests and inspections required by Architect.
7. Attend preconstruction meetings and progress meetings.
8. Submit reports of tests or inspections specified.

B. Limits on Testing or 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 duties of Contractor.
4. Agency has no authority to stop the work.

C. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.

D. Contractor will pay for re-testing required because of non-compliance with specified requirements.

3.4 CONTRACTOR DUTIES AND RESPONSIBILITIES

A. Contractor Responsibilities, General:
1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
2. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
3. Provide incidental labor and facilities:
   a. To provide access to work to be tested or inspected.
   b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
   c. To facilitate tests or 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 or inspection services.
5. Retain special inspection records.

B. Contractor Responsibilities, Seismic Force-Resisting System, Designated Seismic System, and Seismic Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and Owner prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

C. Contractor Responsibilities, Wind Force-Resisting System and Wind Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and Owner prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

3.5 FABRICATORS' FIELD SERVICES

A. When required by AHJ or specified in individual specification sections, require fabricators to provide qualified staff personnel to observe site conditions, installation conditions, quality of workmanship, and start-up of equipment and systems and to initiate instructions when necessary.

B. Submit qualifications of observer to Architect 30 days in advance of required observations.
1. Observer subject to approval of Architect.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.6 ATTACHMENT

~~C.~~A. PA UCC-6 Special Inspections and Observations Statement.

END OF SECTION 01 4533

pennsylvania
DEPARTMENT OF LABOR & INDUSTRY
BUREAU OF OCCUPATIONAL & INDUSTRIAL SAFETY

File No.: _____
Permit No.: _____
Date: _____

Uniform Construction Code
SPECIAL INSPECTIONS AND OBSERVATIONS STATEMENT

This statement must accompany permit applications for all construction for which special inspections and observations are required in Chapter 17 of the ***International Building Code 2018*** *(IBC)*	
Project name: Exeter Township Emergency Services Center	
Project address: 70 Gibraltar Road, Read, PA 19606	
Owner: Exeter Township	Telephone: 610.779.5660

This is to certify that all the inspections and observations that I have checked on pages 2-3 **and** on page 4 of this statement are required for the project named above and will be performed by the designated individuals or firms. By signing this statement, I also acknowledge that:

- these inspections and observations must be performed by competent individuals in accordance with the requirements of the IBC Chapter 17 (as applicable) and that the construction work must comply with the department-approved plans and specifications and all applicable provisions of the uniform construction code;
- records of all required special inspections and testing observations (including any discrepancies and methods of correction of these discrepancies) will be retained and made available to department representatives, upon request; and,
- the final report section of this statement must be signed by me and a copy of this statement submitted to the department inspector, at the time that the final inspection is performed and before a certificate of occupancy is issued.



Affix Seal Here

David Woodward, NCARB, AIA, LEED AP
Name of Design Professional in Responsible Charge

Signature of Design Professional in Responsible Charge

RA405311
PA License Number

10 / 12 / 2026
Date signed (Month/day/year)

CHECK EACH THAT APPLIES	TYPE OF SPECIAL INSPECTION OR OBSERVATION	NAME AND ADDRESS OF INDIVIDUAL AND/OR FIRM PERFORMING INSPECTION OR OBSERVATION	CREDENTIALS (Enter acronym from page 4. If "Other," please specify special training or basis for competency to perform work.)
☒	**Inspection of Steel Construction Section 1705.2**		
☒	**Inspection of Concrete Construction Section 1705.3**		
☒	**Inspection of Masonry Construction Section 1705.4**		
☐	**Inspection of Wood Construction Section 1705.5**		
☒	**Inspection of Soil Conditions Section 1705.6**		
☐	**Inspection of Driven Deep Foundations Section 1705.7**		
☐	**Inspection of Cast-in-Place Deep Foundations Section 1705.8**		
☐	**Inspection of Helical Pile Foundations Section 1705.9**		

CHECK EACH THAT APPLIES	TYPE OF SPECIAL INSPECTION OR OBSERVATION	NAME AND ADDRESS OF INDIVIDUAL AND/OR FIRM PERFORMING INSPECTION OR OBSERVATION	CREDENTIALS (Enter acronym from page 4. If "Other," please specify special training or basis for competency to perform work.)
☐	**Inspection of Fabricated Items** **Section 1705.10**		
☐	**Inspection for Wind Resistance** **Section 1704.6; 1705.11**		
☐	**Inspection and Testing for Seismic Resistance** **Section 1704.6;1705.12;1705.13**		
☐	**Inspection of Sprayed Fire-Resistant Materials** **Section 1705.14**		
☐	**Inspection of Mastic and Intumescent Fire-Resistant Coatings** **Section 1705.15**		
☐	**Inspection of Exterior Insulation and Finish System (EIFS)** **Section 1705.16**		
☒	**Inspection of Fire-Resistant Penetrations and Joints** **Section 1705.17**		
☒	**Testing for Smoke Control** **Section 1705.18**		

FINAL REPORT

Required special inspections or observations:

- ☐ Inspection of Steel Construction
- ☐ Inspection of Concrete Construction
- ☐ Inspection of Masonry Construction
- ☐ Inspection of Wood Construction
- ☐ Inspection of Soil Conditions
- ☐ Inspection of Driven Deep Foundations
- ☐ Inspection of Cast-in-Place Deep Foundations
- ☐ Inspection of Helical Pile Foundations
- ☐ Inspection of Fabricated Items
- ☐ Inspection for Wind Resistance
- ☐ Inspection and Testing for Seismic Resistance
- ☐ Inspection of Sprayed Fire-Resistant Materials
- ☐ Inspection of Mastic and Intumescent Fire-Resistant Coatings
- ☐ Inspection of Exterior Insulation and Finish System (EIFS)
- ☐ Inspection of Fire-Resistant Penetrations and Joints
- ☐ Testing for Smoke Control

I certify that I have reviewed the report on each of the inspections or observations checked above. These reports indicate that the covered work is in compliance with the department-approved plans and specifications and all applicable provisions of the uniform construction code.

Signature of Design Professional in Responsible Charge:

_____

Date signed:

_____/_____/_____
(Day/month/year)

KEY for use in **CREDENTIALS** column:
(on pages 2, 3 and 4)

ACI	American concrete institute certified concrete field testing technician
AWS	American welding society certified welding inspector
ASNT	American society of non-destructive testing
AWCI	Association of wall and ceiling industries
MCA	Model code agency (ICC, BOCA, SBCCI, ICBO) special inspection certification
PA	Professional architect (currently licensed)
PE	Professional engineer (currently licensed)
OTHER	Specialized training coursework or other basis for competency deemed acceptable

Department of Labor & Industry | Bureau of Occupational & Industrial Safety | Building Plan Review Division
651 Boas Street | Room 1600 | Harrisburg, PA 17121-0750 | 717.787.3806 | Fax 717.783.5002 | www.dli.pa.gov

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Equal Opportunity Employer/Program

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
1. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
2. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following.
1. Admixtures:
2. Vapor retarders.
3. Curing materials.
4. Joint fillers.

B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Maximum w/cm.
4. Slump limit.
5. Air content.
6. Nominal maximum aggregate size.

C. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
a. Location of construction joints is subject to approval of the Architect.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
2. Admixtures.
3. Curing compounds.

4. Vapor retarders.
5. Joint-filler strips.

B. Material Test Reports: For the following, from a qualified testing agency:
1. Aggregates.
2. Admixtures:

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.
1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94 and ACI 301.

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Cementitious Materials:
1. Portland Cement: ASTM C150, Type I/II, gray.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C33, coarse aggregate or better, graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size: as noted in the structural drawings.

C. Air-Entraining Admixture: ASTM C260.

D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C494, Type B.

3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

E. Water and Water Used to Make Ice: ASTM C94, potable.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 CURING MATERIALS

In accordance with the structural general notes.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: As indicated on the drawings.

2.6 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
   1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash or Other Pozzolans: 25 percent by mass.
   2. Slag Cement: 50 percent by mass.
   3. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
   4. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
   1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete and concrete with a w/cm below 0.50.

2.7 CONCRETE MIXTURES

In accordance with the structural drawings.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94 and furnish batch ticket information.

PART 3 - EXECUTION

3.1 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
   3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.2 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
   1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
   2. Face laps away from exposed direction of concrete pour.
   3. Lap vapor retarder over footings not less than 6 inches, sealing vapor retarder to concrete.
   4. Lap joints 6 inches and seal with manufacturer's recommended tape.
   5. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
   6. Protect vapor retarder during placement of reinforcement and concrete.

3.3 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
   1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.

2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Dowel Plates: Install dowel plates at joints as indicated on Drawings.

3.4 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Before test sampling and placing concrete, water may be added at Project site, if approved by the Architect in writing, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.5 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:
   1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
      a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
      b. Remove projections larger than 1 inch.
      c. Tie holes do not require patching.
      d. Surface Tolerance: ACI 117 Class D.
      e. Apply to concrete surfaces not exposed to public view.
   2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
      a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
      b. Remove projections larger than 1/4 inch.
      c. Patch tie holes.
      d. Surface Tolerance: ACI 117 Class B.
      e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:
   1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
   2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.6 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:
   1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
   2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
   3. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes

C. Float Finish:
   1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
   2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
   3. Apply float finish to surfaces to receive trowel finish.

D. Trowel Finish:
   1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
   2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
   3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   4. Do not add water to concrete surface.

5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system
7. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases as indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4500 psi at 28 days.
4. 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 concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.8 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. In accordance with the structural general notes.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
1. Begin curing immediately after finishing concrete.
2. In accordance with the structural general notes.

3.9 TOLERANCES

A. Conform to ACI 117.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
a. Test reports to include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:
1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:
1. Verification of use of required design mixture.

2. Concrete placement, including conveying and depositing.
3. Curing procedures and maintenance of curing temperature.
4. Batch Plant Inspections: On a random basis, as determined by Architect.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 shall be performed in accordance with the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
      a. When frequency of testing provides 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:
      a. 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.
      b. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C231 pressure method, for normal-weight concrete;
      a. 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:
      a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C31:
      a. Cast and laboratory cure two sets of two cylinder specimens for each composite sample.
      b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C39.
      a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
      b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
      c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
   7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
   8. Strength of each concrete mixture will be satisfactory if every 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 if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
   9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
   10. Additional Tests:
      a. Testing and inspecting agency to 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 Architect.

b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.
   1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.11 PROTECTION

A. Protect concrete surfaces as follows:
   1. Protect from petroleum stains.
   2. Diaper hydraulic equipment used over concrete surfaces.
   3. Prohibit vehicles from interior concrete slabs.
   4. Prohibit use of pipe-cutting machinery over concrete surfaces.
   5. Prohibit placement of steel items on concrete surfaces.
   6. Prohibit use of acids or acidic detergents over concrete surfaces.
   7. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 03 3511 - CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface treatments.

B. Liquid densifiers and hardeners.

~~C. Dry shake hardeners.~~

~~D.~~C. Low-gloss sealer.

~~E.~~D. Slip-resistant coatings.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the work with concrete floor placement and concrete floor curing.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Instructions: Indicate manufacturer's installation instructions for preparation of substrate, application of finishing products, and requirements for protection of finished surface.

B. Manufacturer's qualification statement.

C. Installer's qualification statement.

D. Specimen warranty.

E. Field quality report.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

B. Executed warranty.

1.6 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 and approved by manufacturer.

1.7 MOCK-UPS

A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
   1. Use manufacturer's application instructions. Install with the same equipment, recommended surface preparation and application procedures planned for general application. Allow mockup to cure or dry 3 to 7 days before inspection.

B. Construct mock-ups of each exposed concrete floor finish indicated on drawings, 10 feet square.

C. Locate where directed.

D. Mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.9 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot 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 minimum.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Slip Resistance: Minimum Dynamic Coefficient of Friction (DCOF) of 0.42 per ASN A326.3.

2.2 SURFACE TREATMENTS

A. Troweling Aid, Densifier and Curing Agent: Liquid reactive colloidal silica-based topical treatment, spray-applied to wet concrete and floated or troweled into the surface.
   1. Product:
      a. Adhesives Technology Corp; SlabArmor Starter and Closer.
      b. Penetron; Peneseal FH-PS.
      c. or comparable product submitted for Architect's review.

2.3 DENSIFIERS AND HARDENERS

A. Liquid Densifier and Hardener: Penetrating chemical compound that reacts with concrete, filling the pores, hardening, and dustproofing. Contractor to select most appropriate system to suit type of cement blend in concrete. As indicated on Structural Contract Documents.

~~1. Composition: Lithium silicate.~~
~~a. Products:~~
~~1) Adhesives Technology Corporation; CONVERGENT Pentra-Sil (244+)~~
~~2) Concrete Sealers USA; PS103.~~
~~3) Kaufman Products Inc; SureHard LS.~~
~~4) PROSOCO, Inc; Consolideck LS.~~
~~5) W. R. Meadows, Inc; Liqui-Hard Ultra.~~
~~2. Composition: Sodium silicate.~~
~~a. Products:~~
~~1) Curecrete Distribution, Inc; Ashford Formula.~~
~~2) Euclid Chemical Company; EUCOSIL.~~
~~3) Kaufman Products Inc; SureHard.~~
~~4) W. R. Meadows, Inc; Liqui-Hard.~~
~~3. Composition: Hybrid silicate/Silicate Blend.~~
~~a. Products:~~
~~1) PROSOCO, Inc; Consolideck BD1~~
~~2) or comparable product submitted for Architect's review.~~

~~B. Dry Shake Hardener: Premixed dry powder for spreading on and working into concrete surface prior to set.~~
~~1. Composition: Metallic, aluminum oxide (emery) aggregate.~~
~~a. Products:~~
~~1) Dayton Superior; Emery Tuff.~~
~~2) L&M Construction Chemicals, Inc; EMERYPLATE FF.~~
~~3) Sika USA; EmeriCrete SH.~~
~~4) or comparable product submitted for Architect's review.~~

2.4 COATINGS

A. Low-Gloss or Matte Clear Coating: Transparent, nonyellowing, acrylic-polymer-based coating.
1. Composition: Water-based urethane.
a. Nonvolatile Content: 20 percent, minimum, when measured by volume.
b. Basis-of-Design Product: Concrete Sealers USA; TS210 or provide one of the following comparable products:
1) EZChem USA; Water Based Urethane.
2) Foundation Armor; UTX60 - Matte.

B. Slip-Resistant Coating:
1. Plastic Aggregate: Finely ground polymer for addition to coatings for slip resistance.
a. Products:
1) Kaufman Products, Inc; SureGrip.
2) Euclid Chemical Company; EUCO GRIP.
3) SpecChem, LLC; Surface Grip.

4) Or comparable product recommended by floor coating manufacturer.

PART 3 EXECUTION

3.1 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.

3.2 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.3 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.

3.4 PROTECTION

A. Protect installed coatings from subsequent construction operations.

B. Do not permit traffic over unprotected floor surface.

3.5 FIELD QUALITY CONTROL

A. Defective Concrete: Repair or replace concrete not complying with required lines, details, dimensions, tolerances, or specified requirements at no additional cost to Owner.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Verify compliance of slip resistance to comply with specified slip-resistance rating.
1. Perform dynamic testing per ASTM E303.
2. Perform testing at 3 locations; perform one test each on stairs and landing (2) at Training Tower and at mechanical room (1).

D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.6 APPLICATIONS

A. Unless otherwise indicated on drawings, finish concrete floors using troweling aid, densifier, and curing agent.

B. Densifier and Hardener: As indicated on Structural.
1. ~~Use at the following locations: Typical Concrete Floors.~~

~~C. Dry Shake Hardener:~~
~~1. Use at the following locations: At Apparatus Bays.~~

~~D.~~C. Low-Gloss Clear Coating:
1. Use at the following locations: at locations indicated to receive SC-1.

~~E.~~D. Slip-Resistant Coating: Finely-ground aggregates added to coatings.
1. Use at the following locations: at locations indicated to receive SC-1.

END OF SECTION 03 3511

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SECTION 04 0511 - MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mortar for masonry.

B. Grout for masonry.

1.2 ACTION SUBMITTALS

A. Product Data:
1. For each type of product.
2. For each type of mortar and grout, include description of design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.

B. Samples: Submit two samples of each pigmented and color-aggregate mortar, illustrating mortar color and color range. Make samples using same sand and mortar ingredients to be used on Project.

1.3 INFORMATIONAL SUBMITTALS

A. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.

B. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's Installation Instructions: Submit packaged dry mortar manufacturer's installation instructions.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

F. Cold-Weather and Hot Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements. It is the Contractors responsibility to determine sequence of Work and project schedule. As such it is the Contractors responsibility to provide within their work scope cold weather and/or hot weather procedures as required to complete the Work within the approved schedule.

1.4 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
1. Maintain one copy of each document on project site.

1.5 PRECONSTRUCTION TESTING

A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 4000 - Quality Requirements.

B. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.
1. Test results will be used to establish optimum mortar proportions and establish quality control values for construction testing.

C. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.
1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials on elevated platforms, under cover, and in dry location. Do not use cementitious materials that have become damp or wet.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver preblended, dry mortar mix in moisture resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

D. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.7 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.
1. Do not use frozen materials or materials mixed or coated with ice of frost.
2. Do not build on frozen substrates.
3. Cold weather cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less then seven days after completing cleaning.

PART 2 PRODUCTS

2.1 MORTAR AND GROUT APPLICATIONS

A. Use factory premixed packaged dry materials for mortar and grout, with addition of water at project site.
1. Exception: If a specified mix design is not available in a premixed dry package, provide equivalent mix design using standard non-premixed materials.

B. Mortar Color for Hidden Masonry Applications: Natural gray unless otherwise indicated.

C. Mortar Color for Exposed Masonry Applications: Use pigmented mortar to produce color required.

D. Mortar Mix Designs: ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. Masonry below grade and in contact with earth: Type S.
2. Exterior Masonry Veneer: Type N.
3. Exterior Cavity Walls: Type S mortar with Type N pointing mortar.
4. Exterior, Loadbearing Masonry: Type N.
5. Exterior, Non-loadbearing Masonry: Type N.
6. Interior, Loadbearing Masonry: Type N.
7. Interior, Non-loadbearing Masonry: Type N; Type O may be used

E. Grout Mix Designs:
1. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
   a. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
   b. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.2 MATERIALS

A. Packaged Dry Material for Mortar for Unit Masonry: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
1. Type: Types as scheduled in this section.
2. Exposed Mortar Color: Mineral pigments added as required to produce approved color sample.
3. Water repellent mortar for use with water repellent masonry units.
4. Basis-of-Design Product:
   a. SPEC MIX, LLC; SPEC MIX Masonry Cement & Sand mortar or comparable product by one of the following:
      1) Lafarge North America.
      2) QUIKRETE.
      3) or submit comparable product for Architect's review.

B. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
1. Type: Use grout of type indicated, or if not indicated, of type (fine or course) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.
3. Manufacturers: Provide products complying with requirements including, but are not limited to, the following:
   a. Amerimix.
   b. Lafarge North America.
   c. Spec Mix, LL
   d. QUIKRETE.

C. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Color(s): As indicated on drawings.

2. Manufacturers: Provide products complying with requirements, from one of the following manufacturers.
   a. Davis Colors; True Tone Mortar Colors.
   b. Lambert Corporation; Mortar Color.
   c. Solomon Colors; SGS Mortar Colors.

D. Water: Clean and potable.

E. Admixtures
1. Cold Weather Accelerating Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
2. Bonding Agent: Epoxy type.
3. Integral Water Repellent Admixture: Polymeric liquid admixture added to mortar at the time of manufacture.
   a. Performance of Mortar with Integral Water Repellent:
      1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours:
         a) No water visible on back of wall above flashing at the end of 24 hours.
         b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
         c) No more than 25 percent of wall area above flashing visibly damp at end of test.
      2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
      3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
   b. Use only in combination with masonry units produced with integral water repellent admixture.
   c. Product: Subject to compliance with requirements, provide one of the following or comparable product by another manufacturer.
      1) ACM Chemistries; RainBloc for Mortar.
      2) Master Builders Solutions; MasterPel 240MA.
      3) GCP Applied Technologies.; Dry-Block Mortar.

2.3 MORTAR MIXING

A. Thoroughly mix mortar ingredients in accordance with ASTM C270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio; mix in accordance with manufacturer's instructions, uniform in coloration.

D. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

E. Do not use anti-freeze compounds to lower the freezing point of mortar.

F. If water is lost by evaporation, re-temper only within two hours of mixing.

2.4 GROUT MIXING

A. Mix grout in accordance with ASTM C94/C94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

D. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 EXECUTION

3.1 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

3.2 INSTALLATION

A. Install mortar and grout to requirements of section(s) in which masonry is specified.

B. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

3.3 GROUTING

A. Perform all grouting by means of low-lift technique. Do not employ high-lift grouting.

B. Low-Lift Grouting:
1. Limit height of pours to 60 inches.
2. Limit height of masonry to 16 inches above each pour.
3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

3.4 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense. Perform field tests, in accordance with provisions of Section 01 4000 - Quality Requirements.

B. Inspections: Special inspections according to Level ~~C~~ 3 in TMS 402~~/ACI 530/ASCE 5.~~.
1. Begin masonry construction only after inspectors have verified proportions of prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of prepared

C. Test and evaluate mortar in accordance with ASTM C780 procedures.
1. Test Prior to Construction: One set of tests.
2. Test Frequency: Once set of tests for each 5000 s.f. of wall area or portion thereof.

3. Test with same frequency as specified for masonry units.

D. Test and evaluate grout in accordance with ASTM C1019 procedures.
   1. Test with same frequency as specified for masonry units.

END OF SECTION 04 0511

SECTION 04 2000 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete block.

B. Clay facing brick.

C. Mortar and grout.

D. Reinforcement and anchorage.

E. Flashings.

F. Lintels.

G. Accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.3 ACTION SUBMITTALS

A. Product Data: Provide data for each product type including, but not limited to, masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.
1. Masonry Units: Indicate sizes (dimensions), profiles, coursing, and locations of special shapes.
2. Indicate anchorage, size and type of fasteners
3. Reinforcing Steel: Detail bending, laps, lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
5. Indicate locations of expansion and control joints on elevations where elevation of walls is provided within Contract Documents. Otherwise show locations of joints on plans.

C. Delegated Design Submittals: For masonry anchors and ties, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
1. Initial Samples:
   a. Masonry Units: Submit, in the form of small scale samples, two samples of decorative block units for initial selection verification.

b. Colored Mortar: Submit two color sample selection kits.
c. Weep Vents: Submit color selection kit/ring.

2. Final Sample Verification: provide Sample panel per Mockups article.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate:
1. Certify that masonry units meet or exceed specified requirements.
2. Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
3. Cementitious Materials: Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirements.

C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

D. Cold-Weather and Hot Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements. It is the Contractors responsibility to determine sequence of Work and project schedule. As such it is the Contractors responsibility to provide within their work scope cold weather and/or hot weather procedures as required to complete the Work within the approved schedule.

E. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

F. Designer's Qualification Statement.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
1. Maintain one copy of each document on project site.

B. Fire Rated Assemblies: Comply with requirements for fire resistance rated assembly designs indicated within Contract Documents.

C. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

D. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

E. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

F. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

1.6 MOCK-UPS AND SAMPLE PANELS

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects.
1. Build panels for each exposed unit masonry construction in sizes approximately 72 inches square by full thickness.
2. Build panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface being matched.

B. Mock-up Assemblies: Build Mock-up assemblies to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mock-up assemblies for typical exterior and interior walls in sizes approximately 72 inches wide by 72 inches high by full thickness of wall assembly, including face and back up wythes and accessories.
   a. Include sealant- filled joint at least 16 inches long in each mock-up.
   b. Include preformed expansion joint splitting entire wall assembly mock-up.
   c. Include lower corner of window opening at upper corner of exterior wall mock-up. Make opening approximately 12 inches wide by 16 inches high.
   d. Include through-wall flashing installed for 24-inch length in corner of exterior wall mock-up assembly, with a 12 inch length of flashing left exposed to view (omit masonry above half of flashing.)

C. Protect accepted sample panels and mock-up assemblies with weather resistant membrane.

D. Approval of sample panels and mock-up assemblies is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities to be specifically approved by Architect
1. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
1. Store on elevated platform in dry location.
2. Cover units to prevent soiling or becoming wet; If units become wet, dry before installation.

B. Handle and store decorative masonry units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

C. Pre-blended, dry mortar mixes: deliver pre-blended, dry mortar mix in moisture resistant containers. Store pre-blended, dry mortar mix in delivery containers on elevated platforms in dry location or in covered weatherproof dispensing silos.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Installed Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings
   4. Turn scaffold boards neat wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
   1. Cold Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design masonry anchors and ties.

B. Seismic Performance: Masonry to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
1. Where fire-resistance-rated construction is indicated, units are listed by UL or a qualified testing agency acceptable to authorities having jurisdiction.

2.3 CONCRETE MASONRY UNITS

A. Concrete Block, General: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
2. Special Shapes: Provide nonstandard blocks with exposed surfaces matching exposed faces of adjacent units and configured for corners, lintels, headers, jambs, sashes, control joint edges, bonding, and other detailed conditions.
    a. Provide bullnose units for outside corners of units with interior exposed corners unless otherwise indicated.
3. Integral Water Repellent: Provide units with integral water repellent that are visible and are exposed to weather/weathering (exterior units) and direct water contact (interior units). Interior units that are subject to direct water contact are exposed masonry units located within apparatus or vehicle bays, sally ports, areas of detention, kitchens, equipment/utility service areas, janitorial, toilet/shower rooms, locker rooms, storage, and other similar rooms/areas.
    a. Polymeric liquid admixture added to concrete masonry units at time of manufacture.
    b. Performance of Units with Integral Water Repellent:
        1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
            a) No water visible on back of wall above flashing at the end of 24 hours.
            b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
            c) No more than 25 percent of wall area above flashing visibly damp at end of test.
        2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
        3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
    c. Use only in combination with mortar that also has integral water repellent admixture.
    d. Use water repellent admixtures for masonry units and mortar by a single manufacturer.
4. Load-Bearing Units: ASTM C90, normal weight.
    a. Unit Compressive Strength: Provide units with minimum average net compressive strength of 2800 psi.
5. Nonloadbearing Units: ASTM C129, normal weight.
    a. Unit Compressive Strength: Provide units with minimum average net compressive strength of 2150 psi.
6. Common/Standard Block Units; for hidden or painted installations only, unless noted otherwise.
    a. Smooth face units.
    b. Color: Gray
    c. Painted Common Block: Where indicated in drawings.

1) Joints: Flush
2) Paint Color: As indicated on drawings.

7. Decorative Block Units:
   a. Split Face Units; EF-2
      1) Basis of Design Product: Subject to compliance with requirements, provide basis of design product indicated on Exterior Finish Key Schedule or one of the other products listed.
         a) York Building Products; Split Face.
         b) Echelon Standard Masonry; Split Face.
         c) Westbrook Concrete Block; Split Face.
      2) Bond/Pattern: Running.
      3) Joint:Concave
      4) Color: As indicated on drawings.
   b. Ground Face Units; Standard Unit; EF-3
      1) Basis of Design Product: Subject to compliance with requirements, provide basis of design product indicated on Exterior Finish Key Schedule or one of the other products listed.
         a) York Building Products; Gemstone.
         b) Echelon Masonry, Trenwyth Architectural Masonry; Trendstone.
         c) Westbrook Concrete Block; Ground Face.
      2) Bond/Pattern: Running.
      3) Joint:Concave
      4) Color: As indicated on drawings

2.4 BRICK UNITS

A. EF-1, Facing Brick: ASTM C216, Type FBX, Grade SW.
1. Basis of Design Product: Subject to compliance with requirements, provide basis of design product indicated on Exterior Finish Key Schedule or comparable product by another manufacturer.
2. Bond/Pattern: Running.
3. Joint:Concave
4. Color: As indicated on drawings.
5. Actual size: Modular: 3-5/8 x 2-1/4 x 7-5/8 inches.
6. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
7. Compressive strength: As indicated on drawings, measured in accordance with ASTM C67/C67M.

2.5 MORTAR AND GROUT MATERIALS

A. Mortar and Grout: As specified in Section 04 0511.

2.6 REINFORCEMENT AND ANCHORAGE

A. Reinforcement
1. Uncoated Reinforcing Steel: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (60,000 psi).
2. Masonry Joint Reinforcement, General: ASTM A951/A951M.
   a. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
   b. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

c. Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

3. Single Wythe Joint Reinforcement: ASTM A951/A951M.
   a. Type: Truss or ladder.
   b. Interior Wall Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
   c. Exterior Wall Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
   d. Size: 0.1483 inch side rods with 0.1875 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
4. Multiple Wythe Joint Reinforcement with Mortar Joint Between Wythes: ASTM A951/A951M.
   a. Type: Truss.
   b. Interior Wall Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
   c. Exterior Wall Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
   d. Size: 0.1875 inch side rods with 0.1875 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
5. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
   a. Type: Truss, with adjustable pintle and eye ties spaced at 16 in on center.
      1) Reinforcement shall have one side rod at each face of masonry shell of backing wythe.
      2) Ties shall not have more than 1/16 inch play in any horizontal direction.
      3) Ties shall be sized to extend minimum of half facing wythe but not extend more than 5/8 inch from face of facing wythe.
   b. Material: stainless steel complying with ASTM A580/A580M Type 304.
   c. Size: 0.1875 inch side rods with 0.1875 inch cross rods and adjustable components of 0.1875 inchwire, width of components as required to provide not less than 5/8 inch of mortar coverage from each masonry face.
   d. Vertical adjustment: Not more than 1 1/4 inches.
   e. Seismic Feature: Provide lip, hook, or clip on extended leg of wall ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter.
   f. Insulation Clips: Provide clips at tabs or ties designed to secure insulation against outer face of inner wythe of masonry.

B. Ties and Anchors
1. Strap Anchors: Bent steel shapes, 1-1/2 inch width, 0.105 inch thick, 24 inch length, with 1-1/2 inch long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.
2. Partition Top Anchor: 0.105 inch thick metal plate with a 3/8 inch diameter metal rod 6 inches long welded to metal plate and with closed end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot dip galvanized after fabrication.
3. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
   a. Concrete frame: Dovetail anchors of bent steel strap, nominal 1 inch width x 0.024 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
   b. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.

4. Masonry Veneer Anchors: Single-Barrel Screw with Double-Pintle Wingnut: Self-drilling single-barrel screw with thermally resistant wingnut head designed to receive double-pintle wire tie. Screw has a smooth barrel the same thickness as insulation with factory installed gasketed washer to seal at face of insulation and sheathing. Provide with seismic tie, clip, and continuous wire in veneer.
    a. Barrel: Stainless steel, AISI Type 304; ASTM A580/A580M.
    b. Screw: Carbon steel; ASTM A510/A510M. Polymer Coating; ASTM C954
    c. Wire: Stainless steel, AISI Type 304; ASTM A580/A580M
    d. Basis of Design Product: Subject to compliance with requirements, provide basis of design product indicated or comparable product by another manufacturer.
        1) Basis of Design: Hohmann & Barnard, Inc.;
            a) Concrete, Masonry, Wood Framing: Thermal Concrete 2-Seal Wing Nut Anchor.
            b) Metal Framing: Thermal 2-Seal Wing Nut Anchor.
            c) Pintle: Mighty-Lok Hook.

2.7 FLASHINGS

A. Application: Unless otherwise indicated, use the following:
1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing or flexible flashing with metal drip edge.
4. Where flashing is fully concealed, use flexible flashing.

B. Metal Flashing: Provide metal flashing complying with 07 6200 - Sheet Metal Flashing and Trim and as follows:
1. Stainless Steel Flashing: ASTM A666/A666M, Type 304, soft temper; 26 gauge, 0.0187 inch thick; finish 2B to 2D.
2. Fabricate continuous flashing in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through wall metal flashing embedded in masonry from stainless steel, with ribs at 3 inch intervals along length of flashing to provide an integral mortar bond.
4. Fabricate through wall flashing with snap lock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out form wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate metal expansion joint strips from stainless steel to shapes indicated.
7. Solder metal items at corners.
8. Prefabricated Metal Flashing: Sawtooth fabricated 16 oz/sq ft stainless steel (type 304) flashing for thru-wall conditions.
    a. Manufacturers: Provide products complying with requirements, from one of the following manufacturers.
        1) Cheney Flashing Company.
        2) Hohmann & Barnard, Inc.
        3) WIRE-BOND.

C. Flexible Flashing
1. Combination Non-Asphaltic Flashing Materials - Stainless Steel:

a. Stainless Steel/Polymer Fabric Drainage Plane Flashing: ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded between one sheet of polymer fabric and one sheet of non-woven drainage material.
   1) Basis of Design Product: Subject to compliance with requirements, provide basis of design product indicated or comparable product by another manufacturer.
      a) Basis of Design: York Flashings; Flash-Vent SS.

D. Factory-Fabricated Flashing Corners and End Dams: Stainless steel.
   1. Manufacturers: Provide products complying with requirements, from one of the following manufacturers.
      a. 3GEN Masonry Products.
      b. Hohmann & Barnard, Inc.
      c. Mortar Net Solutions.
      d. WIRE-BOND.
      e. York Flashings.

E. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.

F. Termination Bars: Stainless steel; compatible with membrane and adhesives.

G. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.

H. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.8 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints; ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall.
   1. Manufacturers: Provide products complying with requirements, from one of the following manufacturers.
      a. Blok-Lok Limited.
      b. Hohmann & Barnard, Inc.
      c. WIRE-BOND.

B. Joint Filler: Closed cell polyurethane; oversized 50 percent to joint width; self expanding; in maximum lengths available.
   1. Manufacturers: Provide products complying with requirements, from one of the following manufacturers.
      a. Hohmann & Barnard, Inc.
      b. WIRE-BOND.

C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
   1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.

a. Locations: Provide continuous cavity drainage material within masonry wall cavity, directly on top of through wall flashing and protecting veneer weeps, at every through wall flashing line, whether specifically indicated in drawings or not; and elsewhere where specifically indicated.
b. Product: Subject to compliance with requirements, provide one of the following or comparable product by another manufacturer.
   1) 3GEN Masonry Products; Wall Defender.
   2) Advanced Building Products, Inc; Mortar Break DT.
   3) Advanced Building Products Inc; Mortar Break.
   4) Mortar Net Solutions; MortarNet.
   5) WIRE-BOND.
   6) York Flashings.

D. Cavity Vents:
1. One-piece flexible extrusion; full height and width of head joint and depth 1/8 inch less than depth of outer wythe.
2. Type: Extruded propylene with honeycomb design.
3. Color: As selected from manufacturer's full range.
4. Product: Subject to compliance with requirements, provide one of the following or comparable product by another manufacturer.
   a. 3GEN Masonry Products; Cell Vent.
   b. Advanced Building Products, Inc; Weep Vents.
   c. Blok-Lok Limited; Cellvent.
   d. Hohmann & Barnard, Inc; QV Quadro-Vent.
   e. Mortar Net Solutions; CellVent.
   f. Heckmann Building Products, Inc; Cell Vent No. 85.
   g. WIRE-BOND; Cell Vent.

E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.9 LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam units matching adjacent units in color texture, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

C. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less than half size units particularly at corners, jambs, and where possible, at other locations.

3.3 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.4 PLACING AND BONDING

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
1. Units shall not be mitered to form corners; provide special shapes where necessary to form corners with finished faces.

D. Exposed Masonry: Mix units to produce uniform blend of colors and textures, unless otherwise indicated.

E. Where existing masonry occurs, match coursing, bonding, color, and texture of existing masonry.

F. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond pattern; do not use units with less than nominal 4 inch horizontal face dimension at corners or jambs.

G. Lay concealed masonry with all units in a wythe in running bond pattern. Bond and interlock each course of each wythe at corners. Do not use units with less than 4 inch horizontal face dimension at corners or jambs.

H. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work. Do not deeply furrow bed joints or slush head joints.

I. Lay hollow masonry units as follows:
1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.

4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

J. Where applicable set masonry trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
1. Clean soiled surfaces with fiber brush an soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.
3. Rake out mortar joints for pointing with sealant.

K. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

L. Remove excess mortar and mortar smears as work progresses.

M. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

N. Interlock intersections and external corners, except for units laid in stack bond.

O. Rake out mortar joints at pre-faced CMUs to uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy mortar manufacturer's written instructions.

P. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

Q. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

R. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

S. Cut mortar joints flush where wall tile is scheduled, other direct applied finishes (other than paint) is scheduled, resilient base is scheduled, cavity insulation vapor barrier adhesive is applied, or other membrane coating is applied.

T. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
1. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
2. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.
3. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2 inch clearance between end of anchor rod and end of tube. Space anchors 48 inches on center unless otherwise indicated.
4. At fire rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 8443 - Joint Firestopping.

U. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

3.5 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

B. Install cavity vents in veneer and cavity walls at 24 inches on center horizontally below shelf angles and lintels and near top of walls.

3.6 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

C. Where air space in cavity wall assemblies is 1-1/2 inches or less, install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions.
1. Verify that airspace width is no more than 3/8 inch greater than panel thickness.
2. Hold cavity mortar control panel tight to face wythe.
3. Install horizontally between joint reinforcement.
4. Stagger end joints in adjacent rows.
5. Fit to perimeter construction and penetrations without voids.

D. Where air space in cavity wall assemblies is greater than 1-1/2 inches, install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.7 REINFORCEMENT AND ANCHORAGE - GENERAL

A. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
1. Unless otherwise indicated, install horizontal joint reinforcement 16 inches on center.
2. Horizontal joint reinforcement in parapets and foundation walls shall be spaced not more than 8 inches on center.
3. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 24 inches each side of opening.
4. Place continuous joint reinforcement in first and second joint below top of walls.

B. Lap joint reinforcement ends minimum 6 inches.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at wall corners by using prefabricated L-shaped units.

E. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.

F. Reinforced Unit Masonry
1. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

a. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
b. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

2. Placing Reinforcement: Comply with requirements in TMS 602.
3. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   a. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   b. Limit height of vertical grout pours to not more than 60 inches.

G. Anchoring Masonry to Structural Steel and Concrete:
1. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
   a. Provide an open space not less than 2 inches wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   b. Anchor masonry with anchors embedded in masonry joints and attached to structure.
   c. Space anchors as indicated, but not more than ~~24~~ 16 inches o.c. vertically and ~~36~~ 16 inches o.c. horizontally.

3.8 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Masonry Back-Up: Embed adjustable multiple wythe joint reinforcement within back-up wythe with pintle and eye veneer anchors (ties) embedded in veneer wythe at maximum 16 inches on center vertically and horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

B. Masonry or Concrete Back-Up, Thermally Broken: Fasten masonry veneer anchors into masonry back-up and embed pintle and eye veneer anchors (ties) within veneer wythe at maximum 1.77 sq ft of wall surface per anchor. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

C. Stud Back-Up, Thermally Broken: Secure veneer anchors to stub framed back-up and embed pintle and eye veneer anchors (ties) within veneer wythe at maximum ~~1.77 sq ft of wall surface per anchor~~16 inches o.c. horizontally and vertically. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

D. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.

3.9 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY

A. Use multiple wythe joint reinforcement installed in horizontal joints to bond wythes together. Space horizontal joint reinforcement as indicated in REINFORCEMENT AND ANCHORAGES - GENERAL article above.

3.10 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing.
   2. Where flashing is within mortar joint, place through wall flashing on sloping bed of mortar and cover with mortar.
   3. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry; turn up flashing ends at least 1 inch, minimum, to form watertight pan.
   4. Seal lapped ends and penetrations of flashing before covering with mortar.

B. At multiple wythe masonry walls, including cavity walls, extend flashing through outer wythe, turn up a minimum of 8 inches, turn and extend through inner wythe to within 1/2 inch of interior face of exposed masonry wall. Where interior masonry wall is covered with furring or other construction assembly continue flashing through inner wythe and turn up interior face 2 inches.

C. Framed or concrete walls with masonry veneer, terminate flashing up 8 inches minimum on vertical surface of backing:
   1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
   2. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer’s directions.
   3. Terminate vertical leg of flashing into reglet in concrete.
   4. Anchor vertical leg of flashing into backing with a termination bar and sealant.
   5. Apply cap bead of sealant on top edge of self-adhered flashing.

D. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

E. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 9200 "Joint Sealants" for application indicated.

F. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

G. Support flexible flashings across gaps and openings.

H. Extend laminated flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

I. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.11 LINTELS

A. Install lintels over openings as indicated.

B. Install loose steel lintels or formed-in-place masonry lintels where shown and indicated and where openings of more than 12 inches for brick size units and 24 inches for block size units are shown without structural steel or other supporting lintels. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.
   1. Provide loose steel lintels unless otherwise indicated.

2. Provide formed-in-place masonry lintels for openings in fire rated masonry walls and masonry walls in damp, wet, or exterior locations.

C. Maintain minimum 8 inches of bearing on each side of opening.

3.12 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Do not allow materials to span control joints without provision to allow for in-plane wall or partition movement.

C. Locate control joints and expansion joints per drawings. Where joints are not specifically indicated on drawings locate joints to comply with NCMA TEK 10-02D. Location of control and expansion joints shall be indicated on shop drawings and approved by architect prior to the start of masonry installation.

D. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

E. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

F. Form expansion joint as detailed on drawings.

3.13 BUILT-IN WORK

A. As work progresses, build in items as specified in this and other Sections. Fill in solidly with masonry around built-in items.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.
1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

E. Fill cores in hollow CMUs with grout 24 inches

F. Do not build into masonry construction organic materials that are subject to deterioration.

3.14 TOLERANCES

A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2 inch maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2 inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2 inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft. or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.15 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense. Perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Inspections: Special inspections to comply with International Building Code.
1. Inspections: Special inspections in accordance with Level 3 in TMS 402.
2. Begin masonry construction only after inspectors have verified proportions of prepared mortar.
3. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
4. Place grout only after inspectors have verified proportions of prepared grout.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.

E. Mortar Tests: Test each type of mortar in accordance with ASTM C780.

1. Prior to Construction: One set of tests.
2. Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

F. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

3.17 REPAIRING, REPOINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-progress cleaning: Clean unit masonry as work progresses by dry brush to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample panel or mock-up assembly; leave one half of panel uncleaned for comparison purposes.
3. Protect adjacent surfaces from contact with cleaner.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with proprietary acidic cleaner applied according to manufacturer's written instructions.

3.18 PROTECTION

A. Stain Prevention: Prevent construction materials and soil from staining the face of masonry to be left exposed or painted. Immediately remove all deleterious and damaging/staining materials and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud by spreading coverings on ground and over wall surface.

B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

3.19 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least 2 parts of specified fill material for each part of masonry waste.
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 2000

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SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Shrinkage-resistant grout.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:
   1. ANSI/AISC 303.
   2. ANSI/AISC 360.
   3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
   a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
   b. Use Allowable Stress Design; data are given at service-load level.

C. Moment Connections: Type FR, fully restrained.

D. Construction: Combined system of moment frame, portal frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

In accordance with the structural general notes.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts.

2.4 RODS

A. Anchor Rods: ASTM F1554, Grade 36, straight.

B. Threaded Rods: ASTM A36.

2.5 PRIMER

In accordance with the structural drawings.

2.6 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time. Strength as indicated on structural drawings.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

2.8 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.
   1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels and shelf angles located in exterior walls.

2.10 SHOP PRIMING

A. Shop prime steel surfaces in accordance with the structural general notes.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the structural general notes.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
   1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
   2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
   3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:
      a. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   4. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.
a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:
1) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

END OF SECTION 051200

SECTION 05 5000 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Shop fabricated steel items, including:
   a. Framing and supports for overhead doors, mechanical and electrical equipment, and applications where framing and supports are not specified in other Sections.
2. Slotted channel framing.
3. Loose bearing and leveling plates for applications where they are not specified in other Sections.
4. Downspout boots.

B. Products furnished, but not installed, under this Section include the following:
1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
1. Fasteners.
2. Shop primers.
3. Shrinkage-resisting grout.
4. Slotted channel framing.
5. Metal downspout boots.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
2. Steel framing and supports for overhead doors.
3. Steel framing and supports for mechanical and electrical equipment.

4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. ~~Miscellaneous steel trim including steel angle corner guards, steel edgings, and loading-dock edge angles.~~

1.4 INFORMATIONAL SUBMITTALS

A. Welders' Qualification Statement and certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculations on surface temperature of materials due to both solar heat gain and nighttime sky heat loss.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MATERIALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Plates: ASTM A283/A283M.

C. Stainless Steel, General: ASTM A666/A666M, Type 304.

D. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
1. Size of Channels: 1-5/8 by [1-5/8] inches ([41] mm).
2. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B, with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.

F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.4 FASTENERS

A. Fasteners: provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Bolts, Nuts, and Washers for fastening Aluminum: Stainless steel.

B. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain, with hex nuts, ASTM A563; and, where indicated, flat washers.

C. High Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 3, plain, heavy-hex steel structural bolts; ASTM 563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ISO 3506-1); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

H. Machine Screws: ASME B18.6.3.

I. Lag Bolts: ASME B18.2.1.

J. Wood Screws: Flat Head ASME B18.6.1.

K. Plain Washers: Round, ASME B18.2.2.1.

L. Lock Washers: Helical, spring type, ASME B18.21.1.

M. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 FABRICATION

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

C. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

D. Galvanize miscellaneous framing and supports where indicated.

2.7 FABRICATED ITEMS

A. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; galvanized finish.

B. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; hot-dipped galvanized per ASTM A653, Grade G90 finish.

~~2.8 SHELF ANGLES~~

~~A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.~~
~~1. Provide mitered and welded units at corners.~~
~~2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.~~

~~B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.~~

~~C. Galvanize and prime shelf angles located in exterior walls.~~

~~2.9~~2.8 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with primer specified in Section 09 9600 "High-Performance Coatings."

~~2.10~~2.9 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

~~2.11~~2.10 DOWNSPOUT BOOTS

A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and on-body cleanout and cover with neoprene gaskets.
   1. Configuration: Offset.
   2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
   3. Finish: Manufacturer's standard factory applied powder coat finish.
   4. Color: To be selected by Architect from manufacturer's standard range.
   5. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, and rubber coupling.
   6. Manufacturers:
      a. Downspoutboots.com, a division of J. R. Hoe & Sons.
      b. Neenah Foundry.
      c. Zurn.

~~2.12~~2.11 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

~~2.13~~2.12 FINISHES - STEEL

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Prime Painting: One coat.

C. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

D. Slotted Channel Framing: ASTM A653/A653M, Grade 33.

~~2.14~~2.13 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 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. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Perform field welding in accordance with AWS D1.1/D1.1M.
   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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Obtain approval prior to site cutting or making adjustments not scheduled.

G. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

3.4 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for overhead doors and overhead grilles securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction with anchor bolts.

~~3.5 SHELF ANGLES~~

~~A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.~~

~~3.6 INSTALLATION OF ELEVATOR PIT SUMP COVERS~~

~~A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.~~

~~3.7 INSTALLATION OF MISCELLANEOUS STEEL TRIM~~

~~A. Anchor to concrete construction to comply with manufacturer's written instructions.~~

~~3.8~~3.5 INSTALLATION OF METAL DOWNSPOUT BOOTS

A. Anchor metal downspout boots to concrete or masonry construction to comply with manufacturer's written instructions.

B. Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

~~3.9~~3.6 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

~~3.10~~3.7 REPAIRS

A. Touchup Painting:
   1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in 09 9600 - High-Performance Coatings.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

~~3.11~~3.8 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 05 5000

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SECTION 05 5113 - METAL PAN STAIRS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Preassembled steel stairs with concrete-filled treads.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs.
1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:
1. Prefilled metal-pan-stair treads.
2. Abrasive nosings.
3. Shop primer products.
4. Nonslip-aggregate concrete finish.
5. Grout.

B. Shop Drawings:
1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

C. Samples for Verification: For each type and finish of nosing.

D. Delegated Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.
1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
a. Repair or replace damaged materials or structures as directed.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design stairs, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: 1.5.

2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

~~C. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.~~

C. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

2.3 ABRASIVE NOSINGS

A. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
   1. Basis-of-Design Product: Nystrom; STSF-N Inset Full Abrasive Stair Nosings or comparable product by one of the following manufacturers:
      a. Balco; a CSW Industrials Company.
      b. Babcock-Davis.
      c. Wooster Products Inc.
   2. Provide solid-abrasive units without ribs.
   3. Nosings, Square-Back Units: 2-1/4 inches wide, without lip.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.4 FASTENERS

A. General: Provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M , Class Fe/Zn 5 where built into exterior walls.
   1. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
   1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.

D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

~~B. Shop Primers: Provide primers that comply with Section 09 9600 - High-Performance Coatings~~

~~C.~~B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

~~D.~~C. Prefilled Concrete Treads:

1. Concrete Materials and Properties: Comply with requirements in Section 03 3000 - Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi and maximum aggregate size of 1/2 inch unless otherwise indicated.
2. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
3. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, galvanized steel, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated on Drawings.
4. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
    a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

~~E.~~D. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.6 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply 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. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.

2.7 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.

B. Stair Framing:
1. Stringers: Fabricate of steel plates, steel channels, or steel rectangular tubes.
   a. Stringer Size: As required to comply with "Performance Requirements" Article.
   b. Provide closures for exposed ends of channel and rectangular tube stringers.
   c. Finish: ~~Shop primed.~~Galvanized.
2. Platforms: Construct of steel plate, steel channel, or steel rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
   a. Provide closures for exposed ends of channel and rectangular tube framing.
   b. Finish: ~~Shop primed.~~Galvanized.
3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
~~2. Steel Sheet, Uncoated: Cold-rolled steel sheet.~~
2. Galvanized Steel Sheet: Galvanized steel sheet
3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
4. Attach abrasive nosings to risers.
5. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.8 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Comply with applicable requirements in Section 05 5213 "Pipe and Tube Railings."

2.9 FINISHES

~~A. Finish metal stairs after assembly.~~

~~B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."~~

~~C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.~~

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
   1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
   2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
   1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
   1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
      a. Clean bottom surface of plates.
      b. Set plates for structural members on wedges, shims, or setting nuts.
      c. Tighten anchor bolts after supported members have been positioned and plumbed.
      d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
      e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
         1) Neatly finish exposed surfaces; protect grout and allow to cure.
         2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.
   1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
   2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
   3. Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 03 3000 - Cast-in-Place Concrete.
   1. Install abrasive nosings with anchors fully embedded in concrete.
   2. Center nosings on tread width.

3.3 REPAIR

~~A. Touchup Painting:~~
~~1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 9600 - High-Performance Coatings.~~

A. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 5113

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SECTION 06 1600 - SHEATHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall and Parapet Plywood Sheathing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Provide technical data on sheathing, ~~wood preservative materials,~~ application instructions, and fire-retardant treatments.
~~2. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.~~
~~3.~~2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
~~4.~~3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5516.
~~5.~~4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.3 INFORMATIONAL SUBMITTALS

A. Certificate: Certify that products of this section meet or exceed specified requirements.

B. Evaluation Reports: For the following, from ICC-ES:
~~1. Wood-preservative-treated plywood.~~
~~2.~~1. Fire-retardant-treated plywood.

C. Qualifications: for manufacturer and installer.

1.4 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 the type specified and with minimum three years of documented experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products above ground in dry ventilated space to protect against moisture. Support stacked products to prevent deformation and allow air circulation.

B. Store panels over stable soil capable of carrying load of pallets.

C. Protect materials from soiling and damage.

D. Deliver materials to site promptly without undue exposure to weather.

E. Deliver in manufacturer's unopened containers, pallets, or panels fully identified with name, brand, type, and grade.

F. Do not stack panels over plus or minus 1/2 inch off pallet edge.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Wood Panel Products:
1. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
2. Factory mark panels to indicate compliance with applicable standard.

2.2 SHEATHING

A. Wall and Parapet Sheathing: Plywood Sheathing, PS 2 type.
1. Bond Classification: Exterior.
2. Grade: Structural I Sheathing.
3. Span Rating: 24.
4. Performance Category: ~~5/16~~3/4 PERF CAT.
5. Edge Profile: Square edge.

2.3 ACCESSORIES

A. Fasteners and Anchors:
1. General: Refer to manufacturer product information for fastener types and requirements.
2. High Humidity and Preservative-Treated Wood Locations: Hot dip galvanized.
3. Anchors: Toggle bolt type for anchorage to hollow masonry.

B. Panel Treatment: Use manufacturer-recommended sealant, transition strips, flashing sheets, termination bars, patching materials, and adhesive tapes at control joints, panel connections, and penetrations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof and floor framing meet deflection criteria noted in drawings, as recommended by manufacturer and local building code requirements.

B. Examine substrates and adjoining construction.

C. Replace damaged framing before installation of cementitious panel subfloor. Proceed with installation only after unsatisfactory conditions corrected.

3.2 PREPARATION

A. Coordinate installation of roof and floor deck construction, framing of openings, and other assembly installation.

B. Coordinate installation of rough carpentry members specified in other sections.

3.3 INSTALLATION, GENERAL

A. Select material sizes to minimize waste.

B. Reuse and clearly separate scrap for use on-site as accessory components, including shims, bracing, and blocking.

C. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws.
1. Use plywood or other acceptable structural panels at building corners, ensure panels measure 96 inches horizontally.

3.4 INSTALLATION OF WOOD STRUCTURAL PANEL

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:
1. Screw to cold-formed metal framing.
2. Space panels 1/8 inch (3 mm) apart at edges and ends.

~~C. Wall and Roof Sheathing:~~
~~1. Nail and screw to wood framing.~~
~~2. Screw to cold-formed metal framing.~~
~~3. Space panels 1/8 inch (3 mm) apart at edges and ends.~~

3.5 TOLERANCES

A. Variation from Plane; Surfaces Other Than Floors: 1/4 inch in 10 feet, maximum, and 1/4 inch in 30 feet, maximum.

3.6 CLEANING

A. Waste Disposal:
1. Comply with applicable regulations.
2. Do not burn scrap on project site.
3. Do not burn pressure treated scraps.

B. Clean material debris, shavings, and sawdust prior to Substantial Completion of project.

3.7 PROTECTION

A. Cover sheathing panels by exterior cladding or other weather-resistive barrier. Do not expose panels to elements for more than 12 months after installation. If exposure anticipated past 12 months, apply joint treatments, weather-resistive barrier, or air barrier according to manufacturer's recommendations.

END OF SECTION 06 1600

SECTION 07 1900 - WATER REPELLENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water repellents applied to exterior, masonry and concrete surfaces.

1.2 ACTION SUBMITTALS

A. Product Data: Provide product description, details of tests performed, limitations, chemical composition, and VOC content.
   1. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.

B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

1.3 INFORMATIONAL

A. Preconstruction Testing Reports: For water-repellent-treated substrates.

B. Manufacturer's Field Reports: Report whether manufacturer's "best practices" are being followed; if not, state corrective recommendations. Email report to Architect the same day as inspection occurs; mail report on manufacturer's letterhead to Architect within 2 days after inspection.

C. Installer's Qualification Statement.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer

B. Owner reserves the right to provide continuous independent inspection of surface preparation and application of water repellent.

1.5 MOCK-UPS

A. Prepare representative surface 36 by 36 inches in size using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.

B. For proposed substitutions, prepare side-by-side mock-ups of specified and substitute products.

C. Locate where directed.

D. Mock-up may remain as part of work.

1.6 FIELD CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
1. Protect liquid materials from freezing.
2. Concrete surfaces and mortar have cured for not less than 28 days.
3. Building has been closed in for not less than 30 days before treating wall assemblies.
4. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
5. Substrate is not frozen and surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).
6. Rain or snow is not predicted within 24 hours.
7. Not less than 24 hours have passed since surfaces were last wet.
8. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which Applicator agree(s) to repair or replace materials that fail to maintain water repellency due to materials and/or workmanship as specified within specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrates, and new substrate cracks in excess of 1/16 inch wide, fire, vandalism, or abuse by maintenance equipment.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.

B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.
1. Cast-in Place Concrete: ASTM C 642.
2. Concrete Masonry Units: ASTM C 140.

C. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.

D. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

E. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
1. Reduction of Water Absorption: 80 percent.

2.2 MATERIALS

A. Water Repellent: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
1. Applications: Exterior, horizontal surfaces.
2. Number of Coats: Two.
3. VOC Content: See Section 01 6116.
4. Solvent-based or water-based, silane, siloxane, silane-siloxane blend, or siliconate that reacts chemically with concrete, masonry.
a. Manufacturers:
1) Diedrich Technologies Inc.; Diedrich 303 WB.
2) Euclid Chemical; Chemstop WB Heavy Duty.
3) PROSOCO, Inc.; Sure Klean Weather Seal H40.
4) Sika USA; Sikagard-200 Enviroseal.
5) SpecChem; White Roc 10 WB.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify joint sealants are installed and cured.

C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

3.2 PREPARATION

A. Protection of Adjacent Work:
1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
2. Protect adjacent surfaces not intended to receive water repellent.

B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.

C. Do not start work until masonry mortar substrate is cured a minimum of 60 days.

D. Remove loose particles and foreign matter.

E. Remove oil and foreign substances with a chemical solvent that will not affect water repellent.

F. Scrub and rinse surfaces with water and let dry.

3.3 APPLICATION

A. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.
1. Precast Concrete: At Contractor's option, first application of water repellent on units may be completed before installing them. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.

B. Apply at rate recommended by manufacturer, continuously over entire surface.

C. Apply two coats, minimum.

D. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.

E. Provide manufacturer's field service representative to inspect preparation and application work continuously during entire application period to ensure that manufacturer's "best practices" for preparation and application are being followed.

3.4 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07 1900

SECTION 07 2100 - THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Extruded polystyrene foam-plastic board insulation.

B. Polyisocyanurate foam-plastic board insulation.

C. Mineral-wool batt insulation.

1.2 ACTION SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

B. Shop Drawings: Submit drawings that indicate location of joint or termination detail conditions, conditions of interface with other materials, and setting plan for insulation.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

B. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
   1. Sign, date, and post the certification in a conspicuous location on Project site.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:
   1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
   2. Protect against ignition. Do not deliver foam-plastic board materials to Project site until just before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 PRODUCTS

2.1 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: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
5. Board Edges: Square.
6. Basis-of-Design Product: provide Owens Corning Corporation; FOAMULAR NGX Next Generation Extruded or comparable product by one of the following:
   a. DuPont de Nemours, Inc.
   b. Kingspan Insulation LLC.
7. Application: Foundation/below grade walls.

B. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
1. Type and Compressive Resistance: Type VII, 60 psi (414 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: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
5. Board Edges: Square.
6. Type and Water Absorption: Type XII, 0.3 percent by volume, maximum, by total immersion.
7. Application: Underslab.

C. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
1. Type and Compressive Resistance: Type V, 100 psi (690 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: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
5. Board Edges: Square.
6. Basis-of-Design Product: provide Owens Corning Corporation; FOAMULAR NGX Next Generation Extruded or comparable product by one of the following:
   a. DuPont de Nemours, Inc.
   b. Kingspan Insulation LLC.
7. Application: High load underslab (~~appratus~~apparatus bay).

D. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, comply with ASTM C1289.
1. Classifications:

a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of core foam.
2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
3) Thermal Resistance, R-value: At 1-1/2 inch thick; Class 2 - 8.0 (1.41), minimum, at 75 degrees F.

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. Water Vapor Permeance: 1.2 perm, maximum, at 1 inch thickness, and when tested in accordance with ASTM E96/E96M, desiccant method.
5. Comply with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
6. Board Size: 48 inch by 96 inch.
7. Board Thickness: 1.5 inch.
8. Board Edges: Square.
9. Basis-of-Design Product: provide Sika USA, Rmax Inc; Durasheath or comparable product by one of the following:
a. Atlas Roofing Corporation.
b. Henry, a Carlisle Company.
c. Ox Engineered Products.
10. Application: ~~Continous~~Continuous and cavity insulation at Exterior walls (Type I-IV): Masonry, steel stud, FRTW stud; exterior stucco, re-siding; vaulted-ceilings; attics and crawls spaces.

E. Structural Insulating Block: High-compressive strength, rigid insulating block. Continuous structural thermal break block.
1. Compressive Strength: 210 psi, minimum, in accordance with ASTM D1621 test methods.
2. Compressive Modulus: 6,155 psi, minimum, in accordance with ASTM D1621 test methods.
3. Water Absorption: 0.5 percent by volume, maximum.
4. Complies with fire-resistance requirements indicated on drawings as part of exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
5. Thermal Resistance: R-value of 3.85 per inch, minimum, at 75 degrees F, minimum, in accordance with ASTM C518 test methods.
6. Basis-of-Design Product: provide Armatherm; Armatherm 500 Foundation Wall Thermal Break or comparable product by the following:
a. Thermal Bridging Solutions.
b. Fabreeka.
7. Application: at masonry shelf angle, foundation to wall transition and cladding/facade connections.

2.2 MINERAL FIBER BATTS INSULATION MATERIALS

A. Flexible Glass Fiber or Mineral Wool Batts Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
3. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
4. Formaldehyde Content: Zero.

5. Thermal Resistance: R-15, at 3-1/2-inches thick, per ASTM C518 on 16-inches o.c. in metal stud assembly.
6. Facing: Unfaced.
7. Products:
   a. Knauf Insulation; Performance+ EcoBatt Insulation.
   b. Owens Corning Corporation; PINK Next Gen FIBERGLAS Insulation.
   c. Nu-Wool; ECOCELL.
   d. ROCKWOOL; COMFORTBATT.
8. Application: Framed exterior wall ~~cavitites~~cavities, soffits, and attic cavity spaces.

2.3 ACCESSORIES

A. Mineral Wool Insulation Attachment:
1. Basis-of-Design Products: provide product indicated below or comparable product submitted for Architect's review.
   a. TruFast Walls, a Division of Altenloh, Brinck & Co. US, Inc; Grip-Lok MW Plate.

B. 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. Basis-of-Design Products: provide product indicated below or comparable product submitted for Architect's review.
   a. TruFast Walls, a Division of Altenloh, Brinck & Co. US, Inc; Thermal-Grip ci Prong Washer.

C. Gas-Actuated Insulation Fasteners: Galvanized steel pins driven through polypropylene anchor with 2-1/4-inch diameter washer head; suitable for fastening insulation to concrete, CMU, or steel studs, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
1. Basis-of-Design Products: provide product indicated below or comparable product submitted for Architect's review.
   a. TruFast Walls, a Division of Altenloh, Brinck & Co. US, Inc; Thermal-Grip Insulation Pin.

D. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

E. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.

F. Protection Board for Below Grade Insulation: Cementitious, 1/4 inch thick.

G. Adhesive: Type recommended by insulation manufacturer for application.

H. Flashing and Sealant: Provide tape, spray or trowel applied flashing for sealing joints, seams and veneer tie penetrations through board insulation as recommended by insulation manufacturer.

~~I. Stud Cavity Foam Insulation: Provide two component spray polyurethane foam (SPF) insulation applied to interior face of board insulation wall sheathing and interior studs, complies with ASTM C1029.~~
~~1. Thickness: 1 inch minimum.~~
~~2. Thermal Resistance (R-value): At least 6.5, for thickness indicated at 75 degrees F.~~
~~3. Products: BASF; SPRAYTITE 81206.~~

PART 3 EXECUTION

3.1 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.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products, applications and applicable codes.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. First paragraph below is required by the International Energy Conservation Code unless insulation Installer is providing certification specified in "Informational Submittals" Article.

D. Install insulation with manufacturer's R-value label exposed after insulation is installed.

E. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

F. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Adhesive Installation: Install with adhesive in accordance with manufacturer's written instructions.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended in writing by manufacturer.
   1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
   2. Press units firmly against inside substrates.
   3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 2000 - Unit Masonry.

B. Structural Insulating Blocks:
   1. Verify manufacturer-recommended cure time for air and water barrier system and waterproofing before installing structural insulating block.
   2. Install a single layer of cellular-glass structural insulating block with facers on top and bottom surfaces fully embedded into mortar set on brick ledge in accordance with manufacturer's written instructions.

3. Install cellular-glass structural insulating block maximum sizes to minimize joints.
4. Locate joints square to framing members. Do not cantilever cellular-glass structural insulating block.
5. Butt joints of cellular-glass structural insulating block with no gaps or mortar between joints.
6. Insulation board edges are to be butted together tightly and fit around openings and penetrations. Install square edges to fit square and tight.
7. Extend insulation in single course to cover entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Do not drill.

3.5 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.

3.6 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.

3.7 BATT INSTALLATION

A. Install insulation 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. Retain insulation batts in place with spindle fasteners at 12 inches on center.

3.8 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 2100

SECTION 07 4113 - METAL ROOF PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulated metal roof panel system of preformed steel panels.

B. Metal roof panel system of preformed steel panels.

1.2 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Summary of test results, indicating compliance with specified requirements.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Specimen warranty.

B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
1. Show work to be field-fabricated or field-assembled.

C. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's qualification statement.

B. Test Reports: Indicate compliance of metal roofing system to specified requirements.

C. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner 's name and are registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.6 FIELD CONDITIONS

A. Do not install metal roof panels, underlayment when surface, ambient air, or wind chill temperatures are below 45 degrees F.

1.7 WARRANTY

A. Finish Warranty: Provide 20-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.

B. RA-2/EF-9, Special Warranty: Provide 2-year warranty for weathertightness of roofing system, including agreement to repair or replace metal roof panels that fail to keep out water commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

C. EF-8 at RA5, Special Warranty for weathertightness of roofing system: Per Section 13 3419 - Metal Building System.

D. EF-8 at RA6, Special Warranty: Provide 2-year warranty for weathertightness of roofing system, including agreement to repair or replace metal roof panels that fail to keep out water commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

~~B.~~

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. EF-8, Structural Metal Roof Insulated Panel Manufacturers: Provide indicated Basis-of-Design indicated on Exterior Finish Key Schedule or comparable product by one of the listed manufacturers:
1. ATAS International, Inc.
2. Centria, a Nucor Company.
3. Kingspan Insulated Panels.

B. RA-2, Architectural Metal Roof Panel Manufacturers: Provide indicated Basis-of-Design indicated on Exterior Finish Key Schedule or comparable product by one of the listed manufacturers:
1. Berridge Manufacturing Company.
2. Metl-Span, a Nucor Company.
3. Petersen Aluminum Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
3. Air Infiltration: Maximum 0.06 cfm/sq ft at air pressure differential of 6.24 lbf/sq ft, when tested according to ASTM E1680.

4. Water Penetration: No water penetration when tested in accordance with procedures and recommended test pressures of ASTM E1646; perform test immediately following air infiltration test.
5. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F.
6. Thermal Resistance: Provide throughout system, R-value of 15 (2.6) at 2 inch (51 mm) thick, minimum, when tested in accordance with ASTM C1363.

2.3 STRUCTURAL METAL ROOF PANELS

A. General: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Structural Insulated Metal Panels: Factory-formed panels with factory-applied finish.
1. Type: Double-skin, factory assembled with foamed-in-place polyurethane insulation.
2. Steel Panels:
   a. Zinc-coated SS (structural steel) sheet complying with ASTM A653/A653M; minimum G60 galvanizing.
   b. Aluminum-zinc alloy-coated SS (structural steel) sheet complying with ASTM A792/A792M; minimum AZ50 coating.
   c. Steel Thickness: Minimum 24 gauge, 0.024 inch.
   ~~c.~~d. Interior Metal Face Thickness: manufacturer's standard with siliconized polyester finish.
3. Profile: Standing seam, with minimum 2-inch seam height; concealed fastener system for integral standing seam-shaped lap seam.
4. Texture: Embossed.
5. Length: As indicated on drawings.
6. Width: Maximum panel coverage of 42 inches.

2.4 ARCHITECTURAL METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Panels: Factory-formed panels with factory-applied finish.
1. Steel Panels:
   a. Zinc-coated steel complying with ASTM A653/A653M; minimum G60 galvanizing.
   b. Aluminum-zinc alloy-coated steel complying with ASTM A792/A792M; minimum AZ50 coating.
   c. Steel Thickness: Minimum 24 gauge, 0.024 inch.
~~2.~~ Profile: Standing seam, with minimum 3-inch seam height; concealed fastener system for integral standing seam-shaped lap seam.~~Batten seam, with integral batten-shaped lap seam; concealed fastener system.~~
~~3.~~2. Texture: Smooth.
~~4.~~3. Length: Full length of roof slope, without lapped horizontal joints.
~~5.~~4. Width: Maximum panel coverage of 16 inches.

2.5 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.6 SECONDARY FRAMING

A. Miscellaneous Secondary Framing: Light gauge steel framing incidental to structural supports; fabricated from steel sheet.

B. Framing Material: ASTM A1011/A1011M Designation SS steel sheet.
1. Profile: Manufacturer's standard cee, zee, asymmetrical zee, hat channel, plain channel, single slope eave strut, double slope eave strut, and angle.
2. Thickness: 12 gauge, 0.1046 inch.
3. Finish: Galvanized per ASTM A653/A653M, G90.

C. Framing Connectors: Factory-made formed steel sheet, ASTM A653/A653M SS Grade 50, with G60/Z180 hot dipped galvanized coating and factory punched holes.

2.7 FABRICATION

A. Panels: Provide factory fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.8 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as indicated on drawings.

B. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.

2.9 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: 2 inches high, narrow batten, close-fitting cap of steel with corrosion resistant finish, closed-cell synthetic rubber, neoprene, or PVC, combination steel and closed-cell foam, copper, or prefinished aluminum.

C. Sealants:
1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.

2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

D. Thermal Insulation: Provide batt type, faced with white, flexible, non-dusting vapor retarder tested for maximum flame spread index of 50, per ASTM E84; for installation using spacer blocks.
1. Thermal Resistance: Minimum, as indicated on Assembly Drawing.

E. Underlayment: Self-adhering polymer modified asphalt sheet complying with ASTM D1970/D1970M, with strippable release film and top surface of woven polypropylene sheet.
1. Minimum Requirements: Comply with requirements of ICC-ES AC188 for non-self-adhesive sheet.
2. Sheet Thickness: 22 mils, 0.022 inch, minimum.
3. Water Vapor Permeance: 0.1 perm, maximum, when tested in accordance with ASTM E96/E96M using Desiccant Method (Method A).
4. Products: provide one of the following or comparable product submitted for Architect's review.
   a. Certainteed Roofing; WinterGuard HT - High Temperature Waterproofing Underlayment.
   b. Henry, a Carlisle Company; Blueskin PE200HT.
   c. Polyglass USA, Inc; Polystick MTS Self-Adhered High Temperature Roof Underlayment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.

B. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.

C. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

D. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.

2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.

B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.
1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by panel manufacturer.
2. Provide concealed clips at panel joints, and apply snap-on battens to provide weathertight joints.
3. Install sealant or sealant tape at end laps and side joints as recommended by metal roof panel manufacturer.

D. Insulation: Install insulation between roof covering and supporting members to present a neat appearance; fold, staple, and tape seams unless otherwise approved by Architect.

3.4 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.5 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION 07 4113

SECTION 08 3516 - FOUR-FOLD DOOR SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes Four-Fold metal doors with surface mounted tube frames.

B. Operation of Four-Fold metal doors includes overhead mounted electro-mechanical operators.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of four-fold door and accessory.
   1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
   2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.
   1. Include 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.

1.3 QUALITY ASSURANCE

A. Doors shall be designed to withstand external or internal horizontal wind loads of (25) pounds minimum per square foot. 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.

1.4 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.

1.5 WARRANTY

A. The door manufacturer shall provide a written standard limited warranty for material and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitation: Obtain four fold doors from single source from single manufacturer.
1. Obtain operators and controls from four fold door manufacturer.

B. Basis of Design Manufacturer: Four-Fold industrial metal doors manufactured by Door Engineering and Manufacturing or equal products by other approved manufacturers.

2.2 FOUR-FOLD DOOR ASSEMBLY

A. Basis of Design Product: Subject to compliance with requirements, provide FF300 Series, Glazed as manufactured by Door Engineering, A Senneca Company or approved equivalent product.

B. Material:
1. Steel Tube: ASTM A513 and ASTM A500/A500M
2. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A1011/A1011M hot-rolled steel sheet.
3. Hardware: Manufacturer's standard components.
4. Fasteners: Zinc-coated steel.

C. Construction: Door framing shall be minimum 11-gauge structural steel tube with 14-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.

D. Surface Mounted Tube Frame: General Contractor to ~~Supply~~ pre-hung tube frame system constructed of minimum TS6x4x0.25, designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports and operator supports shall be factory attached. Coordinate with General Contractor for tube frame requirements and installation.

E. Factory finish: Door Panels and Tube Frames shall be finished with manufacturers standard PPG Spectracron epoxy primer and polyurethane top coat. Customer to select from Manufacturer's standard color chart or furnish sample to match.
1. Operator and operating hardware shall be powder-coated manufacturers standard gray.

F. 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.
1. All hardware, including hinges and trolleys, shall be bolted to the panel for easy removal for service or panel replacement.
2. Doors up to 16 wide and under 30psf windload shall require no floor mounted supports, guides or tracks.
3. 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.

G. 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.

H. Hinge Guards: Provide plastic guards at jamb hinges to prevent access through hinge space.

I. Weatherstripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weatherstripping at center shall be 1/16" cloth inserted neoprene and include no exposed fasteners on the exterior face of the panel. Weatherstripping at sill shall include two 1/16" cloth inserted neoprene sweeps with an aluminum retainer. The retainer shall be attached to the door with adhesive.

J. Perimeter Weatherstripping: Provide jamb and head weatherstripping of 1/16" cloth-inserted neoprene bulb (or closed cell neoprene).

K. Vision Panels: Provide 1" insulated, tempered, vision panels of the size, shape and location as noted on the drawings.

2.3 OPERATOR

A. 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.

B. 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.

C. 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 coordinated and provided to comply with the building electrical system as indicated on the drawings.

D. 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. Incoming electrical shall be as indicated within drawings.
   1. Control panel assemblies shall be UL listed as per NFPA 70.
   2. Controls shall include a programmable logic controller with digital message display or LED indicators. Controller shall include programmable close timers and programmable inputs/outputs.
   3. Controls shall include a variable frequency drive with independent adjustment of the opening and closing speeds.
   4. Enclosures shall be NEMA 4 with disconnect switch.
   5. 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.
   6. Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position.
   7. Safety edges: Provide 4-wire fail-safe electric safety edges on leading edge of all doors to reverse door upon contact with obstruction.

8. 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.
9. Presence Sensor: Provide (1) interior, overhead mounted, presence sensor with pre-open and pre-close safety fields. Sensor shall be LZR-Widescan or equal.
10. Radio Controls: Provide five (5) radio receivers and (5) single button remotes per door. Remotes shall open and close doors with a single button.
11. Timer Activation Loop Detectors: Provide pulse on exit type" loop detector to activate auto close timer once loop has been activated and cleared, include hand/auto switch to deactivate timer. G.C. to coordinate installation of preformed loop with installer prior to exterior apron being poured.
12. 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.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install Four-Fold metal doors 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.

3.2 ADJUSTING AND CLEANING

A. Inspection of the doors and a complete operating test will be made by the installer in the presence of the general contractor or architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the general contractor must assume the responsibility for any damage or rough handling of the doors during construction until the building is turned over to the owner and final inspection is made.

B. Clean surfaces and repaint abraded or damaged finished surfaces to match factory-applied finish.

END OF SECTION 08 3516

SECTION 09 3000 - TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Stone thresholds.

D. Non-ceramic trim.

1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Face Size: Actual tile size, excluding spacer lugs.

C. Large Format Tile: Tile with at least one edge 15 inches (381 mm) or longer.

D. Module Size: Actual tile size plus joint width indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.
   1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, ceramic accessories, and setting details.

C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.

1.5 INFORMATIONAL SUBMITTALS

A. Certificate: Certify products of this section meet or exceed specified requirements.

B. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.

C. Installer's qualification statement.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.7 MAINTENANCE MATERIALS SUBMITTAL

A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Tile: 10 sq ft of each size, color, and surface finish combination.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.6

1.8 QUALITY ASSURANCE

A. Installer Qualifications:
1. Company specializing in performing tile installation, with minimum of five years of documented experience.
2. Installer Certification:
a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
b. Advanced Certifications for Tile Installers (ACT): Certification in installation of membranes, mortar bed (mud) floors, mortar (mud) walls, shower receptors, large format tile, gauged porcelain tile/panels/slabs, and grouts.

1.9 MOCK-UPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

B. Build mockup of each type of wall and floor tile installation.

C. Locate where directed by Architect.

D. Mock-up may remain as part of work.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.11 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

1.12 WARRANTY

A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.
   1. Warranty Period: Lifetime from date of Product Purchase.

PART 2 PRODUCTS

2.1 SOURCE LIMITATIONS

A. Tiling System: Obtain system products from single manufacturer and each aggregate from single source or producer.
   1. Obtain setting and grouting materials, except for unmodified portland cement and aggregate, from single manufacturer.
   2. Obtain underlayment from manufacturer of setting and grouting materials.
   3. Obtain waterproof membrane, crack isolation, and other required membranes from manufacturer of setting and grouting materials.
   4. Obtain joint sealants from manufacturer of setting and grouting materials.

B. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:
   1. Stone thresholds.

2.2 MANUFACTURERS

A. Provide Basis-of-Design Products listed on Interior Material Legend and specified within this specification or comparable products by the following:
   1. CT-#, Tile:
      a. Architessa.
      b. Dal-Tile Corporation.
      c. Mosaic Tile.
      d. Conestogo.
      e. Studio Collection.
      f. Umore.
   2. Setting Materials:
      a. ARDEX Engineered Cements.
      b. Custom Building Products.
      c. TEC Specialty Products LLC.
      d. LATICRETE International, Inc.
      e. Mapei Corporation.

3. Grout:
    a. ARDEX Engineered Cements.
    b. Custom Building Products.
    c. TEC Specialty Products LLC.
    d. LATICRETE International, Inc.
    e. Mapei Corporation.

2.3 PERFORMANCE REQUIREMENTS

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.

B. Floor Tile: Provide tile for flooring applications with minimum wet Dynamic Coefficient of Friction (DCOF) of 0.42 when tested in accordance with ANSI A326.3.

C. Moisture Absorption:
1. Ceramic Mosaic Tile and Porcelain Tile: 0 to 0.5 percent as tested in accordance with ASTM C373.
2. Glazed Wall Tile: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
3. Pressed Floor Tile: Moisture Absorption: 0.5 to 3.0 percent as tested in accordance with ASTM C373.

D. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

E. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

F. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

G. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.4 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, set with tile mortar or adhesive.
1. Applications:
    a. Open edges of wall and floor tile.
    b. Inside and outside wall corners.
    c. Transition between floor finishes of different heights.
    d. Thresholds at door openings.
    e. Floor and wall expansion and control joints.
    f. Floor-to-wall joints, including coved shaped profile.

g. Borders and other trim as indicated on drawings.

2. Basis-of-Design Manufacturer: Schluter Systems or comparable products by one of the following manufacturers:
   a. Blanke Corporation.
   b. Futura Transitions.
   c. LATICRETE International, Inc.
   d. Profilitec.

2.5 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
   1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on one edge, refer to Threshold details; without holes, cracks, or open seams.
   1. Material: Marble, honed finish.
   2. Color and Pattern: Uniform, fine- to medium-grained white stone with gray veining.
   3. Applications:
      a. At doorways where tile terminates.
      b. At open edges of floor tile where adjacent finish is a different height.

2.6 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

~~B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.~~
~~1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.~~
~~2. Applications: Large Format Tile at floors.~~
~~a. Basis-of-Design Products:~~
~~1) Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer.~~

~~C.~~B. Improved Latex-Portland Cement Mortar Bond Coat (thin-set): ANSI A118.15.
   1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.15.
   2. Applications: Use at large format tile floors, exterior or interior locations.
      a. Products:
         1) Mapei Corporation; Kerabond T/Keralastic System.
   3. Application: Use for wall and floor applications of large and heavy tile.
      a. Product:
         1) Mapei Corporation; Ultralite S1 Quick.
   4. Application: Use as typical setting bed for floor and wall installation, unless otherwise indicated.
      a. Product:
         1) Mapei Corporation; Ultralite S2.

~~D.~~C. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.1.
2. Application: Standard tiles and mosaic tiles in dry locations.
   a. Product: TEC Full Set Plus Unmodifed Thin-Set Mortar.

~~E. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, and water.~~
~~1. Products:~~
~~a. Mapei Corporation; Modified Mortar Bed.~~

2.7 GROUTS

~~A. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.~~
~~1. Applications: Use where indicated on drawings and where no other type of grout is indicated.~~
~~2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.~~
~~3. Color: As selected by Architect from manufacturer's full line.~~
~~4. Products:~~
~~a. Mapei Corporation; Ultracolor Plus FA.~~

~~B.~~A. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
1. Applications: Refer to Installation Schedule for locations.
2. Color: As selected by Architect from manufacturer's full line.
3. Products:
   a. Mapei Corporation; Kerapoxy CQ or Kerapoxy. Select to suit tile joints.

2.8 MAINTENANCE MATERIALS

A. Tile Sealant: See Section 07 9200.

~~B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.~~
~~1. Composition: Water-based colorless silicone.~~
~~2. Product: compatible with grout installed.~~

2.9 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 gap, minimum.
2. Fluid or Trowel Applied Type:
   a. Material: Synthetic rubber or Acrylic.
   b. Thickness: 20 mils, maximum.
   c. Products:
      1) Mapei Corporation; Mapelastic CI.
3. Bonded Sheet Membrane Type:
   a. Material: Polyethylene sheet membrane with polyester fleece laminated to underside, 20 mils thick.
   b. Products:

1) Schluter-Systems; DITRA.

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 gap, minimum; comply with ANSI A118.12.
2. Bonded Sheet Membrane Type: Contractor to select one of the following:
a. Material: Polyethylene sheet membrane with nonwoven fabric laminated to both sides, 20 to 30 mils thick, nominal.
b. Material: Polyethylene vinyl acetate (PEVA) core with nonwoven polypropylene laminated to both sides, 8 mils thick.
c. Products:
1) LATICRETE International, Inc; LATICRETE HYDRO BAN Sheet Membrane.
2) Mapei Corporation; Mapeguard WP 200 Membrane.
3) Schluter-Systems; KERDI.

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. Mortar Bonded Sheet Type:
a. Products:
1) LATICRETE International, Inc; LATICRETE HYDRO BAN Sheet Membrane.

~~D. Reinforcing Mesh: 2 by 2 inch size weave of 16/16 wire size; welded fabric, galvanized.~~

~~E.~~D. Tile Underlayment: Specifically designed for bonding to thin-set setting mortar; not primarily waterproofing material and having the following characteristics:
1. Crack Resistance: No failure at 1/16-inch gap, minimum; comply with ANSI A118.12.
2. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
3. Uncoupling Function: Allow for separation between membrane and mortar adhering tile to membrane when subjected to excessive substrate movement.
4. Suitable for installation over green concrete.

~~F. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.~~

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive tile.

B. Verify wall surfaces are smooth and flat within 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. Test in accordance with Section 09 0561.

2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Vacuum clean surfaces and damp clean.

B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

C. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

D. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot (1:50) toward drains.

E. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

F. Substrate Flatness:
1. For tile shorter than 15 inches (381 mm), confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. (6.4 mm in 3 m) from the required plane, and no more than 1/16 inch in 12 inches (1.5 mm in 300 mm) when measured from tile surface high points.

G. For large format tile, tile with at least one edge 15 inches (381 mm) or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. (3 mm in 3 m) from the required plane, and no more than 1/16 inch in 24 inches (1.5 mm in 609 mm) when measured from tile surface high points.

3.3 INSTALLATION - GENERAL

A. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

B. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

C. Mix mortars and grouts and mortar and grout manufacturers' written instructions.
1. Add materials, water, and additives in accurate proportions.
2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

D. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108/A118/A136, manufacturer's instructions, and TCNA (HB) installation methods.
   1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
      a. Tile floors in wet areas.
      b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
      c. Tile floors consisting of rib-backed tiles.
   2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
   3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
   4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
   5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
   6. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
      a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.
      b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
      c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
   7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

E. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly.

F. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

G. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

H. Form internal angles square and external angles square.

I. Install non-ceramic trim in accordance with manufacturer's instructions.

J. Thresholds: Install stone and solid surface thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
   1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in improved modified dry-set mortar (thinset).
   2. Do not extend cleavage membrane, waterproof membrane, or crack isolation membrane under thresholds set in modified dry-set, improved modified dry-set, or standard dry-set mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane, waterproof membrane, or crack isolation membrane with elastomeric sealant.

K. Metal Flooring Transitions: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

L. Metal Wall Trim: Install at locations indicated on Drawings.

M. Sound tile after setting. Replace hollow sounding units.

N. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

O. 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.
1. See Section 07 9200 for installation of sealant.

3.4 TILE BACKING BOARD

A. Refer to Section 09 29 00 - Gypsum Board for tile backer types and installation requirements.

3.5 INSTALLATION SCHEDULE, FLOORS

A. Concrete Subfloors:
~~1. TCNA F114: ANSI A108.1A Cement mortar bed (thickset) with cleavage membrane and reinforcing.~~
~~a. Application: Public Toilets.~~
~~b. Tiles: for tiles over 15 inches on long edge.~~
~~c. Bond Coat for Cured-Bed Method: Latex-Portland Cement Mortar Bond Coat.~~
~~d. Grout: Epoxy grout.~~
~~e. Joint Width: as recommended by tile manufacturer.~~
1. TCNA F125-Full: Thinset mortar on crack isolation membrane.
a. Application: Public Toilets.
b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
c. Grout: Epoxy grout.
d. Joint Width: as recommended by tile manufacturer.

B. Cleavage Membrane: Lap and seal watertight, edges and ends.

C. Waterproofing Membrane: Install as recommended by manufacturer and as specified in the section in which the product is specified.

~~D. Mortar Bed Thickness: 5/8 inchor as indicated as minimum thickness in TCNA manual.~~

~~E.~~D. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.6 INSTALLATION SCHEDULE, WALLS

A. Wood or Metal Studs or Furring:
1. TCNA W243: Thin-set mortar on gypsum board.
a. Application: at Dry Areas only, including backsplashes in kitchens and accent walls in restrooms without plumbing.
b. Thinset Mortar: Standard dry-set mortar.
c. Grout: Water-cleanable epoxy grout.
d. Waterproof Membrane: As recommended by setting material manufacturer.

e. Joint Width: as recommended by tile manufacturer.
f. Movement Joints: Types located on Drawings.

2. TCNA W245: Thinset mortar on glass-mat, water-resistant gypsum backer board over waterproof membrane.
   a. Application: Non-shower wet areas at bathrooms.
   b. Thinset Mortar: Improved modified dry-set mortar.
   c. Grout: Water-cleanable epoxy grout.
   d. Waterproof Membrane: As recommended by setting material manufacturer.
   e. Joint Width: as recommended by tile manufacturer.
   f. Movement Joints: Types located on Drawings.

3.7 CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.8 PROTECTION

A. Do not permit traffic over finished floor surface for 7 days after grout installation.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 09 3000

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SECTION 09 5100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

C. Supplementary insulation above ceiling.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.3 ACTION SUBMITTALS

A. Product Data: Provide data on suspension system components and acoustical units.

B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

C. Delegated Design Submittals: For seismic restraints for ceiling systems.
1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.

f. Access panels.
g. Perimeter moldings.

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/4 inch = 1 foot.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system from ICC-ES.

E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.7 QUALITY ASSURANCE

A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

1.8 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide Basis-of-Design Products indicated on Ceiling Types Schedule or provide comparable product by one of the following acceptable manufacturers.

B. Acoustic Tiles/Panels:
1. Armstrong World Industries, Inc.
2. Certainteed Architectural.
3. Rockfon.
4. USG Corporation.

C. Suspension Systems:
1. Same as for acoustical units.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Class A in accordance with ASTM E84.

B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category C and complying with the following:
1. Local authorities having jurisdiction.

2.3 ACOUSTICAL UNITS

A. Acoustical Panels CLG-1: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Classification: ASTM E1264 Type A.
a. Form: A2.2, wet formed.
b. Pattern: G - smooth.
2. Size: 24 by 24 inches.
3. Thickness: 1 inch.
4. Light Reflectance: 0.90 percent, in accordance with ASTM E1264.
5. Noise Reduction Coefficient (NRC): 0.90, in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 30, in accordance with ASTM E1264.
7. Panel Edge: Square.
8. Color: White.
9. Suspension System: Exposed grid.

B. Acoustical Panels, CLG-3: Mineral fiber with scrubbable finish, with the following characteristics:
1. Classification: ASTM E1264 Type A.
a. Form: A3.2, wet formed.
b. Pattern: G - smooth.
2. Size: 24 by 24 inches.
3. Thickness: 5/8 inch.
4. Light Reflectance: 0.89 percent, in accordance with ASTM E1264.
5. Ceiling Attenuation Class (CAC): 33, in accordance with ASTM E1264.
6. Panel Edge: Square.
7. Color: White.
8. Suspension System: Exposed grid.

2.4 SUSPENSION SYSTEMS

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. Steel Grid: ASTM A653/A653M, G60 coating, unless otherwise indicated.

B. Exposed Suspension System: Hot-dip galvanized steel grid with aluminum cap.
1. Applications: Seismic.
2. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
3. Profile: Tee; 15/16 inch face width.
4. Finish: Baked enamel.
5. Color: White.

2.5 ACCESSORIES

~~A. Plenum Barrier Board Insulation: at CLG-1A and CLG-2A.~~
~~1. Basis-of-Design Product: provide ROCKFON; Plenum Barrier Board or comparable product submitted to Architect for review.~~
~~2. Physical and Performance Characteristics:~~
~~a. Size: 24-inches by 48-inches.~~
~~b. Thickness: 1-1/2-inches.~~
~~c. Warning Label: Printed in black ink on the facing shall be warning labels 4" high by 4" wide spaced 12" inches in both directions with the words "Noise Barrier. Do not remove barrier or damage foil facing." Warning labels shall be oriented in all four directions in ninety degree increments so legible from any edge of the board.~~
~~d. Density: 8.0 lbs/cu ft (actual density).~~
~~e. Fire Class: Class A.~~
~~f. Fire Performance: UL 723 (ASTM E84) Flame Spread / Smoke Developed: no greater than 25/50.~~

A. Acoustical Batt: As indicated in Section 09 2900 - Gypsum Board.
1. Thickness: 2-inches, or as indicated on drawings.
2. Size: to fit acoustical suspension system.

B. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

C. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

D. Hold-Down Clips: Manufacturer's standard clips to suit application.

E. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.

F. Perimeter Moldings: Same metal and finish as grid.
1. Size: As required for installation conditions and specified Seismic Design Category.
2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
3. Channel Molding: U-shaped, for hold-down type installations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.2 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.

3.3 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions, as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Use longest practical lengths.

E. Seismic Suspension System, Seismic Design Category C: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Maintain a 3/8 inch clearance between grid ends and wall.

F. 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.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

3.4 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.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

G. Install hold-down clips on panels within 20 ft of an exterior door.

~~H. Install plenum barrier board insulation to form contiguous sound barrier above demising walls according to manufacturer's instructions.~~
~~1. Install at locations indicated as CLG-1A and CLG-2A.~~

H. At locations indicated on Drawings, place acoustical batt insulation above acoustical ceilings.

3.5 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.6 FIELD QUALITY CONTROL

A. Site Tests and Inspections: Inspect around and between installed plenum barrier boards and around penetrating elements and fill openings with non-hardening acoustic sealant.

B. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
1. Periodic inspection during the installation of suspended ceiling grids in accordance with ASCE/SEI 7.

C. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
1. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
2. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 bf (1957 N) of tension.
3. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. See Section 01 4000 "Quality Requirements" for retesting and reinspecting requirements and Section 01 7300 "Execution" for requirements for correcting the Work.

E. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.7 CLEANING

A. Clean surfaces.

B. Replace damaged or abraded components.

END OF SECTION 09 5100

SECTION 09 6623 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Epoxy matrix terrazzo with ground and polished finish.

B. Divider strips.

1.2 ACTION SUBMITTALS

A. Product Data: Provide data for divider strips, control joint strips, expansion joints, and sealer; include printed copy of current NTMA recommendations for type of terrazzo specified.

B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:
1. Divider strips.
2. Control-joint strips.
3. Accessory strips.
4. Terrazzo patterns.

C. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:
1. Terrazzo: 6 inch square Samples.
2. Accessories: 6 inch long Samples of each exposed strip item required.

1.3 INFORMATIONAL SUBMITTALS

A. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

B. Manufacturer's Qualification Statement.

C. Installer's Qualification Statement.

1.4 CLOSEOUT SUBMITTALS

A. Cleaning and Maintenance Data: Include procedures for stain removal, stripping, protection system, and sealing.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with NTMA recommendations as posted at their web site at www.ntma.com.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section.

1. Minimum five years of documented experience.
2. Approved by matrix manufacturer.
3. Contractor member of the National Terrazzo and Mosaic Association, Inc.

1.6 MOCK-UP

A. Construct mock-up of terrazzo illustrating appearance of finished work in each configuration required. Size mock-up to be not less than 3 by 3 feet.

B. Build mockups for terrazzo including accessories.
1. Include base.

C. Locate where directed.

D. Mock-up may remain as part of the work.

E. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

C. Maintain minimum temperature of 60 degrees F.

D. Keep products away from fire or open flame.

1.8 FIELD CONDITIONS

A. Do not install terrazzo when temperature is below 50 degrees F or above 90 degrees F.

B. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of flooring.

C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

~~D. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.~~

~~E. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.~~

~~F.~~D. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design - Resinous Matrix Terrazzo Flooring: Key Resin; Key Epoxy Terrazzo System or comparable product listed as other acceptable manufacturers.

B. Other Acceptable Manufacturers - Resinous Matrix Terrazzo Flooring:
1. Sherwin-Williams High Performance Flooring.
2. TERRAZZCO, a brand of Concord Terrazzo Company.
3. Terrazzo & Marble Supply Companies.

2.2 EPOXY MATRIX TERRAZZO APPLICATIONS

A. TZ-1, Floors:
1. Thickness: 3/8 inch, nominal.
2. Color(s): As indicated on drawings.
3. Aggregate Type: Marble chips.
4. Aggregate Size: No. 2.

B. B-3, Wall Base:
1. Thickness: Same as floors.
2. Style: Coved.
3. Color(s): As indicated on drawings.
4. Aggregate Type and Size: Same as floors.

2.3 MATERIALS

A. Epoxy Matrix Terrazzo: Aggregate and matrix mix applied to substrate, troweled flat, and ground smooth.
1. Mix Proportions: As required to achieve appearance specified.
2. Physical Properties without Aggregates:
a. Hardness: 60 to 85 per ASTM D2240, Shore D.
b. Minimum Tensile Strength: 3000 psi per ASTM D638 for a 2-inch (51-mm) specimen made using a "C" die per ASTM D412.
c. Minimum Compressive Strength: 10,000 psi per ASTM D695, Specimen B cylinder.
d. Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D1308.
1) Distilled water.
2) Mineral water.
3) Isopropanol.
4) Ethanol.
5) 0.025 percent detergent solution.
6) 1.0 percent soap solution.
7) 5 percent acetic acid.
8) 10 percent sodium hydroxide.
9) 10 percent hydrochloric acid.
10) 30 percent sulfuric acid.

3. Physical Properties with Aggregates: For terrazzo blended according to manufacturer's recommendations with one part epoxy resin with three parts marble aggregate consisting of 60 percent No. 1 chips and 40 percent No. 0 chips that is ground and grouted to a 1/4 inch nominal thickness, and cured for 7 days at 75 deg F plus or minus 2 deg F and at 50 percent plus or minus 2 percent relative humidity.
   a. Flammability: Self-extinguishing, maximum extent of burning 1/4 inch according to ASTM D635.
   b. Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F according to ASTM C 531.

B. Matrix: Two component resin and epoxy hardener with mineral filler and color pigment, non-volatile, thermo-setting.

C. Aggregate: Type as indicated; sized in accordance with NTMA aggregate gradation standards; color(s) as indicated, uniform in color.
1. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M.
2. 24-Hour Absorption Rate: Less than 0.75 percent.
3. Dust Content: Less than 1.0 percent by weight.

D. Finishing Grout: Epoxy, color to match terrazzo matrix.

2.4 ACCESSORIES

A. Substrate-Crack-Suppression Membrane: Product of terrazzo-resin manufacturer, having minimum 120 percent elongation potential according to ASTM D412.
1. Reinforcement: Fiberglass scrim.

B. Divider Strips: 1/8 inch thick zinc exposed top strip, zinc coated steel concealed bottom strip, with anchoring features.

C. Control Joint Strips: 1/8 inch nominal width zinc exposed top strips, zinc coated steel concealed bottom strips, 1/8 inch wide neoprene filler strip between vertical strips, with anchoring features.

D. Divider and Control Joint Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.

E. Base Cap, Base Divider Strip, and Separator Strip: Match divider strips.

F. Sealer: Colorless, non-yellowing,Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer.
1. Surface Friction: Not less than 0.6 according to ASTM D2047.
2. Acid-Base Properties: With pH factor between 7 and 10.

G. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

H. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

I. Primer: as recommended by manufacturer.

2.5 FLOOR PROTECTION SYSTEM

A. Basis-of-Design Product: 3M Stone Floor Protection System or submit for Architect's review comparable floor protection system by another manufacturer.

B. Abrasive Pads:
   1. Product: 3M Trizact Diamond TX Abrasive Pads and Scotch-Brite™ Diamond Floor Pads coarse grit though very fine grit as outlined in the Scotchgard™ Stone Floor Protector Technical Bulletin, Revision C, dated March 2021.

C. Polish: sealer and stain resisting polish.
   1. Product: 3M Scotchgard Stone Floor Protector.

D. Maintenance Brush:
   ~~1.~~1. Scotch-Brite Purple Diamond Floor Pad Plus.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive terrazzo.

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 terrazzo.

C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for terrazzo flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 0561.
   2. Obtain instructions if test results are not within limits recommended by terrazzo flooring manufacturer.
   3. Follow moisture and alkalinity remediation procedures in Section 09 0561.

3.2 PREPARATION

A. Clean substrate of foreign matter.

B. Prepare concrete subfloor by mechanically abrading surface in accordance with manufacturer's instructions.

C. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.
   1. Prepare and prefill substrate cracks with membrane material.
   2. Install membrane at substrate cracks in areas to receive terrazzo.
   3. Reinforce membrane with fiberglass scrim.

D. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
   1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

2. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

E. Apply primer in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
1. Saw cut substrate to install divider and control joint strips.
2. Install control-joint strips with 1/4 inch gap between strips, and install sealant in gap.
3. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
4. Accessory Strips: Install as required to provide a complete installation.
5. Install terminating cap strip at top of base; attach securely to wall substrate.

B. Apply primer in accordance with manufacturer's instructions.

C. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.
1. Installed Thickness: 3/8 inch nominal.
2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
   a. Finish terrazzo to NTMA requirements.
   b. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
   c. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
   d. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with 80-grit stones or with comparable diamond abrasives until grout is removed from surface.
3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.

D. Install and finish poured-in-place terrazzo stairs at the same time the adjacent terrazzo flooring is installed.

E. Install and finish poured-in-place terrazzo base at the same time the adjacent terrazzo flooring is installed.

3.4 FLOOR PROTECTION SYSTEM

A. Aftermarket Floor Protection System: The terrazzo contractor shall furnish and apply the complete 3M Floor Protection System on all epoxy terrazzo floor surfaces during final cleaning, after completion of construction activities and prior to Owner occupancy.

B. Include cleaning, removal of the protective terrazzo seal coat using compatible methods, and surface preparation using 3M Trizact Diamond Abrasive Pads and Scotch-Brite Diamond Floor Pads as outlined in the Scotchgard Stone Floor Protector Technical Bulletin, Revision C, dated March 2021. Apply two thin, uniform coats of Scotchgard Stone Floor Protector. Allow each coat to dry and burnish each coat using Scotch-Brite Purple Diamond Floor Pad Plus in accordance with the manufacturer’s written instructions.

C. Verify compatibility with the installed terrazzo and existing surface treatments. Complete a representative test area for Architect approval before proceeding with the remaining floor areas. Coordinate preparation to preserve the specified terrazzo finish.

D. Floor protection following initial completion of the terrazzo installation remains required in accordance with the Contract Documents. The aftermarket floor protection system does not replace this requirement.

E. Provide the Owner with the manufacturer's written cleaning and maintenance instructions at closeout.

~~3.4~~3.5 REPAIR

A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

~~3.5~~3.6 TOLERANCES

A. Maximum Variation from Flat Surface: 1/4 inch in 10 feet.

B. Maximum Variation from Level (Except Surfaces Sloping to Drain): 1/8 inch.

~~3.6~~3.7 CLEANING

A. Scrub and clean terrazzo surfaces with neutral pH cleaner in accordance with manufacturer's instructions. Let dry.

B. Immediately after terrazzo has dried, apply sealer in accordance with manufacturer's instructions.

C. Polish surfaces in accordance with manufacturer's instructions.

~~3.7~~3.8 PROTECTION

A. Protect finished terrazzo from damage due to subsequent construction until Date of Substantial Completion.

END OF SECTION 09 6623

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. High performance coatings applied at the following locations:
   1. Exterior surfaces including:
      a. Hollow metal doors and frames.
      b. Railings.
      c. Bollards.
   2. Interior surfaces locations: includes vertical surfaces, doors, door frames, mezzanines, guardrails, ladders, and materials within locations indicated below, unless otherwise indicated.
      a. Apparatus bays.
      b. Decontamination/Transition Areas.
      c. Turnout Gear locker rooms.
      d. Water Sprinkler Rooms.
      e. Mechanical and Electrical Rooms.
      ~~f. Exposed Steel Decking.~~
   3. As indicated on Drawings.

B. Surface preparation.

1.2 ACTION SUBMITTALS

A. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
   3. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

B. Samples: Submit two samples 8 by 8 inch in size illustrating colors available for selection.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include cleaning procedures and repair and patching techniques.

1.5 MAINTENANCE MATERIALS SUBMITTALS

A. Extra Coating Materials: 1 gallon of each type and color.

B. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years documented experience.

1.7 MOCK-UPS

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
      a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 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 coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.9 FIELD CONDITIONS

A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.

C. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.

D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

F. Restrict traffic from area where coating is being applied or is curing.

1.10 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.
   1. Warranty: Include coverage for bond to substrate and degradation of chemical resistance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide high performance coating products from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

B. High-Performance Coatings:
   1. Basis-of-Design Products: provide products listed or comparable product by one of the following:
      a. Pittsburgh Paints.
      b. Sherwin-Williams Company.
      c. Tnemec Company, Inc.
      d. Wolf-Gordon.

2.2 HIGH-PERFORMANCE COATINGS

A. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified and as indicated for each system noted:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
   2. NFPA 101, Class A rated.
   3. Lead Content: Not greater than 0.06 percent by weight of total nonvolatile content.
   4. Volatile Organic Compound (VOC) Content: See Section 01 6116.

B. Exterior Contact Steel and Interior Misc Metal Primer:
   1. Waterborne, containing 1 gram/litre or less VOC.
   2. ASTM D 4060 Abrasion – No more than 149 mg loss after 1,000 cycles.
   3. ASTM D 5441 (Method E, Type V) Adhesion – No less than 1,989 psi after 10 freeze/thaw cycles.
   4. ASTM D 4585 Humidity- NO blistering, cracking, rusting or delamination of the film after 2,000 hours exposure.

C. Exterior Contact Steel, Interior Misc Metal, Interior Washdown Concrete Masonry Block and Gypsum Board, Finish Coat:
   1. Waterborne, containing 93 gram/litre or less VOC.
   2. ASTM D 4060, CS-17 Wheel, 1,000 gram load, Abrasion – No more than 30.7 mg loss after 1,000 cycles.

3. Covered Spot Stain Test – No effect after 24 hours exposure to the following reagents; grape jam, lime juice, dish soap, 409 cleaner, margarine, vegetable oil, lipstick, Clorox, vinegar, crayon, toothpaste.
4. ASTM D 3363, Pencil Hardness – No less than a rating of 5H (gouge).
5. ASTM D 4213, Scrubbability – No more than 80 mg loss after 1,000 cycles.

D. Interior Washdown Concrete Masonry Block and Gypsum Board, First and Second Coat:
1. Waterborne, containing 2.51 gram/litre VOC or less.
2. Maximum thickness in one coat , 12.0 mils.
3. ASTM D1308, Stain Resistance – No effect after 24 hour exposure to the following reagents; 5% soap, 5% sodium hydroxide, 5% ammonium hydroxide, toothpaste, 409 cleaner, tea, dish soap, vegetable oil, black shoe polish, crayon, lipstick, lighter fluid.

2.3 COATING SYSTEMS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
1. HPC and RES Colors: As indicated on Drawings.

B. Exterior Contact Steel and Interior Miscellaneous Metals:
1. Primer: Tnemec Series 1224 Epoxoline WB at 4.0-6.0 mils DFT or as indicated in specific material schedule. Ensure compatiblity between primer and topcoats.
2. Intermediate and Finish: Tnemec Series 297 EnviroGlaze, two coats each at 2.0-3.0 mils DFT.
3. Application Locations include, but are not limited to, the following:
   a. Exterior Hollow Metal Doors and Frames.
   b. Exterior and Interior Railings and Guards.
   c. Bollards.

~~C. Dryfall Coating for Interior Steel Decking:~~
~~1. Primer: Tnemec Series 115 at 2.0-4.0 mils DFT.~~
~~2. Finish Coat: Tnemec Series 115 at 2.0-4.0 mils DFT.~~
~~3. Application: As located on Drawings for exposed steel decking.~~

~~D.~~C. Interior Washdown at concrete masonry block walls:
1. Block Filler: Tnemec Series 130 EnviroFill at approx. 80 ft per gallon.
2. First Coat: Tnemec Series 288 EnviroPox at 4.0-6.0 mils DFT.
3. Second Coat: Tnemec Series 288 EnviroPox at 4.0-6.0 mils DFT.
4. Finish Coat: Tnemec Series 297 Enviro-Glaze at 2.0-3.0 mils DFT.
5. Application Locations include, but are not limited to, the following:
   a. Transition and Decontamination.

~~E.~~D. Interior Washdown at gypsum board ceilings:
1. First Coat: Tnemec Series 288 EnviroPox at 4.0-6.0 mils DFT.
2. Second Coat: Tnemec Series 288 EnviroPox at 4.0-6.0 mils DFT.
3. Finish Coat: Tnemec Series 297 Enviro-Glaze at 2.0-3.0 mils DFT.
4. Application Locations include, but are not limited to, the following:
   a. Toilet & Shower Rooms.

~~F.~~E. Interior High Performance at concrete masonry block walls:
1. Block Filler: Tnemec Series 130 EnviroFill at approx. 80 ft per gallon.
2. Intermediate and Finish: Tnemec Series 1028 EnduraTone, two coats each at 2.0-3.0 mils DFT.
3. Application Locations include, but are not limited to, the following:
   a. Turnout Gear Locker Rooms.
   b. Tool Room
   c. SCBA Room.
   d. Apparatus Bays.

~~G.~~F. Interior High Performance at gypsum board walls and ceilings:
1. Primer: Tnemec Series 151-1051 ElastoGrip at 0.7-1.5 mils DFT
2. Intermediate and Finish: Tnemec Series 1028 EnduraTone, two coats each at 2.0-3.0 mils DFT
3. Application Locations include, but are not limited to, the following:
   a. Training Areas.
   b. Locker Rooms.
   c. Water/Sprinkler.
   d. Mechanical Room.
   e. Electrical Room.

~~H.~~G. High-Build Epoxy Coating, Type RES-6:
1. Number of Coats: Two.
2. Product Characteristics:
   a. Percentage of solids by volume, 100, minimum.
3. Top Coat(s): Epoxy/Urethane, High-Build.
   a. Sheen: Gloss.
   b. Products: As indicated on Material Finish Key.
4. Primer: As recommended by coating manufacturer for specific substrate.

~~I.~~H. Shellac: Pure, white type.

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 12 percent.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
3. Concrete Floors and Traffic Surfaces: 8 percent.

G. Masonry: Verify masonry joints are struck flush.

H. Proceed with coating application only after unacceptable conditions have been corrected.
1. Commencing coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

B. Clean surfaces of loose foreign matter.

C. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

D. Remove finish hardware, fixture covers, and accessories and store.

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 coating manufacturer and in accordance with SSPC-SP 13/NACE No.6.

F. Masonry:
1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
2. Prepare surface as recommended by coating manufacturer.

G. 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.

H. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3, and protect from corrosion until coated.

3.3 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

B. Concrete: Prior to priming, patch with masonry filler to produce smooth surface.

C. Concrete Masonry: Apply masonry filler to thickness required to fill holes and produce smooth surface; minimum thickness of 30 mils.

3.4 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.5 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.6 PROTECTION

A. Protect finished work from damage.

END OF SECTION 09 9600

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SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower and bath accessories.

C. Diaper changing stations.

D. Utility room accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.3 ACTION SUBMITTALS

A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify accessories using designations indicated.

C. Delegated Design Submittals: For grab bars ~~and shower seats~~.

D. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.4 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, visible silver spoilage defects.
   2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Design accessories and fasteners to comply with the following requirements:
   1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

~~2. Shower Seats: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.~~

2.2 MANUFACTURERS

A. Provide Basis-of-Design Products listed in Toilet Room Accessories Schedule or comparable products from the following submitted for Architect's review:
1. American Specialties, Inc.
2. Bradley Corporation.
3. Bobrick.
4. Georgia-Pacific Professional.
5. Kimberly-Clark Corporation.

B. Provide products of each category type by single manufacturer.

2.3 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.
1. Grind welded joints smooth.
2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide 6 keys for each accessory to Owner; master key lockable accessories.

2.4 TOILET ACCESSORIES

A. TA1 thru TA5, Grab Bars: Stainless steel, peened surface.
1. Standard Duty Grab Bars:
   a. Push and Pull Point Load: Minimum 250 lbf.
   b. Dimensions: 1-1/4 inch outside diameter, minimum 18-gauge, 0.05-inch steel thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
   c. Finish: Satin.
   d. Length and Configuration: As indicated on drawings.

B. Soap Dispenser:
1. TA9, Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and vertical stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
   a. ADA compliant, less than 5 lbs of force to operate push valve.
   b. Minimum Capacity: 40 ounces.
   c. Concealed, vandal-resistant mounting.

C. Mirrors: Stainless steel framed, 1/4 inch thick tempered safety glass; ASTM C1048.
1. 10A, Frame: 3/4 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; matte black finish ~~finish~~.
2. 10B, Frame: 1/2 inch channel shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.

D. Paper Towel Dispenser:
1. TA11, Folded paper type, stainless steel, surface-mounted, with viewing slots on sides as refill indicator and tumbler lock.
   a. Capacity: 400 C-fold; 525 multifold minimum.
   b. ADA compliant.

E. Sanitary Napkin Disposal Unit:
1. 10A, Stainless steel, surface-mounted, self-closing door with full-length stainless steel piano-type hinge, removable receptacle.
   a. Capacity: 1.0 gal.
   b. ADA Compliant.
2. 10B, Stainless steel, back-to-back partition mounting with adjustable flanges, self-closing door with full-length stainless steel piano-type hinge, removable receptacle.
   a. Capacity: 1.0 gal.
   b. ADA Compliant.

F. Toilet Paper ~~Dispener~~Dispenser:
1. TA15A, Toilet Paper Dispenser: Double roll, surface mounted, for cored type rolls.
   a. Mounting: Surface.
   b. Theft resistant spindles.
   c. Material: Stainless Steel, type 304.
   d. Finish: Satin.
   e. Construction: all-welded.
2. TA15B, Double roll, surface mounted bracket type, stainless steel, spindleless type for tension spring delivery designed to prevent theft of tissue roll.

G. TA25, Combination Sanitary Napkin/Tampon Dispenser: Stainless steel, recessed.
1. Door: Seamless door with returned edges and tumbler lock.
2. Cabinet: Fully welded, 0.048 inch thick sheet.
3. Operation: No charge; no coin slots.
4. Identify dispensers slots without using brand names.
5. Minimum capacity: 20 napkins and 30 tampons.

2.5 COMMERCIAL SHOWER AND BATH ACCESSORIES

~~A. TA7, Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand and L-shaped, left hand seat (reversible).~~
~~1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of white color.~~
~~2. Size: ADA Standards compliant.~~

~~B.~~A. TA12, Robe Hook: Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.6 DIAPER CHANGING STATIONS

A. TA6, Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
1. Material: Plastic molded interior with Stainless steel shell.

2. Mounting: Recessed.
3. Minimum Rated Load: 250 pounds.
4. ADA Compliant.

2.7 UTILITY ROOM ACCESSORIES

A. TA21, Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 3/4 inch returned edges, 0.06 inch steel wall brackets.
1. Hooks: 4, 0.06 inch stainless steel rag hooks at shelf front.
2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
3. Length: 34 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. See Section 06 1053 - Miscellaneous Rough Carpentry and 09 2216 - Non-Structural Metal Framing for installation of blocking, reinforcing plates, and concealed anchors in walls.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3 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.

D. Grab Bars: Install to comply with specified structural-performance requirements.

~~E. Shower Seats: Install to comply with specified structural-performance requirements.~~

3.4 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 2800

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SECTION 12 2400 - WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior manual roller shades.

1.2 ACTION SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
   1. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

B. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

C. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

B. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of this type with minimum 3 years of documented experience with shading systems of similar size and type.

1.6 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.

1.7 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Interior Manually Operated Roller Shades: Provide products indicated on Equipment Schedule or submit for Architect's review comparable products from one of the following:
1. Draper, Inc.
2. Hunter Douglas Architectural.
3. Inpro Corporation.
4. SWFcontract, a division of Springs Window Fashions, LLC..

2.2 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. Roller Shades Type EQ37:
1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   a. Drop Position: Regular roll.
   b. Roll Direction: Roll down, closed position is at window sill.
   c. Size: As indicated on drawings.
   d. 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. Material: Stamped steel.
3. Roller Tubes: As required for type of shade operation.
   a. Material: Extruded aluminum, clear anodized finish.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
   a. Provide a permanently lubricated brake assembly mounted on an oil-impregnated hub with wrapped spring clutch.
   b. Brake must withstand minimum pull force of 50 lb in the stopped position.
   c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 lb minimum breaking strength. Provide upper and lower limit stops.
   a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
7. Accessories:
   a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.

b. Profile: Square.
c. Configuration: Captured; fascia stops at bracket end.

C. Roller Shades Type EQ38:
1. Description - Interior Roller Shades: Double roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   a. Drop Position: Regular roll.
   b. Roll Direction: Roll down, closed position is at window sill.
   c. Size: As indicated on drawings.
   d. 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. Per drawings, provide manufacturer's bracket #10.
   b. Material: Stamped steel.
   c. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
      1) Light-Filtering Fabric: Room-side of opening.
      2) Room-Darkening Fabric: Glass-side of opening.
3. Roller Tubes: As required for type of shade operation.
   a. Material: Extruded aluminum, clear anodized finish.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
   a. Provide a permanently lubricated brake assembly mounted on an oil-impregnated hub with wrapped spring clutch.
   b. Brake must withstand minimum pull force of 50 lb in the stopped position.
   c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 lb minimum breaking strength. Provide upper and lower limit stops.
   a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
7. Accessories:
   a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
   b. Profile: Square.
   c. Configuration: Captured; fascia stops at bracket end.
   d. Room-Darkening Channels: Extruded aluminum side and center channels with brush pile edge seals, SnapLoc mounting base, and concealed fasteners. Channels to accept one-piece exposed blackout hembar to assure side light control and sill light control.
   ~~a.~~e. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.3 SHADE FABRIC

A. Fabric for Light-Filtering Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Material: 100 percent polyester.
   2. Material Certificates and Product Disclosures:
      a. Cradle to Cradle Material Health Certificate: Achievement level of Bronze.
      b. Health Product Declaration (HPD): Complete, published declaration with full disclosure of known hazards.
      c. Environmental Product Declaration (EPD): Complete, published declaration and life cycle analysis.
      d. Declare Label: Published label with disclosure of Red List status.
   3. Performance Requirements:
      a. Flammability: Pass NFPA 701 large and small tests.
   4. Openness Factor: 1 %.
   5. Weight: 8.88 ounces per square yard.
   6. Roll Width: 118 inches.

B. Fabric for Room-Darkening Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Material: Polyester with acrylic backing.
   2. Material Certificates and Product Disclosures:
      a. Health Product Declaration (HPD): Complete, published declaration with full disclosure of known hazards.
      b. Environmental Product Declaration (EPD): Complete, published declaration and life cycle analysis.
   3. Performance Requirements:
      a. Flammability: Pass NFPA 701 large and small tests.
   4. Weight: 11.50 ounces per square yard.
   5. Roll Width: 126 inches.

2.4 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window sill.
   2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

3.2 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.

3.3 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.

3.4 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.5 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 12 2400

SECTION 12 3661 - SIMULATED STONE COUNTERTOPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Simulated stone countertops.
2. Simulated stone backsplashes.
3. Simulated stone end splashes.
4. Simulated stone apron fronts.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials and accessories.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for fittings and plumbing fixtures.
1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification: For the following products:
1. Countertop material, 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For simulated stone countertop countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
1. Build mockup of typical countertop as indicated on Drawings.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Countertops and supports: in accordance with ANSI/AWI 1236 - Countertops.

2.2 COUNTERTOP MATERIALS

A. SS-1, Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
1. Basis-of-Design Products: per Interior Material Schedule or submit for Architect's review comparable products by one of the following:
   a. Corian.
   b. Formica Corporation.
   c. LX Hausys.
   d. Krion.
   e. Meganite Inc.
   f. Terreon.
   g. Wilsonart LLC.
2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Colors and Patterns: As indicated by manufacturer's designations.

B. QZ-1 and QZ-2, Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.
1. Basis-of-Design Products: per Interior Material Schedule or submit for Architect's review comparable products by one of the following:
   a. Evero.
   b. Cambria.
   c. Cosentino North America; C&C North America, Inc.
   d. Corian.
   e. LX Hausys.
   f. Meganite Inc.
   g. MSI Surfaces.
   h. Wilsonart LLC.
2. Colors and Patterns: As indicated by manufacturer's designations.
3. QZ-1, Surface finish: Gloss.

C. Composite Wood Products: Formaldehyde emission rates shall not be greater than the following when tested according to ASTM D 6007 or ASTM E1333:
   1. Hardwood Plywood: 0.05 ppm.

D. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.3 FABRICATION

A. Fabricate countertops according to simulated stone countertop manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
   1. Grade: Premium.

B. Countertops:
   1. 3/4-inch- (19-mm-) thick, simulated stone countertop with front edge built up with same material.

C. Backsplashes: 3/4-inch- (19-mm-) thick, simulated stone countertop.

D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with simulated stone countertop manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   1. Fabricate with loose backsplashes for field assembly.

E. Joints:
   1. Fabricate countertops without joints, unless unavoidable.
   2. Fabricate countertops in sections for joining in field.
      a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
      b. For quartz agglomerate countertops:
         1) Joint Type, Bonded: 1/32 inch or less in width.
         2) Joint Type, Grouted: 1/16 inch in width.
         3) Joint Type, Sealant Filled: 1/16 inch in width.
      c. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints where indicated. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

F. Cutouts and Holes:
   1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
      a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
   2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
   3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.4 INSTALLATION MATERIALS

A. Adhesive: Product recommended by simulated stone countertop manufacturer.
   1. Adhesives shall have a VOC content of 70 g/L or less.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 - Joint Sealants.

C. Countertop Support Brackets: As indicated on Drawings.
~~1. Manufacturer: Centerline Brackets or comparable manufacturer submitted for Architect's review.~~
~~2. Bracket Types:~~
~~a. Concealed Island Support.~~
~~b. Floating Wall Mount Bracket.~~
~~c. T-Bracket or Hidden flat bracket designed for hidden countertop support, ponywall support, or island support.~~
~~3. Length: provide as required to support weight and overhang length of countertop.~~
~~4. Loads: furnish brackets designed to withstand loads of countertops.~~

2.5 ACCESSORIES

A. Grommets:
1. EQ56, Trash Management:
   a. Basis-of-Design: Doug Mockett; TM12B or submit comparable product for Architect's review.
2. Finish: matte black.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive simulated stone countertop countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to simulated stone countertop manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
   1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 07 9200 - Joint Sealants.

END OF SECTION 12 3661

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SECTION 13 3419 - METAL BUILDING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufacturer-engineered, shop-fabricated structural steel building frame.

B. Insulated Metal wall and roof panels including gutters and downspouts.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.
1. Review methods and procedures related to metal building systems including, but not limited to, the following:
   a. Condition of foundations and other preparatory work performed by other trades.
   b. Structural load limitations.
   c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
   d. Required tests, inspections, and certifications.
   e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.
2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
   a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
   b. Structural limitations of purlins and rafters during and after roofing.
   c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
   d. Temporary protection requirements for metal roof panel assembly during and after installation.
   e. Roof observation and repair after metal roof panel installation.
3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
   a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
   b. Structural limitations of girts and columns during and after wall panel installation.
   c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
   d. Temporary protection requirements for metal wall panel assembly during and after installation.
   e. Wall observation and repair after metal wall panel installation.

1.3 ACTION SUBMITTALS

A. Product Data: Provide data on profiles, component dimensions, fasteners.

B. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections, attachments, openings, cambers, and loads; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and installation; framing anchor bolt settings, sizes, locations from datum, and foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
   1. Metal Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
      a. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
   2. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
      a. Flashing and trim.
      b. Gutters.
      c. Downspouts.

C. Delegated Design Submittals: For metal building systems.
   1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Manufacturer's Instructions: Indicate preparation requirements, anchor bolt placement.

E. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.

1.4 INFORMATIONAL SUBMITTALS

A. Designer's Qualification Statement.

B. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under IAS AC472.
   1. Include statement that manufacturer designs and fabricates metal building system as integrated components and assemblies, including but not limited to primary structural members, secondary members, joints, roof, and wall cladding components specifically designed to support and transfer loads and properly assembled components form a complete or partial building shell.

C. Erector's Qualification Statement.

D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

E. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
   1. Name and location of Project.
   2. Order number.
   3. Name of manufacturer.
   4. Name of Contractor.
   5. Building dimensions including width, length, height, and roof slope.
   6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.

7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads.
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

F. Material Test Reports: For each of the following products:
1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of concealed components and utilities.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
1. Design Engineer Qualifications: Licensed in the State in which the Project is located.
2. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.

B. Perform work in accordance with AISC 360 and MBMA (MBSM).
1. Maintain one copy on site.

C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
1. Not less than three years of documented experience.
2. Accredited by IAS in accordance with IAS AC472.
3. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

D. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3, and no more than 12 months before start of scheduled welding work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed.

B. Unload, store, and erect materials in a manner to prevent bending, warping, twisting, and surface damage.

1.8 WARRANTY

A. Provide 20 year manufacturer warranty for metal building system.
   1. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Buildings Systems:
   1. Butler Manufacturing Company.
   2. Ceco Building Systems.
   3. Chief Buildings.
   4. Kirby Building Systems, a Nucor Company.
   5. Metallic Building Systems.
   6. Nucor Building Systems.
   7. Red Dot Buildings.
   8. VP Buildings.

2.2 SYSTEM DESCRIPTION

A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.

2.3 ASSEMBLIES

A. Rigid Modular: Solid-member, structural-framing system with interior columns.

B. Primary Framing: Rigid frame of rafter beams and columns, intermediate columns, braced end frames, and end wall columns, and wind bracing.

C. Secondary Framing: Purlins, Girts, and Eave struts, and other items detailed.

D. Wall System: Preformed metal panels of vertical profile, with sub-girt framing/anchorage assembly and insulation, and accessory components. Refer to Section 07 4213 - Metal Wall Panels for selected materials and installation requirements.

E. Roof System: Preformed metal panels oriented parallel to eave, with sub-girt framing/anchorage assembly and insulation, and accessory components. Refer to Section 07 4113 - Metal Roof Panels for selected materials and instalaltion requirements.

2.4 PERFORMANCE REQUIREMENTS

A. Installed Thermal Resistance of Wall System: R-value of 30.

B. Installed Thermal Resistance of Roof System: R-Value of 30.

C. Design structural members to withstand dead load, applicable snow load, and design loads due to pressure and suction of wind calculated in accordance with design load schedule.
   1. Deflection and Drift Limits:
      a. No greater than the following:
         1) Purlins and Rafters: Vertical deflection of 1/240 of the span.
         2) Girts: Horizontal deflection of 1/240 of the span, except at brick veneer locations where deflection shall be 1/600 of the span.
         3) Metal Roof Panels: Vertical deflection of 1/240 of the span.
         4) Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
            a) Framing at Masonry Veneer Assemblies: Horizontal deflection of 1/600 of the span.
            b) Framing at Metal Wall Panel Assemblies: Horizontal deflection of 1/240 of the span.
         5) Lateral Drift: Maximum of 1/600 of the building height.

D. Design structural members to withstand Class 90 wind uplift in accordance with UL 580.

E. Exterior wall and roof system shall withstand imposed loads with maximum allowable deflection of 1/90 of span.

F. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.

G. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 120 deg F, ambient; 180 deg F, material surfaces

H. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

2.5 MATERIALS - FRAMING

A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

B. Structural Steel Members: ASTM A36/A36M, ASTM A572/A572M Grade 50, or ASTM A992/A992M.

C. Structural Tubing: ASTM A500/A500M Grade C cold-formed.

D. Plate or Bar Stock: ASTM A529/A529M, Grade 50.

E. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

F. Anchor Bolts: ASTM F1554, Grade 36, Class 1A, with hot dip type for protective coating.

G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1; galvanized to ASTM A153/A153M.

H. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

I. Welding Materials: Perform in accordance with AWS D1.1/D1.1M.

J. Primer: SSPC-Paint 20 zinc rich or manufacturer's standard gray primer.

2.6 MATERIALS - WALLS AND ROOF

A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Designation SS (structural steel), Grade 33 (230), with G90/Z275 coating.

B. Insulation: Refer to Section 07 2100 - Thermal Insulation.

C. Joint Seal Gaskets: Manufacturer's standard type.

D. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A153/A153M, finish to match adjacent surfaces when exterior exposed.

E. Bituminous Paint: Asphaltic type.

F. Sealant: ASTM C920, elastomeric sealant with movement capability of at least plus/minus 50 percent; 100 percent silicone; for exposed applications, match adjacent colors as closely as possible.

G. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Fascias and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.7 COMPONENTS

A. Doors and Frames: See Section 08 1113.

B. Overhead Doors: See Section 08 3613.

C. Overhead Door Frame: Formed steel sections braced to building frame; see Section 05 5000.

2.8 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.
1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members to be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

2.9 FABRICATION - FRAMING

A. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
1. Make shop connections by welding or by using high-strength bolts.
2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.

5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

B. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
   1. Make shop connections by welding or by using non-high-strength bolts.
   2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

C. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.

D. Anchor Bolts: Formed with straight shank, assembled with template for casting into concrete.

E. Provide wall opening framing for doors, windows, and other accessory components.

2.10 FABRICATION - WALL AND ROOF PANELS

A. Siding: Refer to Section 04 2000 - Unit Masonry and 07 4213 - Metal Wall Panels.

B. Roofing: Refer to Section 07 4113 - Metal Roof Panels.

C. Girts/Purlins: Rolled formed structural shape to receive siding, roofing sheet.

D. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles. Back brace mitered internal corners with ____ inch thick sheet.

E. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile to suit system.

F. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.

2.11 FINISHES

A. Framing Members: Clean, prepare, and shop prime. Do not prime surfaces to be field welded.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

C. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position.

D. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION - FRAMING

A. Erect framing in accordance with AISC 360.

B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
2. Joint Type: Snug tightened or pretensioned as required by manufacturer.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.

2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

K. Do not field cut or alter structural members without approval.

L. After erection, prime welds, abrasions, and surfaces not shop primed.

3.4 ERECTION - WALL AND ROOF PANELS

A. Install in accordance with manufacturer's instructions.

B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.

C. Fasten cladding system to structural supports, aligned level and plumb.

D. Locate end laps over supports. End laps minimum 2 inches. Place side laps over bearing.

E. Provide expansion joints where indicated.

F. Use concealed fasteners.

G. Install sealant and gaskets, providing weather tight installation.

3.5 ACCESSORY INSTALLATION

A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
1. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.6 INSTALLATION - ACCESSORY COMPONENTS IN WALL SYSTEM

A. Install door frames and insulation in accordance with manufacturer's instructions. Refer to individual technical sections for materials and installation requirements.

3.7 TOLERANCES

A. Framing Members: 1/4 inch from level; 1/8 inch from plumb.

B. Siding and Roofing: 1/8 inch from true position.

END OF SECTION 13 3419

SECTION 22 1500 - GENERAL-SERVICE COMPRESSED-AIR SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reciprocating air compressors.

B. Pipe and fittings.

C. Unions and couplings.

D. Pressure reducing stations.

E. Air outlets.

1.2 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

D. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2024.

E. ASME B31.1 - Power Piping; 2026.

F. ASME B31.9 - Building Services Piping; 2025.

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2026.

I. ASTM B32 - Standard Specification for Solder Metal; 2020.

J. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2026.

L. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2026a.

M. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2026.

N. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe; 2026.

O. ASTM F1282 - Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe; 2023a.

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.

C. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.

D. Project Record Documents: Record actual locations of equipment and components. Modify shop drawings to indicate final locations.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect piping and equipment from weather and construction traffic.

PART 2 PRODUCTS

2.1 RECIPROCATING AIR COMPRESSORS

A. Manufacturers:
1. FS-Curtis, a brand of Curtis-Toledo, Inc; ML Series: us.fscurtis.com/#sle.
2. Ingersoll Rand, Inc: www.ingersollrandproducts.com/#sle.
3. Quincy Compressor, LLC: quincycompressor.com/#sle.
4. Sullair, LLC: www.sullair.com/#sle.

B. Type: Simplex air compressor system with fixed belt-driven mechanism.

C. Capacity: 14 cfm of free air at 175 psi

D. Electrically-driven, air-cooled compressor unit; factory-assembled on surface-mount tank with heat exchanger(s), air intake filter(s), gage(s), sight glasse(s), vibration isolators, thermostats, safeties, differential pressure oil pump, thermal overload protections, oil separator, moisture separator with drain trap, oil charging valve, and compressor bearings with ABMA STD 9, L10 life expectancy at 100,000 hours.

E. Receiver Accumulator Tank: 60 gal, mount compressor on vertical aligned tank.

F. Controls:
1. Pushbutton or Handswitch: Start/stop and load/unload functions.

G. Electrical:
1. 5 hp at 460-VAC, 50 to 60 hz, TEFC motor, _____.
2. Factory mount disconnect switch with terminal box with each circuit identified and spare spare to accommodate field-installed components. Ground each component to base of assembly.

2.2 PIPE AND FITTINGS

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, solder, Grade Sn95.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), annealed.
1. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.

2.3 UNIONS AND COUPLINGS

A. Unions:
1. Copper Tube and Pipe: 150 psi bronze unions with soldered joints.

B. Flexible Connector: Neoprene with brass threaded connectors.

2.4 PRESSURE REDUCING STATIONS

A. Pressure Reducing Station: Consisting of automatic reducing valve and bypass, and low pressure side relief valve and gauge. Provide oil separator where indicated.

B. Valve Capacity: Reduce pressure from 200 psi to 30 psi, adjustable upwards from reduced pressure.

2.5 AIR OUTLETS

A. Quick Connector: 3/8 inch brass, snap-on connector with self closing valve, Style A.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Install valved drip connections at low points of piping system. See Section 22 0523.

C. Install takeoffs to outlets from top of main, with shut off valve after takeoff. Slope takeoff piping to outlets.

D. Install compressed air couplings, female quick connectors, and pressure gauges where outlets are indicated.

E. Identify piping system and components. See Section 22 0553.

3.2 FIELD QUALITY CONTROL

A. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ASME B31.1.

B. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.

C. Cap and seal ends of piping when not connected to mechanical equipment.

SECTION 22 3800 - RADON MITIGATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Radon and soil gas control system for new construction, consisting of an active soil depressurization (ASD) system installed beneath all ground-contact slabs of the building, including apparatus bays, in compliance with ANSI/AARST CC-1000.

B. Delegated design of the complete radon mitigation system by a certified radon mitigation professional retained by the Contractor, based on the performance requirements and design criteria specified in this Section and the diagrammatic layout indicated on the Drawings.

C. Soil gas collection plenums and sub-slab perforated collection piping network, including trenching and stone bedding and backfill in pipe trenches.

D. Coordination and inspection of the gas permeable layer, soil gas retarder, and slab joint sealing provided under the General Construction contract.

E. Sealing of slab penetrations created by work of this Section and by plumbing work, and sealing of floor drains, trench drains, and sumps.

F. Solid-wall riser and exhaust vent piping from below slab to the roof discharge point, PVC below the slab and plenum-rated CPVC above the slab, including supports, insulation, and firestopping.

G. Furnishing, mounting, and commissioning of in-line radon fans, flexible couplings, roof penetrations, and exhaust terminations.

H. Furnishing and mounting of electronic system monitors with failure alarms, and riser pressure test taps.

I. Pressure field extension (PFE) test ports.

J. System identification and labeling.

K. Inspections, PFE testing, system activation, and commissioning of the radon mitigation system.

L. Coordination with post-construction radon testing performed by the Owner’s radon testing agency, and corrective work where test results exceed the specified limits.

M. Operation, maintenance, and monitoring (OM&M) manual.

1.2 DEFINITIONS

A. Active Soil Depressurization (ASD): A radon control method in which a fan continuously draws soil gas from beneath the slab and exhausts it outdoors above the roof, creating a negative pressure field under the slab relative to the occupied space above.

B. Certified Mitigation Professional: An individual holding current certification as a radon mitigation professional from the National Radon Proficiency Program (NRPP) or the National Radon Safety Board

(NRSB), and holding current Pennsylvania Department of Environmental Protection (DEP) radon mitigation certification under 25 Pa. Code Chapter 240.

C. Delegated Designer: The Certified Mitigation Professional retained by the Contractor to design, inspect, commission, and certify the radon mitigation system under this Section.

D. Gas Permeable Layer: The layer of clean aggregate, or other approved material, beneath the slab and soil gas retarder that allows soil gas to move freely to the collection piping network.

E. Soil Gas Collection Plenum: The gas permeable layer area served by a single vent system, bounded by grade beams, thickened slabs, footings, or other features that interrupt air movement.

F. Collection Piping Network: Interconnected perforated pipe installed within the gas permeable layer, connected to one or more solid-wall risers, through which soil gas is drawn from the gas permeable layer.

G. Pressure Field Extension (PFE): The distance that a pressure change, created by drawing soil gas through the collection piping network, extends outward within the sub-slab gas permeable layer.

H. Test Port: A small capped opening through the slab, or a capped tube terminating in the gas permeable layer, used to measure sub-slab pressure during PFE testing and future diagnostics.

I. Soil Gas Retarder: The continuous, sealed membrane between the gas permeable layer and the concrete slab that forms the air barrier between soil gas and indoor air.

J. pCi/L: Picocuries per liter of air; the unit of measure for radon concentration.

1.3 RELATED REQUIREMENTS

A. Section 01 9113 - General Commissioning Requirements: Commissioning Authority and commissioning procedures.

B. Section 03 3000 - Cast-in-Place Concrete: Under-slab vapor retarder, which also serves as the soil gas retarder for this Section.

C. Section 07 9200 - Joint Sealants: Sealing of slab perimeter, isolation, and control joints.

1.4 WORK BY OTHER CONTRACTS

A. Contract Assignment: The work of this Section is part of the Plumbing contract. In this Section, “Contractor” means the Plumbing Contractor.

B. General Construction Contract: The following work is provided under the General Construction contract. The Contractor’s Delegated Designer shall coordinate and inspect this work as specified in Part 3.
1. Base course as indicated on the Structural Drawings, consisting of the PennDOT No. 2A aggregate subbase with a gas permeable layer of ASTM C33/C33M No. 57 clean stone, not less than 4 inches deep, placed directly beneath the soil gas retarder over the entire building footprint, including apparatus bays.
2. Soil gas retarder: The under-slab vapor retarder specified in Section 03 3000, covering the entire building footprint including apparatus bays, lapped not less than 12 inches and taped, sealed to foundations, and sealed at all penetrations, in compliance with ANSI/AARST CC-1000 Section 6.
3. Concrete slabs, and sealing of slab joints and of penetrations by other trades, in compliance with ANSI/AARST CC-1000 Section 6.2, as follows:

a. Saw-cut and formed control joints: Semi-rigid epoxy joint filler as indicated on the Structural Drawings (MM-80 or equal), filling the full depth of the saw cut. This is accepted as an equivalent method under ANSI/AARST CC-1000 Section 6.2.3. Joints where the filler has separated from the joint faces shall be refilled before post-construction radon testing.
b. Perimeter and isolation joints, and penetrations by other trades: ASTM C920 elastomeric sealant, Class 25 minimum.

4. Sleeves through foundations and grade beams, where indicated on the Structural Drawings.
5. Flashing of radon vent piping roof penetrations by the roofing installer.

C. Electrical Contract: Dedicated 120 volt branch circuit for each radon fan, disconnect switch within sight of each fan, GFCI receptacle within 25 feet of each fan, non-switched power to each system monitor, power wiring from disconnect to fan, and electrical labels reading “RADON FAN” at each circuit breaker, disconnect, and junction box, as indicated on the Electrical Drawings.

D. HVAC Contract (Controls): Building automation system (BAS) alarm point for each radon system monitor, and wiring from each monitor dry contact to the BAS.

E. Owner (Commissioning Authority): Post-construction radon testing by an independent Pennsylvania DEP-certified radon testing agency, and commissioning verification of the radon mitigation system.

F. This Contract: All other work of this Section, including the delegated design, collection piping, trenching and stone bedding and backfill in pipe trenches, risers, riser connectors, test ports, piping above the slab, fans, monitors, labels, PFE testing, system activation, DEP filings, and corrective work.

1.5 REFERENCE STANDARDS

A. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.

B. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016, with Editorial Revision (2016).

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

D. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012 (Reapproved 2018).

E. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

F. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

H. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2023.

I. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2024.

J. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2023.

K. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022 (Reapproved 2026).

L. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2025.

M. ASTM F2618 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems; 2024.

N. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2011 (Revised 2012).

O. EPA/625/R-92/016 - Radon Prevention in the Design and Construction of Schools and Other Large Buildings; 1994, with Addendum.

P. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Q. ICC (IMC) - International Mechanical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

R. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

S. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

T. UL 507 - Electric Fans; Current Edition, Including All Revisions.

U. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

V. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

W. 25 Pa. Code Chapter 240 - Radon Certification; Pennsylvania Department of Environmental Protection; current edition.

X. 34 Pa. Code Chapters 401-405 - Pennsylvania Uniform Construction Code (UCC); current edition, which adopts the 2021 International Codes as amended.

Y. ANSI/AARST CC-1000 - Soil Gas Control Systems in New Construction of Multifamily, School, Commercial and Mixed-Use Buildings; 2018, Rev. 5/23.

Z. ANSI/AARST MA-MFLB - Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily, School, Commercial and Mixed-Use Buildings; Current Edition.

AA. ANSI/AARST SGM-MFLB - Soil Gas Mitigation Standards for Existing Multifamily, School, Commercial and Mixed-Use Buildings; 2023.

BB. ASTM A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Current Edition.

CC. ASTM C1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems; Current Edition.

DD. ASTM F758 - Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage; Current Edition.

EE. ASTM D5926 - Standard Specification for Poly(Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems; Current Edition.

FF. EPA 402-R-92-014 - Radon Measurement in Schools; U.S. Environmental Protection Agency; 1993.

1.6 ADMINISTRATIVE REQUIREMENTS

A. Code Basis: The 2021 International Codes adopted by the Pennsylvania UCC do not contain radon control requirements for this occupancy. Radon control for this project is a contract requirement of the Owner, and ANSI/AARST CC-1000 is the governing design and installation standard. Pennsylvania radon certification, testing, and reporting requirements of 25 Pa. Code Chapter 240 apply.

B. Coordination:
1. Basis of Design: The perforated collection piping network is indicated on the Architectural slab plans as “gas piping, typical, spaced 25 feet on center maximum.” The indicated network is the minimum basis of design. The Delegated Designer shall verify, extend, and complete the network as required to comply with this Section.
2. Basis of Design Risers and Fans: Four independent vent systems, each with one riser and one fan, at the approximate riser locations indicated on the Drawings:
    a. System R1, North Strip (north of Grid AA): 4-inch riser, approximately 3,550 sq feet.
    b. System R2, Main Support Wing (Grids 1 to 6, A to H): 6-inch riser, approximately 10,900 sq feet.
    c. System R3, Apparatus Bays (Grids 7 to 14), riser at the Grid 7 bay wall: 6-inch riser, approximately 12,300 sq feet.
    d. System R4, East Wing (Grids 14 to 15, B to J): 4-inch riser, approximately 3,000 sq feet.
    e. Areas are approximate gross areas. The Delegated Designer shall confirm net plenum areas and riser sizes, and shall not join systems unless the combined area complies with ANSI/AARST CC-1000 Table 4.3 for the header and exhaust size used.
3. Coordinate the layout of soil gas collection plenums, collection piping, and riser locations with foundations, grade beams, thickened slabs, and footings indicated on the Structural Drawings. Do not penetrate footings, grade beams, or structural elements without written approval of the Structural Engineer.
4. Gas Permeable Layer: Dense-graded aggregate, including PennDOT No. 2A, does not qualify as a gas permeable layer under ANSI/AARST CC-1000 Section 5.5 and shall not be placed directly beneath the soil gas retarder. The No. 57 stone gas permeable layer shall be placed between the PennDOT No. 2A subbase and the soil gas retarder.
5. The under-slab vapor retarder specified in Section 03 3000 and provided under the General Construction contract shall serve as the soil gas retarder. Coordinate the installation sequence so that collection piping, riser stubs, and test port tubing are installed and inspected before the retarder is placed.
6. Coordinate riser routing with architectural chases, walls, and ceiling spaces so that all piping in finished occupied spaces is concealed. Do not route riser piping through sleeping rooms, day rooms, kitchens, or offices unless concealed within a chase indicated on the Drawings.
7. Coordinate fan locations, roof penetrations, and exhaust terminations with the roofing installer, rooftop HVAC equipment, outdoor air intakes, exhaust fans, plumbing vents, and other openings indicated on the Mechanical and Plumbing Drawings.
8. Coordinate fan power, disconnects, and monitor power with the Electrical Contractor, and alarm wiring and BAS points with the HVAC Contractor (controls).

9. Coordinate collection piping crossings with under-slab sanitary, storm, and trench drain piping. Pass collection piping over or under other piping without cutting or offsetting the other piping. Coordinate apparatus bay collection piping with trench drains, oil-water separator piping, vehicle exhaust system supports, and overhead doors.
10. Notify DEDC, LLC of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with the affected work.

C. Preinstallation Meeting: Convene a meeting at the site before installation of the gas permeable layer. Attendees shall include the Contractor, the Delegated Designer, the General, Electrical, and HVAC Contractors (including their concrete, earthwork, and roofing installers), the Commissioning Authority, the Architect, and DEDC, LLC. Review the delegated design, plenum layout, inspection hold points, protection of piping and the soil gas retarder during concrete placement, and the testing schedule.

D. Sequencing:
1. Installation sequence: (1) General Construction contract places and compacts the PennDOT No. 2A subbase; (2) this Contract excavates pipe trenches and installs collection piping, riser stubs, and test port tubing, with No. 57 stone bedding and backfill in trenches; (3) General Construction contract places the No. 57 stone gas permeable layer; (4) General Construction contract places and seals the soil gas retarder.
2. Install collection piping, riser stubs, and any preinstalled test port tubing before installation of the soil gas retarder. Obtain inspection and acceptance by the Delegated Designer before covering.
3. The General Construction contract installs and seals the soil gas retarder. The Delegated Designer shall inspect and accept the retarder before concrete is placed.
4. The General Construction contract seals slab joints after the concrete has cured, before installation of floor finishes. Control joint filler shall be installed at the time recommended by the filler manufacturer, and before post-construction radon testing. Seal penetrations created by work of this Section at the same time as the slab joints.
5. Install above-slab piping, roof penetrations, and exhaust terminations, and obtain inspection by the Delegated Designer before concealment by walls, ceilings, or finishes.
6. Energize radon fans within three days of mounting the fan on the system piping. Do not leave a fan installed and de-energized.
7. Activate the system and perform PFE testing after the building envelope is substantially closed and the HVAC systems are operating in their normal occupied mode.
8. Notify the Commissioning Authority not less than 7 days before system activation, so that the Owner's post-construction radon testing can be performed within the time window specified in Part 3.

1.7 PERFORMANCE REQUIREMENTS

A. Radon Concentration: The completed radon mitigation system shall reduce and maintain radon concentrations in all ground-contact spaces tested below 4.0 pCi/L, as measured by post-construction testing performed in accordance with ANSI/AARST MA-MFLB and this Section.
1. Design Goal: Design the system to achieve radon concentrations below 2.0 pCi/L in all regularly occupied spaces, including sleeping quarters, day room, kitchen, and offices.

B. Sub-Slab Pressure Field: With the system operating and the building HVAC systems in their normal occupied mode, the system shall produce a sub-slab pressure differential of not less than 0.004 inch water column (1 Pa) negative, relative to the space above, at every test port.

C. Coverage: Provide soil gas vent systems for every ground-contact slab of the building, including apparatus bays. The ventilated garage exemption of ANSI/AARST CC-1000 Section 4.8 shall not be applied to this project.

D. System Capacity: Size each vent system with capacity sufficient for an ASD fan to establish a vacuum under the entire area of each soil gas collection plenum served, in accordance with ANSI/AARST CC-1000 Sections 3 and 4. Plenum area served by each vent pipe shall not exceed the limits of ANSI/AARST CC-1000 Table 4.3 for the pipe size used.

E. System Type: Active soil depressurization system, with fans installed, energized, and operating at Substantial Completion. A passive system without fans is not acceptable.

F. Building Pressure: The HVAC systems are designed by DEDC, LLC to maintain ground-contact occupied spaces at neutral or slightly positive pressure relative to outdoors, in accordance with ANSI/AARST CC-1000 Section 11. The radon mitigation system shall not depend on building pressurization to meet the performance requirements. Report to DEDC, LLC any observed negative pressure conditions in ground-contact spaces during PFE testing.

G. Prohibited Methods: Do not use air cleaners or devices that solely increase ventilation as the radon reduction method.

H. Combustion Appliances: The system shall not cause backdrafting of any fuel-fired appliance or vent.

I. Fan Locations: Radon fans shall be located inside the building at the locations indicated on the Drawings, in mechanical rooms, a storage room, and the apparatus bays, mounted in-line on vertical piping approximately 4 feet above finished floor for service access. This is an engineered deviation from the fan location requirements of ANSI/AARST CC-1000 Section 8.9.1, authorized by DEDC, LLC, subject to the following conditions:
   1. Rooms containing radon fans or pressurized (discharge-side) piping shall not be regularly occupied, shall not serve as return air plenums, shall not contain open-return air handling units, outdoor air intakes, or combustion air openings, and shall not be negatively pressurized relative to adjacent occupied spaces.
   2. Discharge-side piping, from the fan outlet coupling to the roof termination, shall be continuous solvent-welded pipe with no cleanouts, test ports, unions, or mechanical joints other than the fan outlet coupling.
   3. Pressurized discharge-side piping shall be as short as practical, routed directly from the fan to the roof.
   4. Fans in the apparatus bays shall be located out of vehicle paths and protected from vehicle impact, as coordinated with the Architect.
   5. Leak testing and radon testing of fan rooms shall be performed as specified in Part 3.
   6. The Delegated Designer shall acknowledge this deviation in the delegated design submittal and shall certify the system on that basis.

1.8 DELEGATED DESIGN

A. Design Responsibility: Engage the Delegated Designer to design the complete radon mitigation system to comply with the performance requirements of this Section and ANSI/AARST CC-1000. Use EPA/625/R-92/016 as supplemental design guidance. The Drawings indicate design intent, approximate riser and fan locations, and coordination constraints only. The Delegated Designer is responsible for final quantities, locations, and sizes of system components.

B. Delegated Designer Qualifications:
   1. Current NRPP or NRSB certification as a radon mitigation professional.
   2. Current Pennsylvania DEP radon mitigation certification under 25 Pa. Code Chapter 240, for the individual and, where required, the firm.
   3. Minimum five years of experience in the design and installation of radon mitigation systems, including at least three completed ASD systems in new or existing commercial, institutional, school, or multifamily buildings of not less than 10,000 sq feet.

C. Scope of Delegated Design: The delegated design shall include, at a minimum, the following:
   1. Division of the ground-contact slab area, including apparatus bays, into soil gas collection plenums, with the area of each plenum and the vent pipe size serving it, demonstrating compliance with ANSI/AARST CC-1000 Table 4.3.
   2. Final layout of the collection piping network based on the network indicated on the Drawings, including extensions to areas not covered by the indicated network, riser connection points, and identification of footings, grade beams, and thickened slabs that divide the network into separate plenums. Each separate plenum shall have its own riser unless sleeved crossings are indicated on the Structural Drawings.
   3. Gas permeable layer material and depth, and verification that the base course indicated on the Structural Drawings meets ANSI/AARST CC-1000 Section 5.5.
   4. Riser locations and routing, pipe sizes, slopes, supports, and equivalent length calculations demonstrating compliance with ANSI/AARST CC-1000 Section 8.6.
   5. Fan locations, fan selections with performance curves, and calculated system operating points for each vent system.
   6. Exhaust termination locations, with dimensioned separation from roof surfaces, parapets, operable openings, outdoor air intakes, exhaust outlets, and areas where people congregate or traverse, demonstrating compliance with ANSI/AARST CC-1000 Section 9.
   7. Test port type and locations, in accordance with ANSI/AARST CC-1000 Section 7 and Part 2 of this Section.
   8. Locations of system monitors and alarms, electrical power requirements for each fan, and alarm wiring to the BAS.
   9. Slab joint, penetration, block-out, sump, trench drain, and floor drain sealing details, for incorporation into the work of the General Construction contract and this Contract.
   10. Label schedule, including label text and locations.
   11. Extension of the collection piping network into areas not served by the indicated network, including the enclosed room at approximately Grids 4 to 6 and C.2 to E.5, the toilet and shower rooms near Grids 5 to 6 at AA, and the room at Grids 14 to 15 between B and C.
   12. Riser connectors and connection fittings as specified in Part 2.
   13. A capped 4-inch contingency riser stub, connected to the apparatus bay collection piping at the Grid 14 bay wall and extended not less than 24 inches above the slab, labeled “RADON VENT - FUTURE - DO NOT REMOVE CAP,” for use if PFE testing at the east side of the apparatus bays does not meet the specified sub-slab pressure differential.
   14. Inspection and test schedule with hold points as specified in Part 3.

D. Contract Document Basis: The delegated design shall be based on the Contract Documents. Changes to structural, architectural, or MEP work required by the delegated design shall be submitted for approval and shall not be made without written acceptance by the Architect and DEDC, LLC.

E. Acceptance of Delegated Design: Review of the delegated design submittal by the Architect and DEDC, LLC is for general conformance with the design intent and coordination with the Contract Documents only,

and does not relieve the Contractor or Delegated Designer of responsibility for the system meeting the specified performance requirements.

1.9 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Qualification Data: For the Delegated Designer, including NRPP or NRSB certificate, Pennsylvania DEP certification numbers for the individual and firm, and project experience list demonstrating the specified experience, with Owner contact information. For the independent testing firm, Pennsylvania DEP testing certification numbers and laboratory certification.

C. Delegated Design Submittal: Submit before installation of the gas permeable layer.
1. Drawings: Floor plans at a scale not smaller than the Contract Drawings, roof plan, and details, indicating all items listed under “Scope of Delegated Design” above.
2. Calculations: Plenum area per riser, equivalent length of each vent system, and fan selections.
3. Narrative: Description of system operation, sequence of installation, and inspection schedule.
4. Signature: Bear the name, signature, NRPP or NRSB certification number, and Pennsylvania DEP certification number of the Delegated Designer.

D. Product Data: Manufacturer’s data sheets for each product, including radon fans with performance curves and UL listing, piping and fittings, flexible couplings, perforated piping and fittings, system monitors and alarms, test port assemblies, sealants, firestop systems, hangers, and labels.

E. Field Inspection Reports: Signed reports by the Delegated Designer for each inspection hold point specified in Part 3, with photographs documenting the work before concealment.

F. PFE and Commissioning Report: Static pressure at each riser test tap, sub-slab pressure at each test port, building operating conditions at the time of testing, final fan speed settings, and alarm setpoints. Submit to the Architect, DEDC, LLC, and the Commissioning Authority.

G. Pennsylvania DEP Reporting: Copies of mitigation reports and active system fee forms filed by the Delegated Designer with Pennsylvania DEP as required by 25 Pa. Code Chapter 240.

H. As-Built Submittals: Updated delegated design drawings indicating as-built locations of risers, collection piping, test ports, fans, monitors, exhaust terminations, and concealed sub-slab piping, dimensioned from building column lines or fixed walls.

I. Operation, Maintenance, and Monitoring (OM&M) Manual: Prepare in accordance with ANSI/AARST CC-1000 Section 12. Submit in electronic (PDF) format and two printed copies in three-ring binders. Include the following:
1. System description and floor plan diagram identifying all components.
2. Statement of the party responsible for maintaining and monitoring the system.
3. Start-up riser static pressures and alarm setpoints for each vent system, and actions to take upon system degradation or failure.
4. Advisory to check each system monitor at least quarterly, and to retest for radon at least every two years and after any building modifications affecting ground-contact areas or HVAC systems.
5. Fan and monitor manufacturer’s installation, operation, and maintenance instructions, and replacement part numbers.
6. Copies of inspection reports, PFE records, test reports, product data, and warranties.

7. Service contact information for the Delegated Designer, with certification numbers.

J. Warranty Documentation: Submit executed warranties as specified in this Section.

1.10 QUALITY ASSURANCE

A. Comply with ANSI/AARST CC-1000, 25 Pa. Code Chapter 240, and the requirements of this Section. Where requirements conflict, the more stringent requirement governs.

B. Installer Qualifications: Installation shall be performed by, or under the direct on-site supervision of, the Delegated Designer or a Pennsylvania DEP-certified mitigation individual employed by the Delegated Designer's firm.
1. Workers installing collection piping, riser stubs, and penetration seals shall receive instruction from the Delegated Designer on radon control requirements before starting work.
2. Do not perform radon system installation work at the site without the Delegated Designer or the Delegated Designer's certified supervising individual present or immediately available.

C. Owner's Radon Testing Agency: Post-construction radon testing will be performed by an independent radon testing agency and individual holding current Pennsylvania DEP radon testing certification under 25 Pa. Code Chapter 240, retained by the Commissioning Authority on behalf of the Owner, with test devices analyzed by a Pennsylvania DEP-certified radon laboratory. The testing agency will have no financial affiliation with the Contractor or the Delegated Designer.

D. Diagnostic Equipment: Digital micromanometers used for PFE testing shall be capable of reading to 0.001 inch water column (0.25 Pa) and shall have current calibration traceable to national standards. Submit proof of calibration with the PFE report.

E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years of documented experience.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Deliver materials to the site in manufacturer's original, unopened containers with labels intact.

C. Store piping off the ground, protected from weather, ultraviolet exposure, dirt, and physical damage. Store fans and monitors in a clean, dry location.

D. Keep pipe ends and riser openings capped at all times to prevent entry of debris, concrete, and water.

1.12 FIELD CONDITIONS

A. Project Description: The Exeter Township Emergency Services Facility is a new slab-on-grade building located in Berks County, Pennsylvania, within EPA Radon Zone 1 (highest radon potential). The building includes apparatus bays and ground-floor occupied spaces such as sleeping quarters, day room, kitchen, offices, and support spaces. Refer to the Architectural and Structural Drawings for floor plans, foundation layout, slab thicknesses, and base course requirements.

B. Do not install collection piping over standing water, frozen subgrade, or mud.

1.13 WARRANTY

A. Installer Warranty: Provide a written warranty, signed by the Delegated Designer and the Contractor, covering materials and workmanship of the complete radon mitigation system for two years from the date of Substantial Completion. The warranty shall include correction of the system, at no cost to the Owner, if radon testing performed during the warranty period in accordance with ANSI/AARST MA-MFLB indicates radon concentrations of 4.0 pCi/L or greater in any ground-contact space tested.

B. Fan Warranty: Manufacturer's warranty of not less than five years from the date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Radon Fans:
1. Basis of Design: Fantech, a Systemair company; Rn4EC; www.fantech.net.
2. RadonAway, a Spruce Environmental Technologies company; www.radonaway.com.
3. Festa Radon Technologies Co.; www.festaradontech.com.

B. System Monitors:
1. RadonAway, a Spruce Environmental Technologies company; www.radonaway.com.
2. Fantech, a Systemair company; www.fantech.net.
3. Festa Radon Technologies Co.; www.festaradontech.com.

C. Plenum-Rated CPVC Piping, subject to compliance with the specified dry-pipe fire performance in the sizes required:
1. Basis of Design: Spears Manufacturing Company; EverTUFF Industrial CPVC or LabWaste CPVC; www.spearsmfg.com.
2. Pipe extruded from Lubrizol Corzan CPVC compound, by any manufacturer, only where the manufacturer's listing documents dry-pipe 25/50 performance in the sizes provided.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.2 TRENCH BEDDING AND BACKFILL

A. Stone: Clean gravel or crushed stone complying with ASTM C33/C33M size No. 57, matching the gas permeable layer, for bedding and backfill in pipe trenches.

2.3 SUB-SLAB COLLECTION PIPING

A. General: Soil gas shall be collected through a network of perforated pipe within the gas permeable layer. Suction pits are not permitted.

B. Perforated Pipe: 4-inch nominal diameter PVC, factory-perforated, complying with ASTM D2729, or ASTM F758 Type PS 46 where additional crush resistance is required by the delegated design.
1. Perforations: Two rows of 1/2-inch diameter holes, 120 degrees apart, as standard for perforated drainage pipe.
2. Size: All sub-slab collection piping shall be 4-inch nominal diameter, one size throughout.
3. Corrugated pipe, flexible pipe, and pipe with filter socks or geotextile wraps are not permitted.

C. Fittings: PVC fittings of the same material and size as the pipe, solvent-welded or mechanically secured so that joints cannot separate during placement of aggregate, retarder, and concrete. Provide tees or crosses at every intersection of the network. Cap all dead ends.

D. Riser Connections: Solid-wall tee or cross at each riser location, transitioning to the riser piping specified below.

E. Inlet Capacity: The perforated piping connected to each riser shall provide not less than 10 feet of perforated pipe extending from the riser, and combined unobstructed inlet area not less than twice the cross-sectional area of the riser, in accordance with ANSI/AARST CC-1000 Section 5.7.

2.4 RISER AND EXHAUST VENT PIPING

A. Riser and Exhaust Piping Materials:
1. Below Slab: PVC, ASTM D2665, Schedule 40, solid wall, for riser connectors and riser piping below the top of the slab. Cellular-core pipe is not permitted. Solvent-weld joints using primer complying with ASTM F656 and solvent cement complying with ASTM D2564.
2. Above Slab: CPVC, Schedule 40 or Schedule 80, ASTM F441 pipe with ASTM F438 or ASTM F439 fittings, or ASTM F2618 CPVC drainage pipe and fittings, for all riser and exhaust piping above the top of the slab, including exterior and rooftop piping.
    a. Fire Performance: Flame spread index not greater than 25 and smoke-developed index not greater than 50 when tested dry (empty) in accordance with ASTM E84 or UL 723, listed and labeled for installation in air-handling plenums, in every pipe and fitting size used. Submit the listing or evaluation report (such as ICC-ES PMG-1278) confirming dry-pipe performance in the sizes provided. Ratings based on water-filled pipe are not acceptable.
    b. Joints: Solvent-welded using primer and solvent cement complying with ASTM F493 and as required by the CPVC manufacturer to maintain the plenum listing.
    c. Transition: Transition from PVC to CPVC at or immediately above the top of the slab, using a solvent cement listed by the CPVC manufacturer for PVC-to-CPVC joints, or a flexible coupling as specified below.
    d. Exterior Exposure: Protect CPVC exposed to sunlight with an ultraviolet-resistant coating as recommended by the CPVC manufacturer, color as selected by the Architect.

B. Riser and Exhaust Piping Requirements:
1. Size: As indicated in the Basis of Design Risers and Fans paragraph in Part 1, and as confirmed in the delegated design. Exhaust piping shall be the same size as the riser it serves.
2. Plenum Area per Riser: In accordance with ANSI/AARST CC-1000 Table 4.3, not more than the following:
    a. 4-Inch Riser: 4,500 sq feet, increased to 6,200 sq feet where the pre-concrete inspections specified in Part 3 are performed and documented.
    b. 6-Inch Riser: 10,000 sq feet, increased to 14,000 sq feet where the pre-concrete inspections specified in Part 3 are performed and documented.
3. Riser Connectors: Where a riser is located away from the collection piping network, connect the riser to the network with solid-wall pipe of the same size as the riser, installed in the gas permeable layer with the specified bedding and cover.
4. Connection Fittings: The combined cross-sectional area of the 4-inch collection piping legs connected to each riser or riser connector shall be not less than the cross-sectional area of the riser. Connect 4-inch risers to not fewer than two legs, and 6-inch risers to not fewer than three legs, using a solid-wall

tee or reducing cross. Where the connection point has fewer legs, extend perforated piping not less than 10 feet from the connection to provide the additional leg.

5. Crossings: Where a riser connector or collection piping of one system crosses collection piping of another system, cross over or under without fittings so that the systems remain separate.

C. Cast Iron Pipe and Fittings: ASTM A888 hubless cast iron soil pipe, with CISPI 310 couplings. Use for exposed piping in apparatus bays below 8 feet above finished floor, where subject to physical damage. Cast iron may be used in lieu of CPVC elsewhere above the slab at the Contractor's option.

D. Flexible Couplings: Elastomeric couplings complying with ASTM D5926 or ASTM C1173, unshielded, with stainless steel clamps, for connection of fans to system piping and for service disconnects.

E. Hangers and Supports: MSS SP-58, galvanized steel or factory-coated steel.

1. Horizontal Piping: Adjustable clevis or band hangers sized for the pipe outside diameter, with threaded steel rods.
2. Vertical Piping: Riser clamps at each floor and at the roof, with intermediate wall brackets or clamps as required for the specified spacing.
3. Fan Supports: Vibration-isolating clamps or brackets, so that fan weight is not carried by the flexible couplings.

F. Pipe Insulation: Where vent piping passes through unconditioned spaces and condensation could freeze or damage adjacent materials, provide flexible elastomeric or glass fiber pipe insulation with an external vapor barrier jacket and a thermal resistance of not less than R-4, with insulation and jacket having a flame spread index not greater than 25 and smoke-developed index not greater than 50 when tested in accordance with ASTM E84, in accordance with ANSI/AARST CC-1000 Section 8.

G. Firestop Systems: Through-penetration firestop systems tested to UL 1479 and listed for the pipe material and size, with an F rating not less than the rating of the assembly penetrated.

H. Exhaust Termination Screen: Stainless steel or galvanized wire mesh, not smaller than 1/2 inch openings. Rain caps and other devices that obstruct or redirect the upward discharge are not permitted.

I. Riser Pressure Test Tap: 1/4-inch capped test fitting on each riser, located below the fan and accessible from the floor or from an accessible ceiling, for measuring system static pressure with a digital manometer.

2.5 RADON FANS

A. Description: In-line centrifugal fan designed for radon and soil gas applications, with sealed housing to prevent soil gas leakage and thermally protected motor rated for continuous duty.

B. Listing: UL 507.

C. Performance: Rated in accordance with AMCA 210. Select each fan to provide the airflow and static pressure required by the delegated design at the calculated system operating point, with capacity to maintain the specified sub-slab pressure differential at every test port.

D. Capacity:

1. Systems R2 and R3 (6-Inch): Not less than 450 cfm at 0.5 inch water column, and capable of not less than 4.0 inches water column static pressure at low flow.

2. Systems R1 and R4 (4-Inch): The fan model specified for Systems R2 and R3, with speed adjusted to limit velocity in 4-inch piping, or a smaller radon fan selected by the Delegated Designer to suit the system operating point.

E. Motor: Electronically commutated (EC) motor with integral speed adjustment, for setting fan speed during commissioning to achieve the specified sub-slab pressure differential.

F. Connections: Fan collars connected to riser and exhaust piping with flexible couplings sized for the pipe served. Use 6-inch by 6-inch couplings on 6-inch systems, and 6-inch by 4-inch reducing couplings on 4-inch systems where fan collars are 6 inches.

G. Electrical Characteristics: 120 volt, single phase, 60 Hz, not more than 175 watts per fan, unless otherwise indicated on the Electrical Drawings.

H. Mounting: In-line on vertical piping at the locations specified in Part 1, connected with flexible couplings secured with stainless steel clamps.

2.6 SYSTEM MONITORS AND ALARMS

A. Description: Electronic pressure-sensing system monitor for each vent system, connected to the riser by sensing tube, providing local audible and visual alarm upon loss of system vacuum, in compliance with ANSI/AARST CC-1000 Section 10.3.
1. Automatic reset upon restoration of power and system vacuum.
2. Adjustable alarm setpoint.
3. Powered from a non-switched 120 volt circuit. Battery-powered monitors are not acceptable.
4. Normally closed dry contact for remote alarm monitoring by the BAS.

B. Location: Install monitors in a location visible to building occupants or staff, as indicated in the delegated design and coordinated with the Architect. In finished spaces, mount in a recessed or surface box with cover plate.

2.7 TEST PORTS

A. Quantity and Location: Provide test ports for each soil gas collection plenum at locations distant from the risers and between runs of collection piping, including the outer quadrants of each plenum and not less than one port per 8,000 sq feet of plenum area, in accordance with ANSI/AARST CC-1000 Section 7.

B. Type: At the option of the Delegated Designer, provide either of the following:
1. Drilled Ports: Holes 1/4 inch to 1 inch in diameter drilled through the slab after concrete placement, cleared of debris, and closed with a removable, gasketed, flush-mounted plug.
2. Preinstalled Ports: Rigid, non-corroding tubing, 1/4 inch to 1 inch inside diameter, terminating in the gas permeable layer in a constructed void of not less than 1 pint or in perforated pipe not less than 12 inches long, and extending to an accessible location above the slab, with a threaded or gasketed cap.

C. Ports in Finished Spaces: Do not locate drilled ports in finished floors of sleeping rooms, day room, kitchen, or offices. Where test locations are required in these areas, use preinstalled ports terminated in a wall box or within casework, closets, or utility spaces.

D. Ports shall be accessible for future measurement without demolition, and shall be dimensioned on the as-built drawings.

2.8 SEALANTS

A. Slab Penetrations: Polyurethane elastomeric sealant complying with ASTM C920, Type S or M, Grade P for horizontal joints and Grade NS for vertical joints, Class 25 minimum, Use T for traffic areas, for sealing risers, test ports, and plumbing penetrations through the slab.

B. Backer Rod: Closed-cell polyethylene foam, compatible with sealant, for joints and openings wider than 1/2 inch.

C. Expanding foam is not an acceptable permanent sealant for radon control.

D. Sump and Pit Lids: Rigid lids sealed with gasket material or silicone sealant.

E. Non-Shrink Grout: Premixed, non-metallic, non-shrink cementitious grout, for closure of slab block-outs.

2.9 LABELS

A. Materials: Durable, permanent, weather-resistant labels with contrasting colors, suitable for the surface and environment. Title lettering not less than 1/4 inch high; other text not less than 1/8 inch high.

B. Pipe Labels: “RADON REDUCTION SYSTEM - DO NOT ALTER.”

C. System Description Label: At each system monitor location, including the following information:
1. “Radon Reduction System.”
2. Explanation of the monitor indication and alarm.
3. Instructions to follow if the alarm sounds.
4. Advisory to inspect the monitor at least quarterly and to test the building for radon at least every two years.
5. Delegated Designer’s firm name, telephone number, Pennsylvania DEP certification number, and date of installation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subgrade has been prepared and compacted as indicated on the Structural Drawings, and that grading below the gas permeable layer will not allow water to collect and obstruct inlet piping.

B. Verify that foundation walls and grade beams surrounding each plenum are complete and that openings below grade have been closed.

C. Verify that underground plumbing, electrical, and other utilities beneath the slab are installed and tested before installation of the soil gas retarder.

D. Prepare written report, endorsed by the Delegated Designer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION - BELOW SLAB

A. Install the radon mitigation system in accordance with the accepted delegated design, ANSI/AARST CC-1000, and the manufacturer's instructions.

B. Gas Permeable Layer: Provided under the General Construction contract. Verify depth and cleanliness of the base course before installing collection piping, and coordinate placement so that the base course is not disturbed after piping is installed.

C. Collection Piping: Install the network at the locations indicated in the accepted delegated design, at not more than 25 feet on center, and not less than 12 inches from footings, grade beams, and foundation walls.
   1. Bedding and Cover: Embed the pipe completely in the gas permeable layer, with not less than 1 inch of aggregate below the pipe and not less than 2 inches of aggregate between the top of the pipe and the soil gas retarder.
   2. Trenching: Where the gas permeable layer is not deep enough to provide the specified bedding and cover, excavate a trench in the subbase or subgrade beneath each pipe run, not less than 4 inches wider than the pipe, and bed and backfill the pipe with the specified stone to the top of the pipe.
   3. Orientation: Install pipe with perforations facing down, at the 4 o'clock and 8 o'clock positions, so that water drains out of the pipe and aggregate is kept out.
   4. Grade: Install pipe level or sloped to drain. Grade the subgrade beneath pipe runs so that water cannot collect in or obstruct the pipe.
   5. Joints and Intersections: Connect every intersection with a tee or cross fitting; do not overlap or cross pipes without a fitting. Secure all joints and fittings against displacement.
   6. Footings and Grade Beams: Do not pass collection piping through footings, grade beams, or thickened slabs unless sleeves are indicated on the Structural Drawings. Where the network is divided by footings or grade beams, provide a separate riser for each divided area.
   7. Protection: Do not operate compaction equipment or vehicles directly on installed pipe. Repair or replace crushed or displaced pipe before covering.

D. Risers: Extend riser piping not less than 24 inches above the top of the slab, cap and seal the open end immediately, and label "RADON VENT - DO NOT REMOVE CAP" until connected to the above-slab system.

E. Preinstalled Test Ports: Where used, install test port tubing and voids at locations indicated in the delegated design. Cap and protect tubing during concrete placement.

F. Soil Gas Retarder: Provided under the General Construction contract. Before the retarder is placed, verify that collection piping, riser stubs, and test port tubing are complete and inspected. After the retarder is placed, verify that it is sealed at each riser and test port penetration.

3.3 INSTALLATION - SLAB SEALING

A. Comply with ANSI/AARST CC-1000 Section 6.2 for work of this Contract. Slab perimeter, isolation, and control joints, and penetrations by other trades, are sealed under the General Construction contract.

B. Penetrations: Seal openings around risers, test ports, and plumbing penetrations through the slab with ASTM C920 sealant. Install backer rod in openings wider than 1/2 inch.

C. Floor Drains and Trench Drains: Provide trap seals and trap primers at floor drains, trench drains, and oil-water separator connections in ground-contact slabs as indicated on the Plumbing Drawings, so that drains do not allow soil gas entry. Seal around drain bodies and trench drain frames at the slab.

D. Sumps and Pits: Install sealed rigid lids on sumps and other pits open to the soil.

3.4 INSTALLATION - ABOVE SLAB PIPING AND FANS

A. Install riser and exhaust piping plumb and parallel to building lines, concealed in chases, walls, or above ceilings in finished occupied spaces. Exposed piping is acceptable only in mechanical rooms, apparatus bays, and other unfinished spaces.

B. Slope horizontal piping not less than 1/8 inch per foot back toward the riser so condensate drains to the sub-slab area. Do not create traps or low points.

C. Support horizontal plastic piping at intervals not exceeding 4 feet and vertical piping at intervals not exceeding 10 feet, and at each change in direction. Support cast iron piping at each coupling and at intervals not exceeding 5 feet.

D. Where piping is routed through conditioned or occupied spaces, maintain airtight joints throughout. Do not route pressurized (discharge-side) piping through occupied rooms; route it directly from the fan room to the roof.

E. Firestopping: Where piping penetrates fire-resistance-rated assemblies, install the specified firestop system in accordance with its listing.

F. Fans: Install fans at the locations specified in Part 1, approximately 4 feet above finished floor, on vertical piping. Connect fans to piping with flexible couplings and stainless steel clamps, tightened to the coupling manufacturer's torque. Support fans independently of the piping with vibration-isolating supports, and provide clear service access.

G. Fan Labels: Label each fan and its discharge piping "RADON FAN - PRESSURIZED DISCHARGE - DO NOT OPEN OR DISCONNECT. SEE SYSTEM LABEL FOR SERVICE CONTACT."

H. Roof Penetrations: Roof penetrations shall be flashed by the roofing installer, using pipe boots or flashing compatible with the roof system, to maintain the roof warranty.

I. Exhaust Terminations: Comply with ANSI/AARST CC-1000 Section 9 and the following:
   1. Discharge vertically upward, within 45 degrees of vertical, outdoors above the roof.
   2. Not less than 18 inches above a flat roof surface or 12 inches above a pitched roof surface, and above the top of any adjacent parapet within 10 feet.
   3. Not less than 10 feet above grade.
   4. Not less than 4 feet above, or not less than 10 feet horizontally from, any operable opening, door, window, or outdoor air intake, and not less than 10 feet from any rooftop equipment outdoor air intake or economizer.
   5. Not less than 10 feet above or 10 feet horizontally from roof walkways, decks, and other areas where people congregate or traverse.
   6. Increase separation distances as required by ANSI/AARST CC-1000 for exhaust pipes larger than 4 inches.
   7. Provide termination screen as specified.

3.5 INSTALLATION - MONITORS AND ELECTRICAL COORDINATION

A. Monitors: Install each monitor at the location indicated in the delegated design, with sensing tube connected to the riser below the fan.

B. Electrical Coordination: Furnish fan and monitor electrical data to the Electrical Contractor. Verify that power to each fan is a dedicated circuit, is not interlocked with or switched by other mechanical systems, and that monitor power is non-switched. Do not route wiring inside radon vent piping.

C. BAS Coordination: Coordinate the monitor dry contact terminations and alarm points with the HVAC Contractor (controls).

3.6 IDENTIFICATION

A. Label all exposed and accessible vent piping, including piping above accessible ceilings, at intervals not exceeding 10 feet and at each penetration of a wall, floor, or ceiling.

B. Label sealed slab components, test ports, and sealed sump lids as components of the radon mitigation system.

C. Install the system description label at each system monitor location.

D. Label each roof exhaust termination “RADON EXHAUST - DO NOT BLOCK.”

3.7 FIELD QUALITY CONTROL

A. Inspection Hold Points: The Delegated Designer shall inspect and approve in writing each of the following before the work is covered or concealed. Notify the Architect and DEDC, LLC not less than 48 hours before each inspection so that they may attend.
1. Inspection 1: Materials delivered to the site, for compliance with the accepted submittals.
2. Inspection 2: Gas permeable layer, collection piping, fittings, bedding and cover, riser stubs, and any preinstalled test port tubing, before installation of the soil gas retarder.
3. Inspection 3: Soil gas retarder laps, seals, penetrations, and repairs, before placement of concrete.
4. Inspection 4: Slab perimeter, joint, and penetration sealing, and capping and labeling of risers, after slab placement and before installation of floor finishes.
5. Inspection 5: Above-slab piping, supports, slopes, firestopping, roof penetrations, and exhaust terminations, before concealment by walls and ceilings.

B. System Activation and PFE Testing:
1. Activate each system after the building envelope is substantially closed and the HVAC systems are operating in their normal occupied mode. Perform PFE testing in the presence of the Commissioning Authority.
2. Measure and record the static pressure at each riser test tap and the sub-slab pressure differential at each test port with the system operating.
3. Where any test port does not achieve the specified sub-slab pressure differential, investigate the cause, correct the system, and retest.
4. Adjust each fan speed so that the specified sub-slab pressure differential is achieved at every test port at the lowest practical fan speed. Record the final speed setting.
5. Set each monitor alarm setpoint based on the recorded start-up static pressure, as determined by the Delegated Designer.

6. Verify monitor alarm operation, including the alarm signal at the BAS, by simulating loss of system vacuum, together with the HVAC Contractor (controls) and the Commissioning Authority.
7. Verify that the system does not cause backdrafting of fuel-fired appliances.
8. Leak-test the fan connections and all discharge-side piping inside the building with each fan operating, using a chemical smoke tracer or an equivalent method accepted by the Delegated Designer. Correct any leakage and retest.
9. Close each test port and riser test tap after testing.

C. Post-Construction Radon Testing (by Owner): The Owner's radon testing agency, retained by the Commissioning Authority on behalf of the Owner, will perform initial post-construction radon testing as follows. Cooperate with the testing agency and maintain the specified building conditions during testing.
1. Testing will be performed no sooner than 24 hours and no later than 30 days after activation of the radon mitigation system, in accordance with 25 Pa. Code Chapter 240.
2. Testing will be conducted in accordance with ANSI/AARST MA-MFLB and EPA 402-R-92-014 under closed-building conditions, with HVAC systems operating in their normal occupied mode and apparatus bay overhead doors closed.
3. Every occupied room and space in contact with the ground will be tested, including each sleeping room, day room, kitchen, and office, at not less than one test device per 2,000 sq feet and not less than one per enclosed occupied room, excluding closets, toilet rooms, and storage rooms. Apparatus bays will be tested at not less than one test device per 2,000 sq feet, away from overhead doors and vehicle exhaust drops.
4. Each room containing a radon fan or pressurized discharge piping will be tested with not less than one test device.
5. Results will be reported to the Owner, Architect, DEDC, LLC, and the Contractor on the Pennsylvania DEP-approved result report form.

D. Corrective Work: Where any test result is 4.0 pCi/L or greater, the Delegated Designer shall diagnose the cause, submit proposed modifications for review, implement the modifications, reactivate and re-commission the system, and repeat the PFE testing in the affected areas. The Owner's testing agency will retest the affected areas. Corrective work, and the cost of the Owner's retesting after a failed test, shall be at no additional cost to the Owner. Corrective modifications shall comply with ANSI/AARST SGM-MFLB in addition to ANSI/AARST CC-1000.

E. Long-Term Testing (by Owner): During the first heating season following Substantial Completion, the Owner's testing agency will perform one long-term radon test (91 days minimum) in each sleeping room and in not less than 25 percent of the other locations tested. Results of 4.0 pCi/L or greater shall be corrected under the Installer Warranty.

F. Commissioning: Cooperate with the Commissioning Authority in accordance with Section 01 9113. Commissioning verification will include witnessing of PFE testing, verification of fan operation and speed settings, monitor alarm and BAS point verification, and review of labeling and the OM&M manual.

G. Pennsylvania DEP Reporting: The Delegated Designer shall file all mitigation reports and pay all fees required by 25 Pa. Code Chapter 240 for the installed active systems, and shall submit copies to the Owner.

H. The radon mitigation system will be considered defective if it does not pass the specified inspections and tests.

3.8 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate system operation, monitor indication, alarm response, and quarterly inspection procedures to the Owner's designated personnel. Provide not less than one hour of instruction.

B. Certification: Submit a written statement, signed by the Delegated Designer, certifying that the radon mitigation system has been installed in accordance with the accepted delegated design and ANSI/AARST CC-1000, and that post-construction test results comply with the specified performance requirements.

C. Turn over the OM&M manual and as-built drawings to the Owner.

3.9 PROTECTION

A. Protect installed collection piping, riser stubs, and test port tubing during placement of base course, retarder, reinforcing, and concrete by other contracts. Repair damage before concrete placement.

B. Keep riser openings capped until connection of the above-slab piping.

C. Protect installed fans, monitors, test taps, and labels from damage until Substantial Completion.

END OF SECTION 22 3800

SECTION 23 0719 - HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation for HVAC piping systems.

B. Jacketing and accessories.

C. Insulated pipe supports and inserts.

D. Engineered wall outlet seals.

1.2 DEFINITIONS

A. Exposed: Piping visible in finished spaces, mechanical rooms, and other rooms and areas where piping is not concealed within walls, shafts, chases, or above ceilings.

B. Outdoor: Piping located outside the building envelope, including on roofs and within open or unheated enclosures exposed to weather.

C. VRF Systems: Variable refrigerant flow heat pump and heat recovery systems, including single-zone and multi-zone VRF split systems.

1.3 REFERENCE STANDARDS

A. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.

B. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2017.

C. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2017a.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

F. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

H. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; Current Edition.

1.4 SUBMITTALS

A. Product Data: Provide product description, thermal conductivity at the mean rating temperatures of 2021 IECC Table C403.12.3, service temperature limits, surface burning characteristics at the thicknesses to be installed, and jacket temperature ratings.

B. Insulation Schedule: Submit a schedule listing each piping service, insulation material, thickness for each pipe size, and jacket type for exposed and outdoor locations, demonstrating compliance with the SCHEDULE article.

C. VRF Refrigerant Piping: Submit the VRF manufacturer's published insulation requirements for the system provided.

1.5 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 the type of work specified in this section with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Store insulation materials off the ground and protected from weather and moisture. Remove and replace insulation that has become wet.

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723, for insulation, jackets, adhesives, mastics, and tapes.

B. Energy Code: Insulation thickness shall be not less than required by 2021 IECC Section C403.12.3 and Table C403.12.3.

2.2 GLASS FIBER PIPE INSULATION

A. Manufacturers:
1. Johns Manville Corporation; Micro-Lok HP: www.jm.com/#sle.
2. Owens Corning Corporation; Fiberglas Pipe Insulation: www.ocbuildingspec.com/#sle.
3. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: www.knaufnorthamerica.com/#sle.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: Preformed glass fiber pipe insulation complying with ASTM C547, rigid molded, noncombustible.
1. Thermal Conductivity: 0.23 Btu-inch per hour-square foot-degree F maximum at 75 degrees Fahrenheit mean temperature.
2. Maximum Service Temperature: 850 degrees Fahrenheit.

C. Jacket: Factory-applied all-service jacket (ASJ) complying with ASTM C1136 Type I, white kraft paper reinforced with glass fiber scrim and laminated to aluminum foil, with self-sealing longitudinal lap and matching butt strips.
1. Moisture Vapor Permeance: 0.02 perm, maximum, when tested in accordance with ASTM E96/E96M.

D. Fittings and Valves: Mitered or molded glass fiber insulation of the same thickness as adjoining pipe insulation, covered with PVC fitting covers or field-applied jacket.

E. Vapor Retarder Tape and Mastic: Compatible with jacket, rated for the service temperature, with permeance not greater than the jacket.

2.3 FLEXIBLE ELASTOMERIC INSULATION - STANDARD TEMPERATURE

A. Manufacturers:
1. Armacell LLC; AP/ArmaFlex or ArmaFlex Ultra: www.armacell.us/#sle.
2. K-Flex USA LLC; K-Flex Insul-Tube: www.kflexusa.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees Fahrenheit.
2. Maximum Continuous Service Temperature: 220 degrees Fahrenheit.
3. Connection: Waterproof vapor barrier adhesive.

2.4 FLEXIBLE ELASTOMERIC INSULATION - HIGH TEMPERATURE (EPDM)

A. Manufacturers:
1. K-Flex USA LLC; K-Flex HT: www.kflexusa.com/#sle.
2. K-Flex USA LLC; K-Flex Titan, EPDM version: www.kflexusa.com/#sle.
3. Armacell LLC; EPDM-based product meeting the requirements of this article: www.armacell.us/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular insulation complying with ASTM C534/C534M Grade 2, EPDM based; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees Fahrenheit.
2. Maximum Continuous Service Temperature: Not less than 250 degrees Fahrenheit.
3. Connection: Waterproof vapor barrier adhesive rated for the maximum service temperature of the insulation. Do not use factory-applied pressure-sensitive adhesive seams on refrigerant gas lines unless rated by the manufacturer for not less than 250 degrees Fahrenheit.

4. Surface Burning Characteristics: 25/50 at each thickness installed. Where the required thickness exceeds the maximum thickness with a 25/50 rating, install in multiple layers, each layer rated 25/50.

2.5 JACKETING AND ACCESSORIES

A. PVC Jacket:
1. Manufacturers:
   a. Johns Manville Corporation; Zeston 2000 PVC: www.jm.com/#sle.
   b. Proto Corporation: www.protocorporation.com/#sle.
   c. Speedline Corporation: www.speedlinepvc.com/#sle.
   d. Substitutions: See Section 01 6000 - Product Requirements.
2. Jacket: One piece molded type fitting covers and sheet material, white color.
   a. Minimum Service Temperature: 0 degrees Fahrenheit.
   b. Maximum Service Temperature: 150 degrees Fahrenheit at the jacket surface.
   c. Surface Burning Characteristics: 25/50 at the thickness installed.
   d. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
   e. Thickness: 20 mil, 0.020 inch.
   f. Connections: Brush on welding adhesive or manufacturer's tape, rated for the jacket service temperature.

B. Aluminum Jacket: ASTM B209 formed aluminum sheet.
1. Manufacturers:
   a. ITW Insulation Systems (Childers Products): www.itwinsulation.com/#sle.
   b. RPR Products, Inc.; Insul-Mate: www.rpr-products.com/#sle.
   c. Substitutions: See Section 01 6000 - Product Requirements.
2. Thickness: 0.016 inch minimum.
3. Finish: Smooth.
4. Moisture Barrier: Factory-applied polyethylene and kraft paper or polysurlyn moisture barrier on the interior surface.
5. Fitting Covers: Factory-formed aluminum covers for elbows, tees, and valves, of the same alloy, thickness, and finish as the jacket.
6. Bands: Stainless steel, 1/2 inch wide by 0.020 inch thick, with stainless steel closures.

2.6 INSULATED PIPE SUPPORTS AND INSERTS

A. Manufacturers:
1. Hydra-Zorb Company; Klo-Shure Series 8 or 9 strut mounts and TRH hanger system: www.hydra-zorb.com/#sle.
2. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulated Pipe Supports: Factory-fabricated insulation inserts of high-density material with load-bearing capacity for the pipe and contents, and the same thickness as the adjoining insulation, with integral vapor retarder for cold piping.

C. Shields: Galvanized steel, 180 degree, minimum 12 inches long, sized to the insulation outside diameter.

2.7 ENGINEERED WALL OUTLET SEALS

A. Manufacturers:
1. Airex Manufacturing, Inc: www.airexmfg.com/#sle.
2. Substitutions: See Section 01 6000 - Product Requirements.

B. Basis of Design: Airex Manufacturing, Inc; Airex Titan Outlet.

C. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
1. Outlet Cover Color: Gray.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated Pipes Conveying Fluids Below Ambient Temperature:
1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
2. Provide continuous vapor retarder. Seal longitudinal laps, butt joints, and penetrations of the vapor retarder with vapor retarder tape or mastic.

D. For hot piping conveying fluids 140 degrees Fahrenheit or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

E. For hot piping conveying fluids over 140 degrees Fahrenheit, insulate flanges and unions at equipment.

F. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.

G. Supports: Provide insulated pipe supports or inserts and shields at each hanger and support so that insulation is continuous and not compressed.

3.3 INSTALLATION - VRF REFRIGERANT PIPING

A. Insulate each refrigerant line separately, including liquid lines. Do not bundle lines within a common insulation sleeve.

B. Insulate the full length of piping, including fittings, branch joints, headers, valves, and connections at outdoor units, branch selector units (BC controllers), and indoor units. Use insulation covers furnished by the VRF manufacturer for branch joints where provided, and seal joints to adjoining pipe insulation.

C. Insulate flare and equipment connections after pressure testing and leak checking.

D. Seal longitudinal seams and butt joints with adhesive rated for the insulation service temperature to form a continuous vapor barrier.

3.4 JACKETING

A. Outdoor Piping: Provide aluminum jacket over all insulated piping, regardless of insulation type, including fittings, valves, and flanges.
1. Apply vapor retarder jacket or sealed elastomeric insulation under the aluminum jacket on piping conveying fluids below ambient temperature.
2. Lap jacket seams a minimum of 2 inches, with longitudinal seams on the bottom side of horizontal piping and circumferential laps arranged to shed water.
3. Secure with stainless steel bands at 12 inches on center and at each circumferential lap. Seal laps and terminations with weatherproof sealant.

B. Exposed Indoor Piping: Provide jacket over all insulated piping, including fittings, valves, and flanges, with jacket temperature rating not less than the maximum surface temperature of the insulation system.
1. PVC Jacket: Provide on piping conveying fluids at 250 degrees Fahrenheit or less.
2. Aluminum Jacket: Provide on steam, steam condensate, and other piping conveying fluids above 250 degrees Fahrenheit, and where PVC jacket surface temperature rating would be exceeded.

C. Concealed Indoor Piping: Field-applied jacket is not required over factory-applied ASJ or flexible elastomeric insulation.

3.5 SCHEDULE

A. General: Insulation thicknesses scheduled below are in accordance with 2021 IECC Table C403.12.3. Pipe sizes are nominal pipe or tube size. For copper refrigerant tube, nominal size is 1/8 inch less than outside diameter.
1. Insulation Conductivity: Scheduled thicknesses are based on the conductivity ranges in 2021 IECC Table C403.12.3. Where insulation conductivity at the mean rating temperature exceeds the upper value of the range, increase thickness in accordance with Note b of the table.
2. Reduction for Piping in Conditioned Space Partitions: For piping smaller than 1-1/2 inch nominal located in partitions within conditioned spaces, scheduled thicknesses may be reduced by 1 inch, but not to less than 1 inch, in accordance with Note a of 2021 IECC Table C403.12.3. Apply this reduction before any thickness adjustment for conductivity.
3. Reduction for Direct-Buried Piping: For direct-buried heating and hot water piping, scheduled thicknesses may be reduced by 1-1/2 inches, but not to less than 1 inch, in accordance with Note c of 2021 IECC Table C403.12.3. Apply this reduction before any thickness adjustment for conductivity.
4. Insulation Not Required: Factory-installed piping within HVAC equipment tested and rated in accordance with the 2021 IECC, and piping conveying fluids with a design operating temperature range between 60 degrees Fahrenheit and 105 degrees Fahrenheit, except where insulation is scheduled below for condensation control or required by the equipment manufacturer.

B. VRF Refrigerant Piping: High temperature flexible elastomeric insulation (EPDM), with thickness as scheduled below, but not less than the VRF manufacturer's published minimum. Reduced thicknesses permitted by Notes a and c shall not be less than the VRF manufacturer's published minimum.

1. Gas Lines on Heat Pump Systems, High-Pressure Gas Lines on Heat Recovery Systems, and Gas Lines Between Branch Selector Units and Indoor Units (141 to 200 Degrees F):
   a. Up to 1-3/8 Inch OD (Less Than 1-1/2 Inch Nominal): 1-1/2 inch.
   b. 1-5/8 Inch OD (1-1/2 Inch Nominal) and Larger: 2 inch.
2. Low-Pressure Gas Lines on Heat Recovery Systems (40 to 60 Degrees F):
   a. All Sizes: 1 inch, to meet the VRF manufacturer's minimum.
3. Liquid Lines (105 to 140 Degrees F):
   a. Up to 1-3/8 Inch OD (Less Than 1-1/2 Inch Nominal): 1 inch.
   b. 1-5/8 Inch OD (1-1/2 Inch Nominal) and Larger: 1-1/2 inch.

C. Condensate Drains from Cooling Coils: Standard temperature flexible elastomeric insulation, 1/2 inch, for condensation control.

END OF SECTION 23 0719

SECTION 23 0923 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section includes a complete, fully functional, BACnet-based direct digital control (DDC) system for HVAC and related building systems, including controllers, operator interface, sensors, control devices, wiring, programming, graphics, integration, checkout, training, and warranty.

B. The points lists, sequences of operation, control diagrams, and riser diagrams on the Drawings are part of this Section.

1.2 RELATED REQUIREMENTS

A. Division 01: Submittal procedures, closeout, demonstration and training, and general commissioning requirements.

B. Division 23: HVAC equipment, packaged unit controls, ductwork accessories, vehicle exhaust system, and testing, adjusting, and balancing.

C. Division 26: Electrical power and branch circuits.

D. Division 28: Fire alarm system and, where indicated, carbon monoxide and nitrogen dioxide detection.

1.3 SCOPE OF WORK

A. Provide all labor, materials, devices, wiring, conduit, software, licenses, programming, and services required to accomplish every point, sequence, interlock, alarm, and function shown on the Drawings or specified herein, whether or not each component is individually listed.

B. Points lists indicate minimum requirements. Provide any additional physical or virtual points, sensors, relays, or devices required to execute the sequences of operation as written, at no additional cost.

C. Where the Drawings and Specifications conflict, or where requirements are ambiguous, the more stringent or more costly requirement is included in the Contract Sum, subject to the Engineer's interpretation.

D. Integrate the factory controls of packaged equipment listed on the points list over BACnet. Where a unit's factory controller is not BACnet, provide the manufacturer's BACnet communication card or a listed BACnet gateway at no additional cost.

E. Provide all control wiring, including line-voltage wiring for control devices, interlocks, and control power, except branch circuits shown on the Electrical Drawings.

1.4 DIVISION OF WORK

A. For work shared with other trades, provide the following under this Section. All other controls work is furnished, installed, and wired under this Section.

1. 120V control power to control panels and devices, except branch circuits shown on the Electrical Drawings.
2. Control valves, wells, and flow and pressure taps: Furnish and wire. Valves, wells, and taps will be installed by the piping installer.
3. Control dampers not factory-furnished with equipment: Furnish and wire. Dampers will be installed by the ductwork installer.
4. Duct smoke detectors: Fan shutdown interlock wiring.
5. Fire alarm relay modules for HVAC shutdown: Wiring from the relay module to HVAC equipment.
6. Packaged equipment factory controllers: Network and field I/O wiring.
7. Motor starters and VFDs: Control and network wiring.
8. CO/NO2 detection system: Interface wiring to the DDC system.
9. Vehicle exhaust system controls: Interlock and status wiring to the DDC system.
10. Network cabling from the Building Controller to the Owner's network connection point.

1.5 DEFINITIONS

A. BACnet: ASHRAE 135, current edition.

B. BTL: BACnet Testing Laboratories listing at the device profile indicated.

C. Building Controller: The single network controller serving as the building's supervisory device and web server.

D. Owner Access Level: Full administrative rights, including ability to change programming, sequences, setpoints, schedules, alarms, trends, graphics, and user accounts.

1.6 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.7 OPEN SYSTEM REQUIREMENTS

A. All controllers, from the Building Controller to the terminal unit level, shall communicate natively using BACnet/IP or BACnet MS/TP. Proprietary field buses are not acceptable.

B. Each controller shall be BTL-listed at the profile appropriate to its function (B-BC for the Building Controller; B-AAC or B-ASC for application and unitary controllers).

C. At Substantial Completion, transfer to the Owner, at no additional cost:
1. All licenses required to operate and modify the system, registered to the Owner, perpetual, with no annual fees.
2. Current, editable programming files, databases, and graphics for every controller.
3. All usernames and passwords at Owner Access Level.
4. One licensed copy of every software tool required to modify the system, installed on an Owner-furnished computer.

D. The system shall not be locked, keyed, or configured so that service or modification is restricted to the installing contractor or branch. Any factory-authorized dealer or branch of the same manufacturer shall be able to service and modify the system.

E. Where the system uses the Niagara Framework, all Niagara licenses shall be open, with unrestricted compatibility, so that any Niagara-certified integrator can access and modify the system. Brand-restricted or compatibility-locked licenses are not acceptable.

F. No cloud service, remote-access gateway, or subscription is required for full operation. Any remote access shall be provided only at the Owner's written direction.

1.8 SUBMITTALS

A. Product Data: Cut sheets for every controller, sensor, device, and software item, with BTL listings and BACnet Protocol Implementation Conformance Statements (PICS).

B. Shop Drawings:
1. System riser showing every controller, its network address, and the network path to the Building Controller.
2. Control diagram for each system, matching the Drawings, with every device tagged.
3. Points list for each controller showing point name, type, address, range, alarm limits, and trend interval.
4. Wiring diagrams for every panel and every interface to other trades.
5. Sequences of operation, either confirming the Drawings verbatim or with each deviation highlighted. Unhighlighted deviations are not approved by a stamped submittal.
6. Graphic screen layouts for each system and the floor plan.

C. Checkout Documentation: Completed point-to-point checkout reports as specified in "Point-to-Point Checkout" Article.

D. Closeout Submittals: As-built shop drawings, final points lists, programming files and databases (electronic), operation and maintenance manuals, warranty, license certificates, and credential list.

E. Commissioning Documentation: Completed construction checklists, functional test procedures, functional test results, issues log responses, and the energy code functional testing report, as specified in "Commissioning" Article.

F. Partial or incomplete submittals will be returned without review.

G. The Engineer will review each submittal a maximum of two times. The Contractor shall reimburse the Owner for the Engineer's review of the third and subsequent submissions of any submittal at the Engineer's standard hourly rates.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Factory-authorized branch or dealer of the manufacturer, with a service office within 75 miles of the project, employing factory-trained technicians, and with at least 5 years installing the proposed product line.

B. The installer shall program, commission, and warrant the system with its own forces. Subcontracting of programming is not permitted.

C. Provide a list of three similar projects completed in the last five years, with Owner contact information, with the first submittal.

1.10 PRE-BID REVIEW AND CLARIFICATIONS

A. Bidders shall review the Drawings, points lists, and sequences, and submit questions before the deadline for bidder questions. Submission of a bid confirms that the bidder has found the documents sufficient to provide a complete system.

B. Claims for additional cost based on information available in the Contract Documents at the time of bid will not be considered.

1.11 WARRANTY

A. Warrant all materials, labor, and programming for two years from Substantial Completion. Respond on site within 24 hours of notice for loss of heating or cooling and within 72 hours otherwise.

B. The warranty period begins at Substantial Completion, regardless of any earlier use of the system for temporary heating, cooling, or ventilation.

C. Provide all manufacturer firmware and software updates, including security patches, released during the warranty period, installed at no additional cost.

D. Provide one opposite-season visit during the warranty period to verify sequences and retune loops, with a written report. This visit may be combined with seasonal commissioning testing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following, installed by a factory-authorized branch or dealer:
1. Johnson Controls, Inc.: Facility Explorer (FX) product line.
2. Honeywell International Inc.: Optimizer product line.
3. Trane Technologies: Tracer product line.
4. Alerton (a Honeywell company): Ascent product line.
5. Distech Controls, Inc.: ECLYPSE product line.
6. Automated Logic Corporation: WebCTRL product line.
7. Siemens Industry, Inc.: Desigo product line.

B. No substitutions. Manufacturers not listed will not be considered.

C. All controllers, the Building Controller, and the operator interface shall be from a single manufacturer. Factory controllers furnished with packaged equipment are excepted and shall be integrated as specified in "Scope of Work" Article.

2.2 BUILDING CONTROLLER

A. BTL-listed B-BC, BACnet/IP, with integral BACnet MS/TP port(s) as required.

B. Embedded web server providing the complete operator interface specified in "Operator Interface and Graphics" Article through any current standard web browser, with no client software, plug-ins, or per-user licenses.

C. Real-time clock with battery backup and network time synchronization. Retain programming, setpoints, schedules, and trend data through power loss without batteries.

D. Onboard storage for all trends specified in "Trending" Article for a minimum of 90 days, and for a minimum of 500 alarm records.

E. Email notification of alarms to a minimum of 5 recipients, configurable by alarm priority.

F. Minimum of 5 concurrent web users.

G. Automatic restart after power loss, with equipment start sequenced as specified in "Programming" Article.

2.3 FIELD CONTROLLERS

A. Programmable application controllers (BTL B-AAC) for air handling units, energy recovery units, and any equipment with a custom sequence.

B. Application-specific controllers (BTL B-ASC) are acceptable only for terminal units and simple unitary equipment where the factory application executes the sequence on the Drawings without modification.

C. Each controller shall execute its sequence independently of the network and the Building Controller. Loss of communication shall not stop equipment; equipment shall revert to the fail-safe or last-known mode indicated on the Drawings.

D. Provide a minimum of 15 percent spare inputs and outputs of each type across the system, distributed among controllers.

E. Controllers shall operate at 32 to 122 degrees Fahrenheit and 10 to 90 percent RH non-condensing. Controllers in apparatus bays or unconditioned spaces shall be in enclosures rated as specified in "Enclosures" Article.

2.4 OPERATOR INTERFACE AND GRAPHICS

A. Accessible from any computer or tablet on the Owner's network through a standard web browser over HTTPS.

B. Graphics:
1. Building floor plan with each zone color-coded by temperature relative to setpoint, with links to each system.
2. One graphic per major equipment item showing a schematic of the equipment with live values for every point on its points list, setpoints, and operating mode.
3. Alarm summary, schedule, and trend pages.

C. Functions available from the interface: view and command points, adjust setpoints, edit schedules and holidays, acknowledge alarms, view and export trends to CSV, and manage user accounts.

D. A minimum of three user levels: view only, operator (setpoints, schedules, alarm acknowledgment), and administrator.

2.5 CYBERSECURITY

A. Change all default passwords. Provide unique credentials for each user account.

B. Disable unused services and ports. Use HTTPS for all web access.

C. Install the manufacturer's current firmware and software release at Substantial Completion.

D. Coordinate IP addressing, VLAN, and firewall requirements with the Owner's IT representative. Provide the Owner a written network summary listing every IP device, its address, and its function.

2.6 SENSORS

A. Space Temperature Sensors:
1. Thermistor or RTD, accuracy plus or minus 0.5 degree F over 55 to 85 degrees Fahrenheit.
2. Offices, dayrooms, and bunk rooms: setpoint adjustment limited to plus or minus 3 degrees Fahrenheit and occupancy override button.
3. Apparatus bays, mechanical rooms, and public areas: sensor only, no adjustment, with stainless steel wall plate or locking wire guard.

B. Radiant-Compensated Temperature Sensors (Spaces Heated by Infrared Heaters): Black globe type, responding to combined air and radiant temperature, accuracy plus or minus 1.0 degree F over 40 to 100 degrees Fahrenheit, with locking guard.

C. Space Humidity Sensors: Plus or minus 3 percent RH over 20 to 80 percent RH.

D. Duct Temperature Sensors: Plus or minus 0.5 degree F. Averaging type for mixed air and coil discharge, minimum 1 linear foot of element per square foot of duct area.

E. Outdoor Air Temperature and Humidity Sensor: With sun shield, mounted on the north face of the building away from exhaust.

F. CO2 Sensors: NDIR, plus or minus 50 ppm or 3 percent of reading, self-calibrating.

G. Current Switches for Status: Split-core, adjustable trip point, with LED indication. Status proven by current alone is not acceptable for belt-driven fans; provide differential pressure switches.

H. Differential Pressure Switches and Transmitters: Range and accuracy as required by the sequence.

2.7 CONTROL DEVICES

A. Control Valves: Pressure-independent characterized control valves, sized for the flow and pressure drop shown, with close-off rating exceeding pump shutoff head.

B. Control Dampers: AMCA-licensed, Class 1A leakage, with blade and jamb seals. Dampers furnished with equipment shall meet the same leakage class.

C. Actuators: Electronic, modulating or two-position as required by the sequence, with spring return where a fail position is shown on the Drawings. Provide position feedback where shown on the points list.

D. Control Relays: Plug-in, with LED status indication and manual override.

2.8 ENCLOSURES

A. Indoor Conditioned Spaces: NEMA 1, hinged locking door, common key.

B. Apparatus Bays, Wash Bays, Mechanical Rooms with Water Piping, and Unconditioned Spaces: NEMA 4X.

C. Exterior: NEMA 4X, UV-resistant.

D. Provide a laminated as-built control diagram and points list inside each panel door.

2.9 WIRING AND RACEWAYS

A. Comply with NFPA 70 and Division 26.

B. Finished Spaces: Conceal all wiring and raceway. In masonry walls, install conduit in the cores during wall construction; coordinate with the masonry trade. Surface metal raceway is acceptable only where concealment is not possible and only where approved in writing by the Architect.

C. Mechanical Rooms, Apparatus Bays, and Unfinished Spaces: Install all wiring in conduit. Exposed conduit is acceptable.

D. Above Accessible Ceilings: Plenum-rated cable without conduit is acceptable, supported independently of other systems with J-hooks or bridle rings. Install in conduit where cable passes through inaccessible spaces or walls.

E. Minimum conduit size: 3/4 inch.

F. BACnet MS/TP: Shielded twisted pair as recommended by the controller manufacturer, with a distinct jacket color.

G. BACnet/IP: Category 6.

H. Label every conductor at both ends and every device with its points list tag.

PART 3 EXECUTION

3.1 EXAMINATION AND COORDINATION

A. Before rough-in, verify the controls interface of every packaged equipment item against the approved equipment submittals. Report any conflict with the points list or sequences in writing before ordering controls products. Conflicts not reported before rough-in shall be corrected at no additional cost.

B. Coordinate device locations with the architectural, structural, and electrical work. Relocate devices installed without coordination at no additional cost.

3.2 INSTALLATION

A. Install products per manufacturer's instructions, the approved shop drawings, and NFPA 70.

B. Mount panels with the top no higher than 6 feet above finished floor, with 36 inches of clear working space in front.

C. Install control panels, devices, and wiring in apparatus bays above the highest door swing and vehicle clearance line, or where protected by bollards or wall guards, and away from vehicle exhaust drops and wash-down spray.

D. Seal all conduit penetrations into NEMA 4X enclosures and between conditioned and unconditioned spaces.

E. Cutting, Patching, and Firestopping: Perform all cutting, patching, and firestopping for penetrations required by the Work of this Section, in accordance with Division 01 and the Division 07 firestopping section. Restore finishes to match adjacent surfaces.

F. Owner Network: If the Owner's network connection is not available at the time of checkout, provide a local network switch and all connections required to complete checkout, demonstration, and training with the system operating standalone. Connect the system to the Owner's network when it becomes available, at no additional cost.

3.3 SENSOR LOCATIONS

A. Mount space sensors at 48 inches above finished floor to the top of the device, on interior walls, away from supply diffusers, exterior doors, windows, and heat sources. Final locations as approved on shop drawings.

B. Outdoor Air Sensors: As specified in "Sensors" Article, minimum 10 feet from any exhaust or relief opening.

3.4 EXISTING CONTROLS

A. Remove existing controls devices, panels, and wiring made obsolete by the Work. Cut abandoned wiring back to its source and terminate.

B. Existing control devices, wiring, and controllers shall not be reused unless specifically indicated on the Drawings.

C. Removed controllers, sensors, and devices shall become the property of the Contractor and shall be legally disposed of off site.

D. Maintain operation of existing systems serving occupied areas until new controls are operational. Schedule any interruption with the Owner a minimum of 72 hours in advance.

3.5 TEMPORARY OPERATION DURING CONSTRUCTION

A. Where HVAC equipment is operated for temporary heating, cooling, or ventilation before Substantial Completion, provide the controls programming and safeties required for safe operation, including freeze protection and high and low limit safeties.

B. Before Substantial Completion, re-verify all programming, recalibrate all sensors, and replace any controls devices damaged or contaminated during temporary operation, at no additional cost to the Owner.

3.6 PROGRAMMING

A. Program every sequence of operation on the Drawings exactly as written. Do not modify setpoints, deadbands, or logic without written approval from the Engineer.

B. Point Naming: Use a consistent naming convention of building, system, and point, submitted for approval with the points lists.

C. Adjustable Parameters: Every setpoint, deadband, time delay, and limit referenced in the sequences shall be adjustable from the operator interface at administrator level without reprogramming.

D. Restart After Power Loss: Stagger equipment starts at a minimum of 30 seconds between major equipment items.

E. Alarms: In addition to alarms shown on the points list, provide:
1. Equipment failure: command and status disagree for more than 60 seconds.
2. Space temperature more than 5 degrees Fahrenheit from active setpoint for more than 30 minutes.
3. Apparatus bay temperature below 40 degrees Fahrenheit.
4. Loss of communication with any controller.
5. CO/NO2 detection system alarm.
6. Generator running and generator trouble.

F. Schedules: Program occupancy schedules as directed by the Owner during training. Fire station living areas default to continuous occupancy unless directed otherwise.

3.7 COORDINATION WITH TESTING, ADJUSTING, AND BALANCING

A. Provide a controls technician on site during testing, adjusting, and balancing, with the interface and software required to command dampers, valves, and variable frequency drives.

B. Set minimum outdoor air damper positions, airflow setpoints, and drive speeds as determined by the balancer, and enter final values into the programming.

C. Provide all assistance required by the balancer at no additional cost.

3.8 TRENDING

A. Trend every physical input and output and every setpoint at an interval of 15 minutes, and every status point on change of value. Retain as specified in "Building Controller" Article.

B. Trends shall be active before the sequence demonstration.

3.9 POINT-TO-POINT CHECKOUT

A. Before the sequence demonstration, check every point and document results on a checkout form listing each point with date, technician, and result:
1. Inputs: Compare the reading to a calibrated reference instrument. Record both values.
2. Outputs: Command through the full range and verify the device responds correctly.
3. Interlocks and Safeties: Verify each by actual trip, not by simulation.
4. Network Points from Packaged Equipment: Verify each value against the equipment's local display.

B. Submit completed checkout forms a minimum of 7 days before the sequence demonstration. The demonstration will not be scheduled until checkout forms are accepted.

3.10 COMMISSIONING

A. The DDC system shall be commissioned by the Owner's Commissioning Authority (CxA). Where the Contractor engages the CxA, the CxA shall be independent of the Contractor and the installer, and shall be approved by the Owner.

B. Commissioning shall satisfy the adopted energy code, including IECC Section C408 or ASHRAE 90.1 as applicable, and the Division 01 general commissioning requirements.

C. Contractor Responsibilities:
1. Attend commissioning meetings scheduled by the CxA, with the project manager and the lead programming technician.
2. Complete and submit construction checklists provided by the CxA for each controller, panel, and system before functional testing.
3. Complete point-to-point checkout as specified in "Point-to-Point Checkout" Article before functional testing begins.
4. Provide trend logs requested by the CxA, in electronic format, for a minimum of 7 consecutive days of normal operation before functional testing.
5. Provide technicians, tools, instruments, software, and access to the operator interface to execute each functional test, including overriding points and simulating conditions as directed by the CxA.
6. Respond in writing to each item on the CxA issues log within 5 working days, and correct deficiencies at no additional cost.
7. Prepare and submit the energy code functional testing report, documenting results, deficiencies, and corrections, in the form required by the code official.
8. Provide controls content for the systems manual and verify training as required by the CxA.

D. Retesting: Where a functional test fails, correct the deficiency and retest. The Contractor shall reimburse the Owner for the CxA's and the Engineer's time for each retest after the first retest of the same item, at their standard hourly rates.

E. Seasonal Testing: Perform deferred functional tests of heating or cooling sequences that cannot be tested under the conditions present at Substantial Completion during the first opposite season, as scheduled by the CxA, at no additional cost.

3.11 SEQUENCE DEMONSTRATION

A. The sequence demonstration may be performed concurrently with commissioning functional testing when approved by the Engineer and the CxA.

B. Demonstrate each sequence of operation to the Engineer and the Owner, including each mode, alarm, safety, and fail-safe response, using the operator interface and actual equipment operation.

C. Provide two technicians and all tools and instruments required.

D. Correct deficiencies and repeat the demonstration of affected sequences. The Contractor shall reimburse the Owner for the Engineer's time for any demonstration after the second attempt, at the Engineer's standard hourly rates.

3.12 TRAINING

A. Provide 4 hours of on-site training in two sessions, by a technician who programmed the system, covering: system overview, navigating the interface, setpoints and schedules, alarm response, trends, user accounts, and basic troubleshooting.

B. Provide 2 hours of follow-up training within 6 months of Substantial Completion, at a time selected by the Owner.

C. Provide a printed quick-reference guide with the web address, login procedure, and common tasks, mounted at the Building Controller.

3.13 CLOSEOUT AND TURNOVER

A. Submit all closeout submittals and transfer all items listed in "Open System Requirements" Article before Substantial Completion.

B. Provide all programming files, databases, graphics, and as-built documents electronically on a USB drive and by electronic transfer.

C. Final payment for this Section will not be released until the Owner confirms in writing that administrator access, licenses, and programming files have been received and verified.

END OF SECTION 23 0923

SECTION 23 2113 - HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydronic system requirements.

B. Condensate piping, above grade

C. Equipment drains and overflows

D. Pipe hangers and supports.

E. Unions, flanges, mechanical couplings, and dielectric connections.

1.2 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

C. ASME B31.9 - Building Services Piping; 2025.

D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).

F. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

H. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2015.

I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2026.

J. ASTM A536 - Standard Specification for Ductile Iron Castings; 2026a.

K. ASTM B32 - Standard Specification for Solder Metal; 2020.

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2026.

N. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015, with Editorial Revision (2018).

O. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.

P. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.

Q. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2017.

R. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2015.

S. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.

T. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992,with Editorial Revision (2018).

U. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

V. AWWA C606 - Grooved and Shouldered Joints; 2015.

W. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

D. Product Data:
1. Include data on pipe materials, pipe fittings, valves, and accessories.
2. Provide manufacturers catalog information.
3. Indicate valve data and ratings.
4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

E. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

F. Project Record Documents: Record actual locations of valves.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Valve Repacking Kits: One for each type and size of valve.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum 5 years of experience.

C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

D. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
2. Use non-conducting dielectric connections whenever jointing dissimilar metals. Provide shut off valve to allow for replacement of the fitting without draining the entire system. The shut off valve shall be constructed of the material matching the pipe it's on.
3. Grooved mechanical joints may be used in any location.
a. Grooved mechanical connections and joints comply with AWWA C606.
1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.

b. Use gaskets of molded synthetic rubber with central cavity, pressure-responsive configuration, and complying with ASTM D2000, Grade 2CA615A15B44F17Z for circulating medium up to maximum 230 degrees F or Grade M3BA610A15B44Z for circulating medium up to maximum 200 degrees F.

4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
5. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:
1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
2. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
3. For throttling, bypass, or manual flow control services, use globe valves.
4. For throttling and isolation service in chilled and condenser water systems, use only butterfly valves.
5. In heating water systems, butterfly valves may be used interchangeably with gate and globe valves.
6. For shut-off and to isolate parts of systems or vertical risers, use gate, ball, or butterfly valves.

E. Welding Materials and Procedures: Comply with ASME BPVC-IX.

2.2 CONDENSATE PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
1. NOT ALLOWED IN RETURN AIR PLENUMS
2. Fittings: ASTM D2466 or ASTM D2467, PVC.
3. Joints: Solvent welded in accordance with ASTM D2855.

C. CPVC Pipe ASTM F441, Schedule 40, or ASTM D2846, SDR 11 (CTS)
1. Where installed in return air plenums, provide CPVC pipe and fittings listed for maximum 25/50 flame spread/smoke developed per ASTM E84.
2. Fittings: ASTM F438 (Schedule 40 socket type), or ASTM D2846 for CTS pipe, CPVC.
3. Joints: Solvent welded in accordance with ASTM D2855, using ASTM F656 primer and ASTM F493 solvent cement.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
1. NOT ALLOWED IN RETURN AIR PLENUMS
2. Fittings: ASTM D2466 or D2467, PVC.
3. Joints: Solvent welded in accordance with ASTM D2855.

C. CPVC Pipe ASTM F441, Schedule 40, or ASTM D2846, SDR 11 (CTS)
1. Where installed in return air plenums, provide CPVC pipe and fittings listed for maximum 25/50 flame spread/smoke developed per ASTM E84.
2. Fittings: ASTM F438 (Schedule 40 socket type), or ASTM D2846 for CTS pipe, CPVC.
3. Joints: Solvent welded in accordance with ASTM D2855, using ASTM F656 primer and ASTM F493 solvent cement.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Conform to ASME B31.9.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

D. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

F. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.

G. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

H. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

I. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.

J. Vertical Support: Steel riser clamp.

K. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

L. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.5 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches and Less:

B. Flanges for Pipe 2 Inches and Greater:
1. Gaskets: 1/16 inch thick, preformed neoprene.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment using jointing system specified.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. See Section 23 2500 for additional requirements.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. CPVC / PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

C. Route piping in orderly manner, parallel oer perpendicular to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interference with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls, and floors.

G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified _____.

H. Slope piping and arrange to drain at low points.

I. Inserts:
1. Provide inserts for placement in concrete formwork.

J. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 0719.

L. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100 .

M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

N. Install valves with stems upright or horizontal, not inverted.

3.3 SCHEDULES

A. Hanger Spacing for Copper Tubing.
1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.

B. Hanger Spacing for Plastic Piping.
1. 1/2 Inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
2. 3/4 Inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
3. 1 Inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
4. 1-1/4 Inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.
5. 1-1/2 Inches: Maximum span, 63 inches; minimum rod size, 3/8 inch.

END OF SECTION 23 2113

SECTION 23 2300 - REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Refrigerant.

B. Refrigerant piping, fittings, and joints common to all systems.

C. Refrigerant piping requirements specific to variable refrigerant flow (VRF) systems.

D. Refrigerant piping requirements specific to conventional direct-expansion (DX) systems.

E. Refrigerant specialties for conventional DX systems.

F. Pipe hangers and supports.

1.2 DEFINITIONS

A. VRF Systems: Variable refrigerant flow heat pump and heat recovery systems, including single-zone and multi-zone VRF split systems, consisting of outdoor units, branch selector units, and indoor units furnished by a single VRF manufacturer.

B. Conventional DX Systems: Split-system and packaged direct-expansion air-conditioning and heat pump systems that are not VRF systems.

C. A2L Refrigerant: Refrigerant classified as lower toxicity, lower flammability in accordance with ASHRAE Std 34.

1.3 REFERENCE STANDARDS

A. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.

B. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2013.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

D. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2016.

E. ASME B31.9 - Building Services Piping; 2025.

F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

H. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2016.

I. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

K. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

L. 40 CFR 84 Subpart B - Technology Transitions; Current Edition.

M. ISO 14903 - Refrigerating Systems and Heat Pumps - Qualification of Tightness of Components and Joints; 2017.

N. UL 60335-2-40 - Household and Similar Electrical Appliances - Safety - Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's catalog data for tube, fittings, brazing filler metals, hangers and supports, and specialties, including pressure ratings and load capacities.

B. Press Fittings: Where press fittings are used, submit manufacturer's product data indicating UL 207 listing for field installation, ISO 14903 test compliance, pressure and temperature ratings, size range, and published compatibility with R32, R454B, and the system lubricant. Submit written acceptance of press fittings from the refrigeration equipment manufacturer for each system on which press fittings will be used.

C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

D. Shop Drawings: Indicate layout of each refrigerant system, including equipment, pipe routing, pipe sizes, developed pipe lengths, elevations, and locations of branch joints, headers, valves, and specialties.
1. VRF Systems: Include the VRF manufacturer's piping design software output for each system, based on the actual routing, indicating pipe sizes, total and branch pipe lengths, vertical separations, and calculated additional refrigerant charge. Submit evidence that the VRF manufacturer has reviewed and accepted the piping layout before fabrication.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

F. Qualification Data:
1. Brazer qualifications in accordance with ASME BPVC-IX.
2. VRF manufacturer's training certificate for the installer of VRF piping.
3. Press fitting manufacturer's training certificate for each installer who will make press joints.

G. Test Reports: Submit pressure test, evacuation, and refrigerant charge records specified in Part 3.

H. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

I. Project Record Documents: Record actual routing, pipe sizes, and developed lengths of refrigerant piping, locations of branch joints, valves, and specialties, and total refrigerant charge of each system.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of documented experience.

B. VRF Installer Qualifications: Trained and certified by the VRF manufacturer in the installation of the VRF system to be provided.

C. Press Fitting Installer Qualifications: Installers making press joints shall be trained and certified by the press fitting manufacturer in the installation of the specific fitting system and press tools to be used.

D. Brazers: Qualified in accordance with ASME BPVC-IX.

E. Refrigerant Handling: Technicians certified in accordance with EPA Section 608 for the type of equipment served.

F. Comply with ASHRAE Std 15, ASME B31.5, and the mechanical code adopted by the authority having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Deliver copper tube cleaned, dehydrated, and capped or nitrogen charged by the manufacturer.

C. Protect piping and specialties from entry of moisture and contaminating material by leaving end caps and plugs in place until installation. Cap open ends of installed piping at the end of each work day.

PART 2 PRODUCTS

2.1 REFRIGERANT

A. Refrigerant: R32 or R454B as indicated for each system, as defined in ASHRAE Std 34.

B. Refrigerant shall have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 700, in compliance with 40 CFR 84 Subpart B.

C. Piping, fittings, joints, and specialties shall be rated and listed for the refrigerant and lubricant used in each system.

2.2 PIPING AND FITTINGS - ALL SYSTEMS

A. Copper Tube: ASTM B280, ACR type, cleaned and capped.
1. Temper and Wall Thickness: Rated for the system design pressure in accordance with ASME B31.5 and not less than the equipment manufacturer's published requirements for the refrigerant used.
2. Annealed Tube: O60 soft annealed, only in sizes permitted by the equipment manufacturer.
3. Drawn Tube: H58 hard drawn for all other sizes.

B. Fittings: ASME B16.22 wrought copper, rated for the system design pressure.

C. Brazed Joints:

1. Copper to Copper: AWS A5.8M/A5.8 BCuP-5 silver/phosphorus/copper alloy, without flux.
2. Copper to Brass or Steel: AWS A5.8M/A5.8 BAg silver alloy, with flux as recommended by the filler metal manufacturer.

D. Press Fittings: At Contractor's option, mechanical press-connect fittings may be used in lieu of brazed joints for ASTM B280 copper tube within the size range listed by the fitting manufacturer, subject to the following:
1. Description: Copper or copper alloy fitting body with factory-installed HNBR sealing element, designed for permanent, non-reusable field-installed joints on ACR copper tube.
2. Listings: UL 207 listed for field installation, and tested in accordance with and compliant with ISO 14903 for use as a permanent joint on A2L refrigerant systems.
3. Ratings: Maximum operating pressure of not less than 700 psig, minimum burst pressure of 2100 psig, and operating temperature range of minus 40 degrees Fahrenheit to 250 degrees Fahrenheit.
4. Compatibility: Manufacturer's published approval for use with R32 and R454B refrigerants and with POE and PVE lubricants.
5. Size Range: Use press fittings only within the manufacturer's listed size range. Provide brazed joints for tube sizes larger than the listed range.
6. Equipment Manufacturer Acceptance: Use press fittings only on systems where the refrigeration equipment manufacturer accepts press fittings in writing. Do not use press fittings where their use would void or limit the equipment warranty.
7. Manufacturers:
   a. Parker Hannifin Corporation, Sporlan Division; ZoomLock MAX.
   b. RLS LLC (Rapid Locking System); RLS Press Fittings.
   c. Mueller Industries, Inc. (Mueller Streamline Co.); Streamline ACR Copper Press Fittings.
   d. Or approved equal.

E. Flared Joints: Only at equipment connections where flare connections are provided by the equipment manufacturer, using flare nuts furnished or specified by the equipment manufacturer and rated for the refrigerant used. Indoors, use flared joints only where permitted by UL 60335-2-40 for the listed equipment.

2.3 PIPING AND FITTINGS - VRF SYSTEMS

A. Branch Joints and Headers: Furnished by the VRF manufacturer for the specific system. Field-fabricated tees, branches, and headers are not permitted.

B. Pipe Sizes: As determined by the VRF manufacturer's piping design software for the actual routing. Pipe sizes indicated on drawings are for coordination only.

C. In-Line Specialties: Do not provide field-installed filter-driers, moisture and liquid indicators, strainers, check valves, solenoid valves, or other in-line specialties unless furnished or accepted in writing by the VRF manufacturer.

D. Isolation Valves: Where indicated, provide only ball valves furnished or accepted in writing by the VRF manufacturer, rated for the system design pressure.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

E. Vertical Support: Steel riser clamp.

F. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

G. Insulated Pipe: Provide insulation protection shields and inserts as specified in Section 23 0719, sized so that insulation is not compressed at supports.

H. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

I. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

J. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
1. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
2. 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. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
5. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

PART 3 EXECUTION

3.1 PREPARATION

A. Cut tube square with a rotary tube cutter. Ream tube ends and remove burrs, keeping chips out of the tube.

B. Remove scale and dirt on inside and outside before assembly.

C. Verify equipment connection sizes and locations with the equipment manufacturer's data before fabrication.

3.2 INSTALLATION - ALL SYSTEMS

A. Install piping and specialties in accordance with ASHRAE Std 15, ASME B31.5, and the equipment manufacturer's instructions.

B. Route piping in orderly manner, with piping parallel or perpendicular to building structure.

C. Install piping to conserve building space and avoid interference with use of space.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. Provide clearance for installation of insulation and access to valves and fittings.

F. Brazing: Braze joints while flowing dry nitrogen through the piping to prevent formation of oxides inside the tube. Protect valves and equipment from heat in accordance with the manufacturer's instructions.

G. Joints Indoors on A2L Refrigerant Systems: Comply with UL 60335-2-40 and ASHRAE Std 15. Provide brazed joints, or press fittings tested in accordance with ISO 14903. Do not provide reusable mechanical connectors indoors.

H. Insulation: Insulate liquid and suction or gas piping separately in accordance with Section 23 0719.

I. Identification: Identify refrigerant piping in accordance with Section 23 0553, including refrigerant designation and safety classification as required by ASHRAE Std 15 and the authority having jurisdiction.

J. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

3.3 INSTALLATION - PRESS FITTINGS

A. Install press fittings in accordance with manufacturer's written instructions, using only press tools and jaws approved by the fitting manufacturer. Do not combine fittings, tools, or jaws of different manufacturers.

B. Deburr inside and outside of tube, and remove dirt, oil, and debris. Verify tube is round and free of dents and scratches in the sealing area. Do not use a hacksaw to cut tube.

C. Mark insertion depth on tube using manufacturer's gauge, fully insert tube, and verify depth mark before pressing.

D. Do not braze or apply heat within the distance from press fittings recommended by the manufacturer. Protect completed press joints from heat during adjacent brazing.

E. Press joints are permanent. Do not reuse fittings. Cut out and replace any joint that is improperly pressed, leaks, or shows incomplete insertion.

F. Do not use press fittings where operating pressure or temperature exceeds the fitting's listed rating, or where prohibited by the refrigeration equipment manufacturer.

G. Support piping in accordance with manufacturer's recommendations at press fittings. Do not use press fittings to correct misalignment.

3.4 INSTALLATION - VRF SYSTEMS

A. Install piping in accordance with the VRF manufacturer's installation instructions and the accepted piping layout. Where field conditions require changes in routing that affect pipe lengths or fitting quantities, rerun the VRF manufacturer's piping design software and obtain the VRF manufacturer's acceptance before proceeding.

B. Do not exceed the VRF manufacturer's limits for total pipe length, length between outdoor unit and farthest indoor unit, length after the first branch, and vertical separation between units.

C. Install branch joints and headers in the orientation required by the VRF manufacturer, with the minimum straight pipe lengths before and after each branch joint required by the manufacturer.

D. Install branch selector units where indicated, with service access as required by the VRF manufacturer.

E. Coordinate locations of refrigerant detection sensors and refrigerant safety shutoff valves furnished under Section 23 8129.

3.5 FIELD QUALITY CONTROL

A. Press Fittings: Visually inspect each press joint for full insertion depth and complete press before pressure testing.

B. Pressure Test: Test each refrigerant system with dry nitrogen in accordance with ASHRAE Std 15, ASME B31.5, and the equipment manufacturer's requirements, at the test pressure stated by the equipment manufacturer. Do not exceed the press fitting manufacturer's maximum test pressure where press fittings are used.
1. VRF Systems: Hold the test pressure for 24 hours, or longer period required by the VRF manufacturer. No pressure loss is permitted after correction for ambient temperature change.
2. Conventional DX Systems: Hold the test pressure for the period required by the equipment manufacturer, but not less than 1 hour, with no pressure loss.
3. Locate and repair leaks, and retest. Do not use refrigerant for pressure testing.

C. Evacuation: Evacuate each system with a vacuum pump and a micron gauge connected at the point farthest from the pump. Triple evacuate, breaking each vacuum with dry nitrogen, and evacuate to 500 microns or the lower value required by the equipment manufacturer. Isolate the pump and verify that the vacuum holds within the equipment manufacturer's limits.

D. Charging: Charge each system by weight.
1. VRF Systems: Calculate the additional refrigerant charge from the actual liquid line lengths in accordance with the VRF manufacturer's instructions. Record the total system charge on the label at the outdoor unit.
2. Conventional DX Systems: Adjust charge to the equipment manufacturer's superheat or subcooling requirements.

E. Startup of VRF systems shall be performed by the VRF manufacturer's authorized representative as specified in Section 23 8129.

F. Test Reports: Record test pressure, duration, ambient temperatures, evacuation levels, vacuum hold results, and refrigerant charge added for each system.

3.6 SCHEDULES

A. Hanger Spacing for Copper Tubing.
1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.

END OF SECTION 23 2300

SECTION 23 3439 - HIGH-VOLUME, LOW-SPEED PROPELLER FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. High-volume, low-speed propeller fans.

B. Fan controller and fire alarm shutdown relays.

1.2 RELATED REQUIREMENTS

A. Section 230923 - Direct Digital Control System for HVAC: BACnet integration of the fan controller.

B. Division 28: Fire alarm system connection to the fan fire alarm relays.

1.3 REFERENCE STANDARDS

A. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

B. Controls: Provide product data for the fan controller, including the BACnet Protocol Implementation Conformance Statement (PICS) and BACnet object list, and wiring diagrams for the fan network, BACnet, and fire alarm relay connections.

C. Manufacturer's Instructions: Indicate installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store under cover and elevated above grade.

1.8 FIELD CONDITIONS

A. Fans may not be used for ventilation during construction.

1.9 WARRANTY

A. Provide 10 year manufacturer warranty for mechanical and 5 year manufacturer warranty for electrical (1 year labor included).

PART 2 PRODUCTS

2.1 HIGH-VOLUME, LOW-SPEED PROPELLER FANS

A. Manufacturers:
1. Big Ass Fans.
2. Greenheck.

B. Performance Ratings: See Drawing Schedule.

C. Mounting: Structure, using the manufacturer's mounting kit for the structure indicated, with safety restraint cable and guy wires.

D. Direct Drive Fan:
1. Statically and dynamically balanced.
2. Airfoils: Extruded aluminum.
3. Motor: Manufacturer's standard direct drive motor with integral variable frequency drive, factory mounted and wired, suitable for forward and reverse operation.
4. Motor and Drive Enclosure: IP54 minimum.
5. Bearings: Manufacturer's standard, permanently sealed.

E. Fire Alarm Relay: Factory-installed relay at each fan that stops the fan on a signal from the fire alarm system, independent of the fan controller and the building automation system. Relay coil voltage compatible with the fire alarm system.

F. Fan Network: Manufacturer-furnished shielded communication cable and connectors for plug-and-play connection between fans and the fan controller, with each cable length within the manufacturer's limits.

2.2 FAN CONTROLLER

A. Manufacturer: Same as fans.

B. Description: Wall-mounted touchscreen controller with backlit LCD display, minimum 4 inches, controlling all fans in the space individually or as a group.

C. Functions: On/off, speed, and direction of rotation; fan diagnostics and fault history; schedules; and password-protected security with a minimum of two user access levels.

D. Building Automation Interface: Native BACnet MS/TP server allowing the building automation system to command on/off, speed, and direction, and to monitor run status and faults of each fan. Gateways are not acceptable.

E. Power: 120 V plug-in power adapter furnished with the controller.

F. Mounting: Surface-mounted enclosure kit.

G. Do not provide the manufacturer's temperature or humidity sensors. Automatic operation is by the building automation system as indicated on the Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure each fan to structure using the manufacturer's mounting kit and hardware. Install safety restraint cable and guy wires as required by the manufacturer.

C. In sprinklered buildings, locate each fan approximately centered between four adjacent sprinklers, with a minimum vertical clearance of 3 feet from the fan to the sprinkler deflectors, as required by NFPA 13.

D. Install the fan controller where indicated on the Drawings.

E. Install the fan network cable between fans and the fan controller in accordance with the manufacturer's wiring diagrams.

3.2 FIELD QUALITY CONTROL

A. Start up fans and the fan controller in accordance with the manufacturer's instructions.

B. Configure fan grouping and BACnet addressing in coordination with the installer of Section 230923.

C. Verify that a fire alarm signal stops each fan, regardless of the fan controller and building automation system commands.

3.3 TRAINING

A. Instruct the Owner's personnel in operation of the fan controller, including manual operation, schedules, and fault display.

END OF SECTION 23 3439

SECTION 23 8129 - VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. AHRI 1230 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment; 2021.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

C. ASTM B32 - Standard Specification for Solder Metal; 2020.

D. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

E. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.

F. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2016.

G. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2013.

H. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

I. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015, with Editorial Revision (2018).

J. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2017.

K. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012 (Reapproved 2018).

L. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2017.

M. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2015.

N. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.

O. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2025.

P. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

Q. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use; 2026.

R. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

S. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces; 2023.

1.2 SUMMARY

A. Section includes complete VRF HVAC system(s) which may include, but not limited to, the following components:
1. Indoor, exposed, wall-mounted units.
2. Indoor, concealed, ceiling-mounted units for ducting.
3. Indoor, concealed, multi-position units for ducting.
4. Indoor, recessed, ceiling-mounted units with 33x33” grilles.
5. Indoor, recessed, ceiling-mounted units with 24x24” grilles.
6. Indoor, recessed, one-way ceiling-mounted units.
7. Indoor, suspended, ceiling-mounted units.
8. Indoor, energy recovery ventilator.
9. Indoor, shut-off valve kits (SVKs)
10. Indoor, heat recovery control units (HRCUs).
11. Indoor, water-source heat recovery units.
12. Outdoor, air-source heat-pump units.
13. Outdoor, air-source heat recovery units.
14. VRF system controls.
15. VRF system refrigerant and oil.
16. VRF system control cable.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Nationally recognized manufacturer of VRF HVAC systems and products.
2. Shipped VRF HVAC systems with similar requirements to local market for a continuous period of 5 years within time of bid.
3. VRF HVAC systems and products that have been successfully tested and in use on at least 5 completed projects.
4. Having complete published online catalog literature, installation, and operation and maintenance manuals for all products intended for use. Resources must be publicly available without login or sign-in as registered account.
5. Having full-time in-house employees for the following:
   a. Product research and development.
   b. Product and application engineering.
   c. Product manufacturing, testing, and quality control.
   d. Technical support for system installation training, startup, commissioning, and troubleshooting of installations.
   e. Owner training.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.

1. Each employee shall be certified to have successfully completed manufacturer training for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
2. Installer certificate shall be valid and current for duration of Project.
3. Retain copies of Installer certificates on-site and make available on request.
4. Each person assigned to Project shall have demonstrated past experience.
    a. Demonstrated experience with VRF products being installed for period within 3 consecutive years before time of bid.
    b. Demonstrated experience on 3 projects of similar VRF system complexity, scope, and value.

C. ISO Compliance: System equipment and components furnished by VRF HVAC system manufacturer shall be manufactured in an ISO 9001 and ISO 14001 facility.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in a clean and dry place. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
    1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.

B. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.

C. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.

1.5 SUBMITTALS

A. Product Data: Provide drawings indicating dimensions, rough-in connections, and electrical characteristics and connection requirements.

B. Manufacturer's Instructions: Include assembly instructions, support details, connection requirements, and start-up instructions.

C. Manufacturer's qualification statement.

D. Installer's qualification statement.

E. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

F. Operation and Maintenance Data: Provide maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of the type this section and approved by manufacturer, with minimum three years of documented experience.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Faulty operation.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
   2. Warranty Period:
      a. For Compressor 10 year(s) from date of Substantial Completion.
      b. For Parts, 10 year(s) from date of Substantial Completion.

B. Installer's Labor Warranty: Installer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.
   1. Warranty Period 1 year from date of substantial completion.

PART 2 PRODUCTS

2.1 VRF HVAC SYSTEMS

A. Manufacturers: Basis of design is CITY MULTI. Subject to compliance with requirements, provide products by one of the following brands only:
   1. Mitsubishi Electric & Electronics USA, Inc.
   2. Trane, Inc.
   3. Daikin Applied
   4. Samung
   5. LG

2.2 SYSTEM DESCRIPTION

A. VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, outdoor unit module(s), and HRCUs or SVKs when shown on Drawings. Piping, controls, and electrical power to components make operating system(s) complying with requirements indicated.
   1. System(s) operation being heat pump or heat recovery as indicated on Drawings.
   2. Each system with one refrigerant circuit serving all indoor units connected to system.

B. 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.

C. AHRI Compliance: System and equipment performance certified according to AHRI 1230-2023.

D. UL Compliance: Comply with UL 60335-2-40.

2.3 INDOOR, EXPOSED, WALL-MOUNTED UNITS

A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

B. Cabinet:
1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
4. Coil Assembly:
5. Coil Casing: Aluminum, galvanized, or stainless steel.
6. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
7. Coil Tubes: Copper, of diameter and thickness required by performance.
8. Capacity Control: DX coil by electronic modulating type valve with linear or proportional characteristics. Hydronic coil by modulating control valve.
9. Unit Internal Tubing: Copper tubing with brazed joints.
10. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
11. Factory Charge: Dehydrated air or nitrogen.
12. Testing: Factory pressure tested and verified to be without leaks.

C. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Gravity.
    a. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.
3. Field Piping Connection: Non-ferrous material.

D. Fan and Motor Assembly:
1. Fan(s):
    a. Direct-drive arrangement.
    b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    d. Wheels statically and dynamically balanced.
2. Motor: Brushless DC or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Multiple or variable speed with speed setting adjustable via central or wall controllers when present.
5. Vibration Control: Integral isolation to dampen vibration transmission.

E. Filter Assembly:
1. Access: Front, to accommodate filter replacement without the need for tools.
2. Media: Manufacturer's standard washable filter with antimicrobial treatment.

F. Grille Assembly: Manufacturer's standard discharge grille within front face of unit cabinet.
1. Motorized Vane: Adjustable or oscillating flow pattern.

G. Field-Installed Unit Accessories:
1. Condensate pump with integral white plastic housing for exposed surface mounting directly under indoor unit capable of at least 10 feet of lift with drain pan level sensor and overflow switch.

H. Unit Controls:
1. Factory-Installed Sensors:
   a. Unit inlet air temperature.
   b. Coil entering refrigerant or water temperature.
   c. Coil leaving refrigerant or water temperature.
   d. Refrigerant detection if coil is DX.
2. Features and Functions:
   a. Self-diagnostics.
   b. Time delay.
   c. Auto-restart.
   d. Auto operation mode.
   e. Manual operation mode.
   f. Filter service notification.
   g. Run test switch.

I. Unit Electrical:
1. Field Connection: Single point connection to power entire unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch, complying with NFPA 70.

2.4 INDOOR, CONCEALED, CEILING-MOUNTED UNITS FOR DUCTING

A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:
1. Material: Galvanized steel.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Capacity Control: DX coil by electronic modulating type valve with linear or proportional characteristics. Hydronic coil by modulating control valve.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Factory Charge: Dehydrated air or nitrogen.
8. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:
   1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
   2. Condensate Removal: Unit-mounted lifting mechanism, capable of lifting drain water to an elevation above top of cabinet (sizes 54 and smaller only).
   3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:
   1. Fan(s):
      a. Direct-drive arrangement.
      b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
      c. Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
      d. Wheels statically and dynamically balanced.
   2. Motor: PSC, Brushless DC or electronically commutated with permanently lubricated bearings.
   3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
   4. Speed Settings and Control: Multiple or variable speed with speed setting adjustable via central or wall controllers when present.
   5. External Static Settings: Vary based on Low, Medium, or High Static models. Models as shown on Drawings
      a. Low Static settings include 0.02, 0.06, 0.14, or 0.20” WG.
      b. Medium Static settings include 0.14, 0.20, 0.28, 0.40, or 0.60” WG.
      c. High Static settings include 0.40 or 1.00” WG for 208V and 0.60 or 1.00” WG for 230V.
   6. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:
   1. Access: Bottom, side, or rear to accommodate field installation and replacement without need for tools.
   2. Media: Poly Propylene Honeycomb Fabric (Washable) with Low and Medium Static models. No filter provided with High Static models.

G. Field-Installed Unit Accessories:
   1. Condensate pump capable of at least 10 feet of lift.

H. Unit Controls:
   1. Factory-Installed Sensors:
      a. Unit inlet air temperature.
      b. Coil entering refrigerant or water temperature.
      c. Coil leaving refrigerant or water temperature.
      d. Refrigerant detection if coil is DX.
   2. Features and Functions:
      a. Self-diagnostics.
      b. Time delay.
      c. Auto-restart.
      d. External static pressure control.
      e. Auto operation mode.
      f. Manual operation mode.
      g. Filter service notification.
      h. Drain assembly high water level safety shutdown and notification.
      i. Run test switch.

I. Unit Electrical:
1. Field Connection: Single point connection to power unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch.

2.5 INDOOR, CONCEALED, MULTI-POSITION UNITS FOR DUCTING

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:
1. Material: Painted steel.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Capacity Control: DX coil by electronic modulating type valve with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Factory Charge: Dehydrated air or nitrogen.
8. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Gravity.
   a. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:
1. Fan(s):
   a. Direct-drive arrangement.
   b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
   c. Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
   d. Wheels statically and dynamically balanced.
2. Motor: Brushless DC or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Multiple or variable speed with speed setting adjustable via central or wall controllers when present.
5. External Static Settings: 0.30, 0.50, or 0.80” WG.

6. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:
1. Access: Front to accommodate field installation and replacement without need for tools.
2. Media: Poly Propylene Honeycomb Fabric (Washable).

G. Field-Installed Unit Accessories:
1. Accessory electric heat kit mounted directly to unit air outlet connection, heat amount per Drawings, separate power supply required.
2. Condensate pump capable of at least 10 feet of lift with drain pan level sensor and overflow switch.

H. Unit Controls:
1. Factory-Installed Sensors:
   a. Unit inlet air temperature.
   b. Coil entering refrigerant temperature.
   c. Coil leaving refrigerant temperature.
   d. Refrigerant detection.
2. Features and Functions:
   a. Self-diagnostics.
   b. Time delay.
   c. Auto-restart.
   d. External static pressure control.
   e. Auto operation mode.
   f. Manual operation mode.
   g. Filter service notification.
   h. Drain assembly high water level safety shutdown and notification.
   i. Run test switch.

I. Unit Electrical:
1. Field Connection: Single point connection to power unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch.

2.6 INDOOR, RECESSED, CEILING-MOUNTED UNITS WITH 33x33” GRILLES

A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:
1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.

4. Capacity Control: DX coil by electronic modulating type valve with linear or proportional characteristics. Hydronic coil by modulating control valve.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Factory Charge: Dehydrated air or nitrogen.
8. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:
1. Fan(s):
   a. Direct-drive arrangement.
   b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
   c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
   d. Wheels statically and dynamically balanced.
2. Motor: Brushless DC or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Multiple or variable speed with speed setting adjustable via central or wall controllers when present.
   a. Airflow volume shall vary based on three unit height settings.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:
1. Access: Bottom, to accommodate filter replacement without the need for tools.
2. Media: Washable screen.

G. Return/Discharge-Air Grille Assembly: Attached to bottom of unit cabinet.
1. Discharge Pattern: Include accessory air outlet shutter plates as required for two, three, or four-way throw as indicated on Drawings.
   a. Discharge Pattern Adjustment: Field-adjustable settings for up and down range of motion.
   b. Discharge Pattern Closure: Ability to close individual discharges of units with multiple patterns using wall-mounted controller.
2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.
3. Alternate Branch Supply Duct Connection: Sheet metal knockout for optional connection to one supply branch duct as shown on Drawings. Utilize accessory air outlet shutter plate with branch ducting.

H. Integral Occupant and Location Detection: Unit includes occupant and location detection for automatic air distribution and energy saving setback control in the following manner.
1. Air Distribution
   a. Distribution operation: Integral occupant and location detection will not be utilized to control air distribution. During COOL mode, vanes move to horizontal airflow direction. During HEAT mode, vanes move to down airflow direction.

I. Outdoor Air Ventilation Connection: Sheet metal knockout for connection to outdoor air ventilation duct per Drawings.

J. Unit Controls:
1. Factory-Installed Sensors:
   a. Unit inlet air temperature.
   b. Coil entering refrigerant or water temperature.
   c. Coil leaving refrigerant or water temperature.
   d. Room occupancy/location.
   e. Refrigerant detection if coil is DX
2. Features and Functions:
   a. Integral occupancy and location sensor.
   b. Time delay.
   c. Auto-restart.
   d. Auto operation mode.
   e. Manual operation mode.
   f. Filter service notification.
   g. Drain assembly high water level safety shutdown and notification.
   h. Run test switch.

K. Unit Electrical:
1. Field Connection: Single point connection to power entire unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch, complying with NFPA 70.

2.7 INDOOR, RECESSED, CEILING-MOUNTED UNITS WITH 24x24” GRILLES

A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:
1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Capacity Control: DX coil by electronic modulating type valve with linear or proportional characteristics. Hydronic coil by modulating control valve.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Factory Charge: Dehydrated air or nitrogen.
8. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:
1. Fan(s):
   a. Direct-drive arrangement.
   b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
   c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
   d. Wheels statically and dynamically balanced.
2. Motor: Brushless DC or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Multiple or variable speed with speed setting adjustable via central or wall controllers when present.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:
1. Access: Bottom, to accommodate filter replacement without the need for tools.
2. Media: Washable screen.

G. Return/Discharge-Air Grille Assembly: Attached to bottom of unit cabinet.
1. Discharge Pattern: Four-way throw.
   a. Discharge Pattern Adjustment: Field-adjustable settings for up and down range of motion for individual vanes. Provide Deluxe controller to enable configuration.
2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.

H. Integral Occupant and Location Detection: Unit includes occupant and location detection for automatic air distribution and energy saving setback control in the following manner-
1. Air Distribution
   a. Default distribution operation: Integral occupant and location detection will not be utilized to control air distribution. During COOL mode, vanes move to horizontal airflow direction. During HEAT mode, vanes move to down airflow direction.

I. Outdoor Air Ventilation Connection: Sheet metal knockout for optional connection to outdoor air ventilation duct.

J. Unit Controls:
1. Factory-Installed Sensors:
   a. Unit inlet air temperature.
   b. Coil entering refrigerant or water temperature.
   c. Coil leaving refrigerant or water temperature.
   d. Refrigerant detection if coil is DX.
2. Features and Functions:
   a. Integral occupancy and location sensor.
   b. Time delay.
   c. Auto-restart.
   d. Auto operation mode.
   e. Manual operation mode.

f. Filter service notification.
g. Drain assembly high water level safety shutdown and notification.
h. Run test switch.

K. Unit Electrical:
1. Field Connection: Single point connection to power entire unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch, complying with NFPA 70.

2.8 INDOOR, RECESSED, ONE-WAY CEILING-MOUNTED UNITS

A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:
1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Capacity Control: DX coil by electronic modulating type valve with linear or proportional characteristics.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Factory Charge: Dehydrated air or nitrogen.
8. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:
1. Fan(s):
a. Direct-drive arrangement.
b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
d. Wheels statically and dynamically balanced.
2. Motor: PSC, Brushless DC or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Multiple or variable speed with speed setting adjustable via central or wall controllers when present.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:
1. Access: Bottom, to accommodate filter replacement without the need for tools.
2. Media: Washable screen.

G. Return/Discharge-Air Grille Assembly: Attached to bottom of unit cabinet.
1. Discharge Pattern: One-way throw.
a. Discharge Pattern Adjustment: Field-adjustable settings for up and down range of motion for individual vanes.
2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.

H. Field-Installed Unit Accessories:
1. Condensate pump capable of at least 10 feet of lift.

I. Unit Controls:
1. Factory-Installed Sensors:
a. Unit inlet air temperature.
b. Coil entering refrigerant temperature.
c. Coil leaving refrigerant temperature.
d. Refrigerant detection.
2. Features and Functions:
a. Integral occupancy and location sensor.
b. Time delay.
c. Auto-restart.
d. Auto operation mode.
e. Manual operation mode.
f. Filter service notification.
g. Drain assembly high water level safety shutdown and notification.
h. Run test switch.

J. Unit Electrical:
1. Field Connection: Single point connection to power entire unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch, complying with NFPA 70.

2.9 INDOOR, SUSPENDED, CEILING-MOUNTED UNITS

A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

B. Cabinet:
1. Material: Painted or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.

3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Factory Charge: Dehydrated air or nitrogen.
8. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Gravity.
    a. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:
1. Fan(s):
    a. Direct-drive arrangement.
    b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    d. Wheels statically and dynamically balanced.
2. Motor: Brushless DC or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Multiple or variable speed with speed setting adjustable via central or wall controllers when present.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:
1. Access: Bottom, to accommodate filter replacement without the need for tools.
2. Media: Manufacturer's washable filter with antimicrobial treatment.

G. Discharge-Air Grille Assembly: Mounted in front of unit cabinet.
1. Discharge Pattern: One-way throw.
2. Discharge Pattern Adjustment: Field-adjustable limits for range of pattern.
3. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.

H. Return-Air Grille Assembly: Manufacturer's standard.

I. Outdoor Air Ventilation Connection: Sheet metal knockout for optional connection to outdoor air ventilation duct.

J. Field-Installed Unit Accessories:
1. Condensate pump capable of at least 10 feet of lift with drain pan level sensor and overflow switch.

K. Unit Controls:
1. Factory-Installed Sensors:
    a. Unit inlet air temperature.
    b. Coil entering refrigerant temperature.
    c. Coil leaving refrigerant temperature.
    d. Refrigerant detection.

2. Features and Functions:
    a. Time delay.
    b. Auto-restart.
    c. Auto operation mode.
    d. Manual operation mode.
    e. Filter service notification.
    f. Drain assembly high water level safety shutdown and notification.
    g. Run test switch.

L. Unit Electrical:
1. Field Connection: Single point connection to power entire unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch, complying with NFPA 70.

2.10 INDOOR, ENERGY RECOVERY VENTILATOR

A. Description: Factory-assembled and tested complete unit with components, wiring, and controls required for mating to ductwork, power, and controls field connections.

B. Cabinet:
1. Material: Galvanized steel.
2. Insulation: Self-extinguishing urethane foam.
3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Energy Recovery Heat-Exchanger Bypass:
1. Low Leakage Damper: with electric actuator with integral controls to bypass up to 70% of outdoor air flow around the energy recovery heat exchanger during times of favorable weather, and there is no energy-saving benefit to circulate air across the energy recovery heat exchanger.

D. Fan and Motor Assemblies: Separate fan and motor assemblies for supply and exhaust airstreams with control for equal airflow.
1. Fan(s):
    a. Direct-drive arrangement.
    b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    c. Wheels statically and dynamically balanced.
2. Motor: Brushless DC or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control:
    a. Single-phase units shall include four speed settings or variable speed with a speed range of least 25 percent.
    b. Three-phase units shall include independent control for supply and exhaust air to enable & control pressurization.
5. Vibration Control: Integral isolation to dampen vibration transmission.

E. Filter Assemblies: Separate filter assemblies for outdoor air and exhaust airstreams entering energy recovery heat exchanger.
1. Access: Removable maintenance access panel.

2. Efficiency: MERV 7.
3. Replaceable Media: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.

F. Energy Recovery Heat Exchanger:
1. Total (sensible and latent) energy exchange between outdoor air and exhaust airstreams with performance indicated on Drawings.
2. Fixed element with no moving parts.
3. Plate Material and Coating: Chemically treated paper with selective hygroscopicity, moisture permeability, and gas barrier properties.
4. AHRI 1060 certified and bearing the AHRI label.
5. Entering Outside Air Temperature Range: Shall be between 14°F and 104°F to avoid intermittent supply air fan operation-
   a. OFF for 10 minutes, ON for 60 minutes if entering OA below 14ºF.
   b. OFF for 55 minutes, ON for 5 minutes if entering OA below 5º F.

G. Unit Controls:
1. Factory-Installed Sensors:
   a. Unit entering outdoor air temperature.
   b. Unit entering exhaust air temperature.
2. Features and Functions: Self-diagnostics, time delay, auto-restart.

H. Unit Electrical:
1. Field Connection: Single point connection to power entire unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch, complying with NFPA 70.

2.11 INDOOR, VENTILATED HEAT RECOVERY CONTROL UNITS (HRCUs)

A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
1. Specially designed for use in systems with simultaneous heating and cooling.
2. Systems shall include one or multiple units designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit and multiple indoor units.
3. Units shall respond to calls for HEAT or COOL operation from indoor units by enabling refrigerant or water flow as equipment shown on Drawings require.
   a. If flow direction from HRCU alternates, flow in COOL direction to indoor units in HEAT mode during outdoor unit defrost sequence is not allowed.

B. Cabinet:
1. Galvanized-steel construction.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Internal Access:
   a. Removable panels or hinged doors of adequate size.
   b. Access to all internal components for inspection, cleaning, service, or replacement.
4. Qty (2) 4” duct connection ports for exhaust and intake air

C. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

D. Assemblies and Specialties:
1. Specially designed by manufacturer for type of VRF HVAC system being installed, either two or three pipe.
2. Each branch circuit shall have refrigerant and/or water control valve(s) to control flow.
3. Units serving DX indoor units shall include mitigation shut-off valves at each branch circuit.
4. Each branch port connection shall be fitted with an isolation valve to simplify service to any individual branch.

E. Unit Controls:
1. Factory-Installed Sensors:
   a. Liquid inlet temperature.
   b. Bypass exit area temperature.
   c. Bypass outlet temperature.
   d. Bypass inlet temperature.
   e. High pressure sensor.
   f. Medium pressure sensor.
   g. Integral Refrigerant Leak Detector Sensor

F. Refrigerant Leak Detection:
1. Sequence upon receiving leak detection signal from any DX indoor unit:
   a. Shut-off valves for each port(s) connected DX indoor unit(s) having detected refrigerant close.
   b. If indoor unit fan(s) where refrigerant is detected is set to AUTO, fan switches to ON.
   c. Refrigerant detection signal output activated.
   d. Normal operation continues uninterrupted for ports and DX indoor units where refrigerant is not detected.
2. Sequence upon receiving leak detection signal from integral leak detection sensor
   a. All connected indoor and outdoor units within the system are stopped
   b. Shut-off valves for liquid and suction lines close
   c. Dry contact output from TBX1-2 is activated
   d. Alarm output signal TBX3-4 is activated
   e. Error Code 1524 appears on local controller and central controller

G. Unit Electrical:
1. Field Connection: Single point connection to power entire unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch, complying with NFPA 70.

2.12 OUTDOOR, AIR-SOURCE HEAT RECOVERY UNITS

A. Description: Factory-assembled and tested complete unit designed for use in systems with simultaneous heating and cooling.
1. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit, heat recovery control unit(s), and multiple indoor units.

B. Cabinet:
1. Galvanized steel and coated with a corrosion-resistant finish.
   a. Coating with documented salt spray test performance of 2000 hours according to ASTM B117 surface scratch test (SST) procedure.

2. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Compressor and Motor Assembly:
1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive. Non-inverter compressors—where LRA applies—are not allowed.
2. Protection: Integral protection against the following-
   a. Refrigerant overcharge and undercharge
   b. High and low refrigerant pressure.
   c. High refrigerant and oil temperature.
   d. Liquid flood back.
   e. Thermal and overload.
   f. Voltage fluctuations.
   g. Phase failure and phase reversal.
   h. Short cycling.
3. Speed Control: Configurable to maintain refrigerant evaporating and condensing temperatures while varying refrigerant flow to satisfy cooling and heating loads.
   a. Cooling mode fixed 32°F evaporator temperature.
   b. Cooling mode fixed 43°F evaporator temperature.
   c. Cooling mode variable 32-48°F evaporator temperature.
   d. Heating mode high COP operation.
   e. Heating mode high heating output operation.
4. Vibration Control: Integral isolation to dampen vibration transmission.
5. Oil Management: Timed sequence enabled during extended periods of reduced refrigerant flow to ensure proper lubrication over entire operating range. Sequences which rely on sensing oil level risk sensor failure or sensor placement not accounting for line length and are not allowed.
6. Crankcase heaters with integral control to maintain safe operating temperature.
7. Fusible plug.

D. Heat-Exchanger Assembly: Individual coil segments for each unit face to simplify future service replacement costs. Documented salt spray test performance of 2000 hours according to ASTM B117 surface test (SST) procedure.
1. Plate Fin Coils:
   a. Casing: Aluminum, galvanized, or stainless steel.
   b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
   c. Tubes: Copper, of diameter and thickness required by performance.
2. Zinc-Coated Aluminum Vertical Flat Tube Coils:
   a. Series of tubes containing a series of multiple, parallel flow channels layered between refrigerant header manifolds.
   b. Construct fins, tubes, and header manifolds of aluminum alloy.

E. Heat-Exchanger Defrost Strategy:
1. Alternate methods based on ambient temperatures.
   a. Hot-gas method to maximize efficiency during mild ambient temperatures. Method prolongs defrost sequence.
      1) Segmented coil (single-module systems) or alternating modules (twinned systems) to deliver simultaneous defrost and HEAT delivery indoors.

b. Reverse-cycle method to maximize comfort during extreme ambient temperatures. Method shortens defrost sequence.
1) Leverage below 33.8°F for single-module systems and below 23°F for twinned systems to deliver shorter defrost cycles.

2. Preheat Defrost Operation: Signal to indoor units operating in HEAT to increase space temperature before the start of defrost sequence.

F. Heat-Exchanger Fan and Motor Assembly:
1. Fan(s): Propeller type.
a. Direct-drive arrangement.
b. Fabricated from non-ferrous components.
c. Statically and dynamically balanced.
2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for heat exchanger coil.
3. Motor(s): Brushless DC or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.

G. Field-Installed Unit Accessories:
1. Snow/Hail Protection Kit: Provide heat exchanger coil guards and fan hoods to protect against hail damage.

H. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:
a. Refrigerant suction temperature.
b. Refrigerant discharge temperature.
c. Outdoor air temperature.
d. Refrigerant high pressure.
e. Refrigerant low pressure.
4. Features and Functions: Self-diagnostics, time delay, auto-restart, USB connector to allow running system data up to five days based on storage capacity of memory stick when provided.

I. Unit Electrical:
1. Field Connection: Single point connection to power each unit module or factory-twinned unit and integral controls.
2. Disconnecting Means: Field-installed circuit breaker or switch, complying with NFPA 70.

2.13 VRF SYSTEM CONTROLS

A. General Requirements:
1. Communicating network may include: Indoor units, outdoor units, HRCUs, SVKs and integral controls connect through a manufacturer-selected network.
2. Network Communication Protocol: Manufacturer proprietary control communication between interconnected units.
3. Integration with Building Automation System: ASHRAE 135, BACnet IP and certified by BACnet Testing Lab (BTL), including the following-

a. Ethernet connection via RJ-45 connectors and port with transmission
b. Integration shall include control,monitoring,scheduling,change of value notifications

4. Operator Interface:
   a. Operators shall interface with system and unit controls through the following:
      1) Operator interfaces integral to controllers
      2) [Manufacturer-provided central controller.
      3) Integration with Building Automation System.
   b. Users shall be capable of interface with controllers for indoor units' control to extent privileges are enabled. Control features available to users shall include the following:
      1) On/off control.
      2) Temperature set-point adjustment.
      3) Fan speed control.

B. Wired Controllers and Sensors for Indoor Units
1. Simple Controllers for Indoor Units:
   a. Single controller capable of controlling multiple indoor units as group.
   b. Integral room temperature sensor
   c. Temperature Units: Fahrenheit and Celsius.
   d. On/Off: Turns indoor unit on or off.
   e. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only.
   f. Temperature Display and Set-Point: Separate set points for Cooling, Heating. Adjustable in 1-degree Fahrenheit increments between.
   g. Fan Speed Setting: Select between available options furnished with unit.
   h. Airflow Direction Setting: If applicable to indoor unit style, select between available options furnished with the unit.
   i. Service Notification Display: "Filter".
   j. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
   k. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.

2.14 VRF SYSTEM REFRIGERANT AND OIL

A. Refrigerant:
1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. ASHRAE 34, Class A2L
3. R-32 or R454B

B. Oil:
1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.15 VRF SYSTEM CONTROL CABLE

A. General Requirements: Refer to and verify all wire and cabling requirements with the manufacturer's current installation and operation manuals to ensure compliance with the latest standards and

specifications. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable.

B. Low-Voltage Control Network Cabling:
   1. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
      a. Shielded wire (2-core) 16 AWG—CVVS, CPEVS or MVVS.
      b. PVC insulation and jacket.
      c. Foil shielded.
      d. Flame Resistance: Comply with NFPA 262.
      e. Maximum cable distance (distance to farthest components) is 1,640 feet.
      f. Maximum cable distance from OU to connected IU is 656 feet.
      g. Maximum total cable length (sum of all network cabling) is 6,560 feet.

C. Low-Voltage Wall-Mounted Controller Cabling to Indoor Units:
   1. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
      a. 22 AWG, 2-conductor unshielded 7-stranded bare copper wire.
         1) Residential / multi-family style controllers require 4-conductor.
         2) Touch controllers with integral occupancy and light sensing controllers require low-voltage control network cabling to the network.
      b. PVC insulation and jacket.
      c. Flame Resistance: Comply with NFPA 262.
      d. Maximum cable distance (distance from controller to indoor unit) varies by controller style. Refer to manufacturer Submittal or Installation Guides.

D. Transmission power booster provided if additional signal power is required based on connected devices. Coordinate with VRF manufacturer and install near middle of communication bus when required.

PART 3 EXECUTION

3.1 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 products before installation. Reject products that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.

D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.

E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.

F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.

G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION, GENERAL

A. Clearance:
1. Maintain manufacturer's recommended clearances for service and maintenance.
2. Maintain clearances required by governing code.

B. Equipment Restraint Installation: Install equipment with seismic-restraint device. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 INSTALLATION OF INDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch

C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.

D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.

E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.

G. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.

3.4 INSTALLATION OF OUTDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Install outdoor units on support structures indicated on Drawings.

C. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
1. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
2. Grouting: Place grout under equipment supports and make bearing surface smooth.

D. Roof-Mounted Installations: Install outdoor units on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, stainless-steel fasteners.

3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping and tubing to permit valve servicing.

F. Install piping and tubing at indicated slopes.

G. Install piping and tubing free of sags.

H. Install fittings for changes in direction and branch connections.

I. Install piping and tubing to allow application of insulation.

J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.

K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."

L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Common Work Results for HVAC."

3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

A. General Requirements for Drain Piping and Tubing:
1. Install a union in piping at each threaded unit connection.
2. Install an adjustable stainless steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
   a. Details indicated on Drawings.
   b. Manufacturer's requirements.
   c. Governing codes.
   d. In the absence of requirements, comply with requirements of ASHRAE handbooks.
4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

B. Gravity Drains:
1. Slope piping from unit connection toward drain termination at a constant slope of not less than one percent.

C. Pumped Drains:
1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.7 INSTALLATION OF REFRIGERANT PIPING

A. Refrigerant Tubing Kits:
1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
2. Support tubing as specified in Section 230516 “Hangers and Supports for HVAC Piping and Equipment.”
3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.

B. Select system components with minimum 650 psig pressure rating.

C. Install piping as short and direct as possible, with a minimum number of joints and fittings.

D. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

E. Install refrigerant piping and tubing in protective conduit where installed below ground.

F. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.

G. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:
1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Traps to entrain oil in vertical runs are not allowed.
4. Inverted traps for twinned systems may be required by manufacturer.
5. Liquid lines may be installed level.

H. When brazing, remove or protect components that could be damaged by heat. Braze pipes with a dry nitrogen purge to avoid oxidation.

I. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.

J. Joint Construction:
1. Brazed Joints
a. Ream ends of tubes and remove burrs.
b. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
c. Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
d. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.
e. The piping being brazed shall be purged of air to remove the oxygen and filled with one of the following inert gases: oxygen-free nitrogen, helium or argon. The piping system shall be purged with an inert gas for a minimum time corresponding to five volume changes through the piping system prior to brazing. The pre-purge rate shall be at a minimum velocity of 100 feet per minute (0.56 yard/s). The inert gas shall be directly connected to the tube system being brazed to

prevent the entrainment of ambient air. After the pre-purge, the inert gas supply shall be maintained through the piping during the brazing operation at a minimum pressure of 1.0 psi and a maximum pressure of 3.0 psi. The joint shall be brazed with a filler metal conforming to AWS A5.8

2. Mechanically Pressed Joints
    a. The installing contractor shall be fully trained and qualified by the manufacturer of the mechanically pressed joints to install the selected piping connections.
    b. Mechanical joints shall be installed in accordance with the manufacturer's instructions.
3. Flared Joints
    a. Flared fittings shall be installed in accordance with the manufacturer's instructions. The flared fitting shall be used with the tube material specified by the fitting manufacturer. The flared tube end shall be made by a tool designed for that operation.
4. Soldered Joints
    a. Use of soldered joints is prohibited within VRF systems.

3.8 INSTALLATION OF PIPING AND TUBING INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Installation to maintain a continuous vapor barrier.

B. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are unavailable, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints, for horizontal applications. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

E. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.9 INSTALLATION OF DUCT, ACCESSORIES, AND AIR OUTLETS

A. Where installing ductwork adjacent to equipment, allow space for service and maintenance.

3.10 IDENTIFICATION

A. Identify system equipment, piping, tubing, and valves. Comply with requirements for identification specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.11 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.
   1. Field service shall be performed by a manufacturer-trained and authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.
   2. Manufacturer-trained and authorized service representative shall provide on-site visits during construction at installation milestones indicated. System Installer shall coordinate each visit in advance to give manufacturer sufficient notice to plan the visit.
      a. First Visit: Kick-off meeting.
      b. Second Visit: At approximately 50 percent completion of system(s).
      c. Fifth Visit: Final inspection before system startup.
   3. Kick-off Meeting:
      a. Meeting shall include system Installer and other related trades with sole purpose of reviewing VRF HVAC system installation requirements and close coordination required to make a successful installation.
      b. Meeting shall be held at Project site and scheduled at a mutually agreed to time that occurs before the start of any part of system installation.
      c. Meeting shall cover the following as a minimum requirement:
         1) Review of latest issue of Contract Documents, Drawings, and Specifications, relevant to VRF HVAC systems.
         2) Manufacturer's installation requirements specific to systems being installed.
         3) Review of all relevant VRF HVAC system submittals, including delegated-design submittals.
         4) Required field activities related installation of VRF HVAC system.
         5) Project team communication protocol, contact information, and exchange of responsibilities for each party involved, including manufacturer, supplier, system Installer, and other related trades.
   4. Site Visits: Activities for each site visit shall include the following:
      a. Meet with VRF HVAC system Installer to discuss field activities, issues, and suggested methods to result in a successful installation.
      b. Offer technical support to Installer and related trades as related to VRF system(s) being installed.
      c. Review progress of VRF HVAC system(s) installation for strict compliance with manufacturer's requirements.
      d. Advise and if necessary, assist Installer with updating related refrigerant calculations and system documentation.
   5. Final Inspection before Startup:
      a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according to manufacturer's requirements and ready for final inspection.

b. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
c. A factory-trained and authorized service representative shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
d. Inspection reports for indoor units shall include, but not be limited to, the following:
    1) Unit designation on Drawings.
    2) Manufacturer model number.
    3) Serial number.
    4) Network address, if applicable.
    5) Each equipment setting.
    6) Mounting, supports, and restraints properly installed.
    7) Proper service clearance provided.
    8) Wiring and power connections correct.
    9) Line-voltage reading(s) within acceptable range.
    10) Wiring and controls connections correct.
    11) Low voltage reading(s) within an acceptable range.
    12) Controller type and model controlling unit.
    13) Controller location.
    14) Temperature settings and readings within an acceptable range.
    15) Condensate removal acceptable.
    16) Fan settings and readings within an acceptable range.
    17) Unit airflow direction within an acceptable range.
    18) If applicable, fan external static pressure setting.
    19) Filter type and condition acceptable.
    20) Noise level within an acceptable range.
    21) Refrigerant or hydronic piping properly connected and insulated.
    22) Condensate drain piping properly connected and insulated.
    23) If applicable, ductwork properly connected.
    24) If applicable, external interlocks properly connected.
    25) Remarks.
e. Inspection reports for outdoor units shall include, but not be limited to, the following:
    1) Unit designation on Drawings.
    2) Manufacturer model number.
    3) Serial number.
    4) Network address, if applicable.
    5) Each equipment setting, including compressor speed control.
    6) Mounting, supports, and restraints properly installed.
    7) Proper service clearance provided.
    8) Wiring and power connections correct.
    9) Line-voltage reading(s) within acceptable range.
    10) Wiring and controls connections correct.
    11) Low voltage reading(s) within an acceptable range.
    12) Condensate removal acceptable.

13) Noise level within an acceptable range.
14) Refrigerant piping properly connected and insulated.
15) Condensate drain piping properly connected and insulated.
16) For water-source outdoor units, water piping properly connected and insulated.
17) For water-source outdoor units, proof of water flow checked for proper operation.
18) Remarks.

f. Installer shall provide manufacturer with the requested documentation including as-built piping lengths and technical support during inspection.
g. Installer shall correct observed deficiencies found by the inspection.
h. Upon completing the on-site inspection, manufacturer shall provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
i. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved, and systems are deemed ready for startup.
j. Final report shall indicate the system(s) inspected are installed according to manufacturer's requirements and are ready for startup.

B. Perform the following tests and inspections with the assistance of manufacturer's service representative:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: Not less than 24 hours 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.

C. Refrigerant and Hydronic Tubing Positive Pressure Testing:
1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing installation, pressurize tubing systems to a test pressure:
   a. Refrigerant piping to a test pressure of not less than 600 psig using dry nitrogen.
   b. Hydronic piping to a test pressure of not less than 43 psig.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
4. Prepare test report to record the following information for each test:
   a. Name of person starting test, company name, phone number, and e-mail address.
   b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
   c. Detailed description of extent of tubing tested.
   d. Date and time at start of test.
   e. Test pressure at start of test.
   f. Outdoor temperature at start of test.
   g. Name of person ending test, company name, phone number, and e-mail address.
   h. Date and time at end of test.
   i. Test pressure at end of test.
   j. Outdoor temperature at end of test.
   k. Remarks:

5. Submit test reports for Project record and to system manufacturer.

D. Refrigerant Tubing Evacuation Testing:
1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour with no change.
4. Prepare test report to record the following information for each test:
   a. Name of person starting test, company name, phone number, and e-mail address.
   b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
   c. Detailed description of extent of tubing tested.
   d. Date and time at start of test.
   e. Test pressure at start of test.
   f. Outdoor temperature at start of test.
   g. Name of person ending test, company name, phone number, and e-mail address.
   h. Date and time at end of test.
   i. Test pressure at end of test.
   j. Outdoor temperature at end of test.
   k. Remarks:
5. Submit test reports for Project record and to system manufacturer.
6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

E. System Refrigerant Charge:
1. System Installer shall consult system manufacturer to determine the correct system refrigerant charge based on as-built piping lengths.
2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
3. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

3.12 STARTUP SERVICE

A. Installer shall engage a factory-trained and authorized service representative of VRF HVAC system manufacturer to perform system(s) startup supervision.
1. Complete startup service of each separate system.
2. Complete system startup service according to manufacturer's written instructions.

B. Startup checks shall include, but not be limited to, the following:
1. Check control communications of equipment and each operating component in system(s).
2. Check each outdoor unit’s power supply is connected 12 to 24 hours before startup of system.
3. Check each indoor unit's response to demand for cooling and heating.
4. Check each indoor unit's response to changes in airflow settings.
5. Check each indoor unit, outdoor unit, and HRCU when present for proper condensate removal.

C. Installer shall accompany factory-trained and authorized service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.

1. Installer shall correct deficiencies found during startup service for reverification.

D. System Operation Report:
1. After completion of startup service, manufacturer shall issue a report for each separate system.
2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
3. Manufacturer shall electronically record not less than one hour of continuous operation of each system and submit with report for historical reference.
   a. All available system operating parameters shall be included in the information submitted.

3.13 ADJUSTING

A. Adjust equipment and components to function smoothly and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points. Adjust initial airflow settings and discharge airflow patterns.

C. Set field-adjustable switches according to VRF HVAC system manufacturer's written instructions, and as indicated.

3.14 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include four service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.15 DEMONSTRATION

A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

B. Instructor:
1. Instructor shall be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.

C. Schedule:
1. Schedule training with Owner at least 10 business days before first training session.
2. Training shall occur before Owner occupancy.
3. Training shall be held at mutually agreed date and time during normal business hours.

D. Location: Owner shall provide a suitable on-site location to host classroom training.

E. Training Attendance: For record purposes, document training attendees at the start of each new training session. Record attendee's name, signature, phone number, and e-mail address.

F. Training Format: Individual training modules shall include classroom training followed by hands-on field demonstration and training.

G. Training Materials: Provide training materials in electronic format to each attendee.

1. Offer online instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.

H. Acceptance: Obtain Owners written acceptance that training is complete, and requirements indicated have been satisfied.

END OF SECTION 23 8129

SECTION 23 8210 - GAS-FIRED INFRARED UNIT HEATERS

PART 1 GENERAL

1.1 CODES AND STANDARDS

A. American National Standard / CSA Standard Gas-Fired Low Intensity Infrared Heaters: Construct and certify gas-fired infrared heaters in accordance with latest edition ANSI Z83.20 / CSA 2.34 "Gas-Fired Low-Intensity Infrared Heaters" including all current supplements.

B. Installation Compliance: Refer to National Fuel Gas Code NFPA 54/ANSI Z223.1 - latest revision.

C. CSA Compliance: Provide CSA Seal affixed to each burner name plate and provide CSA Certification of heater design as vented infrared heater for indoor installation.

D. National Standard Gas Piping Compliance: Install and connect gas piping to gas fired infrared heaters in accordance with National Fuel Gas Code NFPA 54/ANSI Z223.1 - latest revision.

E. National Electrical Code Compliance: Install and connect electrical wiring to gas fired infrared heaters in accordance with National Electrical Code, NFPA 70 - latest revision. Wiring must conform to the most current National Electrical Code, local ordinances and any special diagrams furnished.

F. National Performance Rating for Gas Fired Infrared Heaters Standard: Radiant output of gas fired infrared heaters shall be rated in accordance with AHRI Standard 1330.

1.2 REFERENCE STANDARDS

A. NFPA 54 - National Fuel Gas Code; 2018.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 WARRANTY

A. Provide written warranty, by manufacturer, agreeing to replace/repair, within warranty period, components of gas fired infrared systems furnished by manufacturer, which are defective in either material or workmanship, provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty periods as follows:
   1. Three (3) year warranty on the burner system from the date of final acceptance of the infrared heaters.

1.4 SUBMITTALS

A. Product Data: Provide typical catalog information for burners, radiant tube, reflectors, vacuum pumps, pressure switches, and heating control panel.

B. Shop Drawings: Provide system layout showing burners, radiant tube and tailpipe runs, reflectors, vacuum pumps, vent and outside air connections, and hanger locations, with the heat output of each zone compared to the heat output indicated.

C. Wiring Diagrams: Provide power and control wiring diagrams for burners, vacuum pumps, and heating control panel, including zone call inputs and status contacts for the building automation system.

D. Manufacturer's Instructions: Indicate installation instructions and recommendations.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

F. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Approved Manufacturer: Infrared heating system shall be CORAYVAC CRV-Series low-intensity vacuum infrared heating system as manufactured by Roberts-Gordon LLC, Buffalo, New York.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of gas fired radiant systems with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 15 years.

C. Alternate Manufacturers:
1. Other low intensity vacuum infrared heating systems (of equal or greater thermal efficiency) (of an Infrared Factor (IF) as high as 15 when tested in accordance with AHRI Standard 1330 for Radiant Output of Gas Fired Infrared Heaters) and with the same or lower burner firing rate capacity, and with the infrared distribution pattern shown on drawing may be acceptable provided they meet the intent of these specifications and prior approval in writing is obtained from the engineer at least twenty (20) days before the bid date. If such systems are approved, the contractor assumes responsibility for the design, performance and expense of same. The redesigned system, gas piping, and electric wiring shall be done by a registered mechanical engineer. Shop drawings of the entire new system shall be provided by this contractor. The contractor should state the amount to be credited to the owner due to this substitution.
2. Where approved substitutes are used, the contractor assumes all responsibility for physical dimensions and all other resulting changes. This responsibility extends to cover all extra work as necessitated by other trades as a result of the substitutions.
3. The engineer reserves the right to require the contractor to remove and replace any material or equipment which does not meet specifications or does not have any prior approval as a substitute item. Work shall be completed immediately without cost or inconvenience to the owner.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Low-intensity, gas-fired, vacuum-operated infrared heating system with burners fired in series along a common radiant tube. A vacuum pump at the end of each system draws combustion air through the burners and exhausts the products of combustion through a common vent. The system operates under negative pressure.

B. Provide two independent heating zones, Zone 1 and Zone 2, each served by its own vacuum pump, VP-1 and VP-2, as indicated on the Drawings.

2.2 EQUIPMENT

A. Burners:
1. Natural gas burners with direct spark ignition and outside air connection, with gas and electric controls easily accessible.
2. Factory Wired: Burners shall be factory wired for 120 volts AC with transformer for 24 volts AC ignition operation.
3. Fail-Safe Controls: Burners shall not fire until the vacuum pump pressure switch proves system operation. In the event of a power failure the gas valve in each burner shall close in safe position.
4. Ignition Controls: All burners shall be equipped with a fully automatic direct spark ignition module with a 15-second flame response time per ignition trial before lockout occurs, capable of a minimum of 3 trials for ignition.

B. Vacuum Pumps: Manufacturer's vacuum pump assemblies, sized by the manufacturer for the burners and tube length served, one per zone. Provide a pressure switch at each pump to prove pump operation before burners fire.

C. Reflectors - High Efficiency:
1. Provide high radiant reflective (aluminum) (stainless steel) reflectors installed over all heat exchanger tube. Provide wide parabolic design reflector with 12 reflective surfaces and additional ribbing formed into reflector sides for added rigidity. Reflector shall be capable of producing an Infrared Factor (IF) as high as 15 when tested in accordance with AHRI Standard 1330 for Radiant Output of Gas Fired Infrared Heaters. Reflector shall reflect 100 percent of the infrared energy that it receives from the heat exchanger tube directly to the floor. Reflectors with less than 12 reflective surfaces shall not be allowed. In order to maximize radiant output and reduce convective heat losses, reflectors are to extend below the bottom of the heat exchanger tube. Provide continuous reflector over all tube and fitting heat exchanger surfaces. Provide reflector end caps as necessary to reduce convective heat losses.

D. Radiant Piping - Heat Exchanger:
1. Radiant Tube: Shall be new 4 inch. (0.33 feet) O.D. (Heat Treated Aluminized) (Hot-Rolled) steel tube X 16 gauge wall with an emissivity factor of 0.80 or greater. Provide manufacturer's high-temperature tubing on the first 10 feet downstream of each burner.
2. Fittings: Shall be 4 inch. (0.33 feet) O.D. aluminized steel X 16 gauge wall. Tubes shall be as described in the installation, operation and service manual.
3. Hanging Materials: All system tube must be supported in accordance with acceptable practices, local codes, seismic requirements, and applicable standards and as shown on plans. Pitch the tube as required by the manufacturer's installation, operation and service manual.

2.3 HEATING CONTROL PANEL

A. Provide one Roberts-Gordon CORAYVAC Heating Control panel, manufacturer model 0277002, 120 V, 20 A, controlling vacuum pumps VP-1 and VP-2 and heating Zones 1 and 2. Each zone shall operate only its own vacuum pump.

B. The panel shall provide post-purge operation of each vacuum pump after its zone is satisfied, and status indication for power, pumps, zones, and pressure switches.

C. Provide dry contacts for vacuum pump status (each pump) and panel fault, for monitoring by the building automation system.

2.4 ZONE CONTROL

A. Do not provide manufacturer thermostats. Zone control is by the DDC system, Section 230923. Zone call contacts from the DDC system connect to the 24 V thermostat terminals of the heating control panel for Zones 1 and 2. See Drawings.

PART 3 EXECUTION

3.1 INSTALLATION OF GAS FIRED RADIANT HEATERS

A. General: Install gas fired infrared heaters as indicated, in accordance with manufacturer's installation operation and service manual and in compliance with applicable codes and approvals. Allow adequate space for servicing or removal of the unit without disturbing other piping or equipment.

B. Support: Suspend heat exchanger, burner, gas piping, conduit, and reflectors from building substrate as indicated, or if not indicated, in manner to provide durable and safe installation; and in accordance with manufacturer's installation operation and service manual. Mounting height to be a minimum of ___ feet from floor level.

C. Clearance to Combustibles: Always maintain clearance to combustibles as outlined and printed on burner nameplate and in manufacturer's product data. Measure clearance distance from surface of heat exchanger or as indicated by approval agency's listing.

D. Venting: Install vent piping as indicated on plans and as required by the manufacturer. Terminate where indicated on the drawings with a vent terminal assembly as supplied by the manufacturer. The venting must be installed in accordance with the requirements within the installation operation and service manual and National Fuel Gas Code NFPA 54/ANSI Z223.1 - latest revision.

E. Gas Piping:
1. Install gas piping as indicated and in compliance with National Fuel Gas Code NFPA 54/ANSI Z223.1 - latest revision.
2. Gas supply pressure at each burner shall be within the manufacturer's listed minimum and maximum inlet pressures.
3. Local Codes: Gas supply piping must meet local requirements and be sized in accordance with Btu/h demand, available pressure and total length of supply line required for the installation. Connection from supply line to burner unit must be made in accordance with installation operation and service manual.
4. Drip Legs: Provide drip legs at all gas risers.

F. Electrical Wiring: Install electrical wiring as indicated. Connect power and control wiring between burners, vacuum pumps, pressure switches, and the heating control panel in accordance with manufacturer's wiring diagrams. Zone call and status wiring to the DDC system is under Section 230923.

3.2 FIELD QUALITY CONTROL

A. Start-Up: Start-up, test, and adjust gas fired infrared heaters in accordance with manufacturer's start-up instructions in the installation operation and service manual, and Utility Company's requirements. Check and calibrate controls, adjust burners if applicable according to manufacturer's installation operation and service manual instructions for maximum efficiency.

B. Verify that each zone operates only its own vacuum pump, that burners do not fire until the pressure switch proves pump operation, and that post-purge operates after each zone is satisfied.

C. Verify operation of the vacuum pump status and panel fault contacts with the installer of Section 230923.

3.3 CLOSEOUT PROCEDURES

A. Training: Provide services of manufacturer's technical representative to instruct operating personnel in operation and maintenance of gas fired radiant heaters. Schedule instruction with operating building owner, provide at least 7 days notice.

END OF SECTION 23 8210

SECTION 26 0533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Floor boxes.

E. Wall and ceiling outlet boxes.

F. Pull and junction boxes.

1.2 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

C. Section 26 0526 - Grounding and Bonding for Electrical Systems.

D. Section 26 0529 - Hangers and Supports for Electrical Systems.

E. Section 26 0533.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 26 2726 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.
   3. Additional requirements for locating boxes for wiring devices.

H. Section 27 1000 - Structured Cabling: Additional requirements for communications systems outlet boxes.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

I. UL 508A - Industrial Control Panels; 2013.

J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify DEDC, LLC of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for underground handhole enclosures, underground handhole enclosures, underground handhole enclosures, and underground handhole enclosures.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use suitable concrete type boxes where flush-mounted in concrete.
4. Use suitable masonry type boxes where flush-mounted in masonry walls.
5. Use raised covers suitable for the type of wall construction and device configuration where required.
6. Use shallow boxes where required by the type of wall construction.
7. Do not use "through-wall" boxes designed for access from both sides of wall.
8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
12. Wall Plates: Comply with Section 26 2726.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
   a. Indoor Clean, Dry Locations: Type 1, painted steel.
   b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
   a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
   a. Back Panels: Painted steel, removable.

5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.

E. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron floor boxes within slab on grade.
3. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
4. Manufacturer: Same as manufacturer of floor box service fittings.

2.2 MANUFACTURERS

A. Appleton Electric: www.appletonelec.com.

B. Hoffman

C. Steel City

D. Crouse-Hinds

E. Substitutions: See Section 01 6000 - Product Requirements.

2.3 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.

B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

C. Wall Plates for Finished Areas: As specified in Section 26 2726.

2.4 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.
3. Locate boxes as required for devices installed under other sections or by others.
    a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
    b. Communications Systems Outlets: Comply with Section 27 1000.
4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
    b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.

c. Electrical rooms.
d. Mechanical equipment rooms.

I. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Install boxes as required to preserve insulation integrity.

M. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

N. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

P. Close unused box openings.

Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

R. Provide grounding and bonding in accordance with Section 26 0526.

S. Identify boxes in accordance with Section 26 0553.

T. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

U. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

V. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

W. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
1. Adjust box locations up to 10 feet if required to accommodate intended purpose.

X. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.

Y. Maintain headroom and present neat mechanical appearance.

Z. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

AA. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

BB. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

CC. Use flush mounting outlet box in finished areas.

DD. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

EE. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.

FF. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

GG. Do not fasten boxes to ceiling support wires.

HH. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

II. Use gang box where more than one device is mounted together. Do not use sectional box.

JJ. Use cast outlet box in exterior locations exposed to the weather and wet locations.

KK. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

3.3 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

3.4 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.5 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

B. Clean exposed surfaces and restore finish.

END OF SECTION 26 0533.16

SECTION 26 2100 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical service requirements.

1.2 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0533.13 - Conduit for Electrical Systems.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 2416 - Panelboards: Service entrance equipment.

G. Section 26 2816.16 - Enclosed Switches: Service entrance equipment.

H. Section 26 3213 - Engine Generators: Emergency/standby power systems for interconnection with normal utility electrical supply.

I. Section 26 3600 - Transfer Switches: Service entrance equipment.

J. Section 26 4300 - Surge Protective Devices: Service entrance surge protective devices.

K. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.

1.3 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.4 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code; 2017.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:
1. Verify the following with Utility Company representative:
   a. Utility Company requirements, including division of responsibility.
   b. Exact location and details of utility point of connection.
   c. Utility easement requirements.
   d. Utility Company charges associated with providing service.
2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.
5. Notify DEDC, LLC of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide temporary and permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing temporary and permanent service to be paid by Contractor..

E. Preinstallation Meeting: Convene one month prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:
1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.
2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.6 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.
1. Obtain Utility company approval of shop drawings prior to submittal.

D. Drawings prepared by Utility Company.

E. Project Record Documents: Record actual locations of equipment and installed service routing.

1.7 QUALITY ASSURANCE

A. Comply with the following:
1. IEEE C2 (National Electrical Safety Code).
2. NFPA 70 (National Electrical Code).
3. The requirements of the Utility Company.
4. The requirements of the local authorities having jurisdiction.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: MET-ED.

D. Division of Responsibility: As indicated on drawings.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Verify and mark locations of existing underground utilities.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required trenching and backfilling in accordance with Section 31 2316.13.

E. Provide pre-cast concrete vault for utility equipment in accordance with Utility Company requirements.

F. Provide required support and attachment components in accordance with Section 26 0529.

G. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.

H. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

3.4 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION 26 2100

SECTION 26 2200 - LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General purpose transformers.

B. K-factor transformers rated for nonlinear loads.

C. Buck-boost transformers.

D. Shielded transformers.

E. Small power centers.

1.2 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0533.13 - Conduit for Electrical Systems: Flexible conduit connections.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.

B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.

C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.

F. NEMA ST 20 - Dry Type Transformers for General Applications; 2021.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.

I. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify DEDC, LLC of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual locations of transformers.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. 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.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton Electrical/Cutler-Hammer: www.eatonelectrical.com.

B. GE Industrial: www.geindustrial.com.

C. Square D: www.squared.com.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.2 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
1. Altitude: Less than 3,300 feet.
2. Ambient Temperature:
   a. Greater than 10 kVA: Not exceeding 104 degrees F.
   b. Less than 10 kVA: Not exceeding 77 degrees F.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.3 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Insulation System and Allowable Average Winding Temperature Rise:
1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

C. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.

D. Winding Taps:
1. Less than 3 kVA: None.
2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

E. Energy Efficiency: Comply with 10 CFR 431, Subpart K.

F. Energy Efficiency: Standard efficiency complying with NEMA TP 1.

G. Sound Levels: Standard sound levels complying with NEMA ST 20

H. Mounting Provisions:
1. Less than 15 kVA: Suitable for wall mounting.
2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

I. Transformer Enclosure: Comply with NEMA ST 20.
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
2. Construction: Steel.
   a. Less than 15 kVA: Totally enclosed, non-ventilated.
   b. 15 kVA and Larger: Ventilated.
3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
4. Provide lifting eyes or brackets.

J. Primary Voltage: 480 volts, 3 phase.

K. Secondary Voltage: 208Y/120 volts, 3 phase.

L. Mounting:
1. Larger than 75 kVA: Suitable for floor mounting.

M. Energy Efficient Per NEMA TP-1

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Install transformers plumb and level.

G. Transformer Support:
1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.
2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

H. Set transformers plumb and level.

I. Use flexible conduit, under the provisions of Section 26 0534, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

J. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

K. Provide grounding and bonding in accordance with Section 26 0526.

L. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

M. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

N. Install transformer identification nameplate in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA STD ATS, except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.2.1.1. In addition to the basic requirements of Section 7.2, include the following:
   1. Perform turns ratio tests at all tap positions.
   2. Verification that as-left tap connections are as specified.
   3. Perform excitation-current tests on each phase.
   4. Measure the resistance of each winding at each tap connection.
   5. Overpotential test on all high- and low-voltage windings-to-ground.

3.4 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

END OF SECTION 26 2200

SECTION 26 2416 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 2813 - Fuses: Fuses for fusible switches and spare fuse cabinets.

1.3 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

E. NEMA PB 1 - Panelboards; 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.

G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

O. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

P. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify DEDC, LLC of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
2. Include documentation of listed series ratings upon request.
3. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. 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.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation: www.eaton.com/#sle.

B. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

C. Substitutions: See Section 01 6000 - Product Requirements.

D. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
1. Altitude: Less than 6,600 feet.
2. Ambient Temperature:
a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:
1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
3. Label equipment utilizing series ratings as required by NFPA 70.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.
2. Boxes: Galvanized steel unless otherwise indicated.
   a. Provide wiring gutters sized to accommodate the conductors to be installed.
   b. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
3. Fronts:
   a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
   b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
   c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

M. Load centers are not acceptable.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:

a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.

3. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
   b. Provide interchangeable trip units where indicated.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   a. Provide the following field-adjustable trip response settings:
      1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      2) Long time delay.
      3) Short time pickup and delay.
      4) Instantaneous pickup.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
   d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
8. Do not use tandem circuit breakers.
9. Do not use handle ties in lieu of multi-pole circuit breakers.
10. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
11. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.4 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

I. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

J. Provide grounding and bonding in accordance with Section 26 0526.

K. Install all field-installed branch devices, components, and accessories.

L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

M. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

O. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.

P. Install panelboards plumb. Install recessed panelboards flush with wall finishes.

Q. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

R. Provide filler plates to cover unused spaces in panelboards.

S. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
1. Fire detection and alarm circuits.
2. Communications equipment circuits.
3. Intrusion detection and access control system circuits.
4. Video surveillance system circuits.

T. Identify panelboards in accordance with Section 26 0553.

U. Provide computer-generated circuit directory for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.

V. Provide identification nameplate for each panelboard in accordance with Section 26 0553.

W. Provide arc flash warning labels in accordance with NFPA 70.

X. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.

Y. Ground and bond panelboard enclosure according to Section 26 0526.

3.3 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform field inspection and testing in accordance with Section 01 4000.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 225 amperes. Tests listed as optional are not required.

E. Test GFCI circuit breakers to verify proper operation.

F. Test AFCI circuit breakers to verify proper operation.

G. Test shunt trips to verify proper operation.

H. Correct deficiencies and replace damaged or defective panelboards or associated components.

I. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2416

SECTION 26 2416.23 - PANELBOARDS - SCHNEIDER ELECTRIC SQUARE D I-LINE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Circuit breaker power distribution panelboards.

B. Circuit breaker combination power distribution/lighting panelboards.

1.2 Related Requirements

A. Section 26 0160.13 - Maintenance Services for Electrical Distribution Equipment - Schneider Electric EcoCare.

B. Section 26 0160.23 - Digital Modeling and Monitoring Services - Schneider Electric Digital Twin.

C. Section 26 0573.10 - Power System Studies - Schneider Electric.

D. Section 26 0913.83 - Condition Monitoring Services - Schneider Electric Square D EcoStruxure Asset Advisor.

1.3 Reference Standards

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.

B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

C. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

D. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use; 2026.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

F. NEMA PB 1 - Panelboards; 2011.

G. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 70E - Standard for Electrical Safety in the Workplace; 2027.

J. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

L. UL 67 - Panelboards; Current Edition, Including All Revisions.

M. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

N. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.4 Administrative Requirements

A. Digital Model Support:
1. Contractor to provide required support for digital first/digital continuity approach employed for all project stages from design through commissioning to operation and maintenance.
2. Electrical system design and analysis software was used to model, design, and analyze facility electrical power network. Digitized network model will be made available to Contractor to enable end-to-end life cycle management of various project assets.
   a. Basis of Design: ETAP by Operation Technology, Inc: www.etap.com/#sle.
3. Alternate digital tools proposed must be fully compatible with digitized network operational model provided, with ability to import and integrate design project file and libraries supplied by specifier, and upgradeable to digital twin to facilitate integrated and unified model from design and analysis to operation and maintenance.
4. Resulting digital twin technologies will help predict outcomes of operation and maintenance activities with model-driven applications for predictive simulation, operator training simulator/simulation before operation integration with electrical power management and control or SCADA software.
5. See Sections 26 0160.23, 26 0573.10, and 26 0913.83 for additional requirements.

1.5 Submittals

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Provide sufficient information to determine compliance with Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, surge protective devices, components, and accessories.

D. Manufacturer's qualification statement.

E. Specimen Warranty: Statement of standard warranty.

F. Executed warranty.

1.6 Quality Assurance

A. Manufacturer Qualifications:
1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 50 years.
2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.

3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
4. Certified in accordance with ISO 14001, with product environmental profiles (PEPs) for specified products.

1.7 Delivery, Storage, And Handling

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

C. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.

D. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.

E. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.

F. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Engineer.

1.8 Field Conditions

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 Warranty

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for 12 months from date of commissioning or 18 months from date of shipment, whichever comes first. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 Manufacturers

A. Schneider Electric; Square D I-Line Panelboard and I-Line Combo Panelboard; www.se.com/#sle.

B. Substitutions: See Section 01 6000 - Product Requirements.

C. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project and obtained from single supplier.

2.2 Panelboards - General Requirements

A. Comply with NEMA PB 1; listed and labeled as complying with UL 67.

B. Short Circuit Current Rating: Where not specified, provide panelboards with listed short circuit current rating as determined by short-circuit study.
1. Listed circuit breaker/circuit breaker and fuse/circuit breaker combinations for series-connected interrupting ratings are acceptable; label equipment utilizing series ratings in accordance with NFPA 70.

C. Provide panelboards marked for use as service equipment where required for application.

D. Markings and Labeling:
1. Provide identification and warning labels/nameplates exterior to equipment resistant to weather, UV, and intended installation environment.
2. Provide engraved nameplate identifying project-specific equipment tag and service description.
3. Provide warning labels/nameplates complying with ANSI Z535.4 at access locations to advise personnel of possible hazards in accordance with listing, NFPA 70, NFPA 70E, and other applicable standards.
4. Provide nameplates containing system information and catalog number or factory order number.
5. Display interior wiring diagram, neutral wiring diagram, and short circuit current rating on interior or in booklet format.

E. Surge Protective Device (SPD):
1. See Section 26 4313 for additional information.
2. Factory installed, integrated within panelboard.
3. Listed as complying with UL 1449.
4. Surge Current Rating:
a. Service Entrance Locations: Not less than 240 kA per phase.
5. Provide surge counter, visible display, and circuit breaker disconnect.
6. Connect to each phase bus; locate close to main incoming lugs or main circuit breaker.
7. Products:
a. Schneider Electric SurgeLogic IMA series.
b. Substitutions: See Section 01 6000 - Product Requirements.

2.3 Circuit Breaker Panelboards

A. Circuit Breaker Combination Power Distribution/Lighting Panelboards:
1. Basis of Design: Schneider Electric; Square D I-Line Combo Panelboard; www.se.com/#sle.
2. Interiors:
a. Maximum voltage ratings of 600 VAC and 250 VDC.
b. Continuous main current ratings up to 1,200 A for main lugs or main circuit breaker.
c. Short circuit current ratings up to 200 kA.
d. Horizontally Oriented Power Distribution Section: Provide three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases to provide support and phase isolation for entire bus length.
e. Lighting Sections:
1) Provide one or more continuous bus bar(s) per phase.

2) 240 VAC and 48 VDC Maximum Lighting Sections: Provide branch circuit connectors suitable for both plug-on and bolt-on branch circuit breakers.
3) 480Y/277 VAC and 600Y/347 VAC Maximum Lighting Sections: Provide branch circuit connectors suitable for bolt-on branch circuit breakers.
4) Insulate current carrying parts from ground and phase-to-phase using high dielectric strength thermoplastic.

f. Bussing:
1) Provide fully rated bussing up to 800 A for copper and up to 400 A for aluminum; provide tapered bussing for higher ratings through 1,200 A.
2) Determine bus current ratings in accordance with UL 67 heat-rise tests.
3) Provide sequentially phased branch distribution.
4) Bus Material: Plated copper.

g. Neutral:
1) Provide solid neutral with full-capacity bonding strap for service entrance applications.

h. Ground:
1) Provide solidly bonded copper equipment ground bar.
2) Provide additional copper isolated/insulated ground bar where indicated.

i. Provide interior leveling provisions for flush mounting applications.
j. Provide interior trim of dead-front construction to shield user from energized parts.
k. Main Lugs and Main Circuit Breaker Interiors: Field convertible for top or bottom incoming feed.

3. Products:
a. Schneider Electric Square D I-Line Combo Panelboard.
b. Substitutions: See Section 01 6000 - Product Requirements.

B. Enclosures:
1. Comply with UL 50 and UL 50E.
2. Key all lock assemblies alike.
3. Type 1 Enclosures:
a. Boxes:
1) Hot zinc dipped galvanized steel; unpainted galvannealed steel is not acceptable.
2) Provide removable blank end walls and interior mounting studs; provide interior support bracket for interior installation.
3) Standard Enclosure Widths: 26 inches, 32 inches, 42 inches, and 44 inches as required by application.

b. Trim Fronts:
1) Finish: ANSI 49 gray enamel paint electrodeposited onto cleaned, phosphatized steel.
2) Provide four-piece fronts, surface or flush mount as indicated.
a) Doors:
(1) Provide rounded corners and edges, free of burrs.
(2) Mount clear plastic directory cardholder on inside of door.
(3) Provide cylindrical tumbler-type lock or sliding vault locks with 3-point latching.

C. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break circuit breakers with over-center, trip-free toggle mechanism; ratings, configurations, and features/accessories as indicated on drawings.
2. Comply with FS W-C-375; listed labeled as complying with UL 489.
3. Interrupting Capacity: As required to provide short circuit current rating indicated.

4. Multi-Pole Circuit Breakers: Provide common tripping for all poles.
5. Thermal Magnetic Circuit Breakers:
    a. Provide permanent trip unit with thermal and magnetic trip elements in each pole.
    b. Thermal Elements: True RMS-sensing, factory calibrated to operate in 104 degrees F ambient temperature.
6. Power Distribution Main and Branch Circuit Breakers:
    a. Group-Mounted Branch Circuit Breakers:
        1) Utilize jaw-type line side circuit breaker connections, without requiring additional external hardware.
        2) Hold circuit breakers in position with self-contained bracket secured to mounting pan by fasteners.
        3) Support mounting of circuit breakers of different frame sizes across from each other.
        4) Unless otherwise indicated, equip unused spaces for future devices, including connectors and mounting hardware.
    b. Available nominal current ratings up to 1,200 A.
    c. Trip Units:
        1) Up to 400 A: Thermal magnetic.
        2) Above 400 A: Electronic trip.
    d. Electronic Trip Units:
        1) Basic Electronic Trip Units: Provide adjustable trip current.
        2) Where indicated on drawings, provide electronic trip units with field-adjustable long-time and instantaneous protection settings.
        3) Provide current transformers combining iron-core sensors for self-powered electronics and air-core, Rogowski coil sensors for measurement accuracy.
    e. Provide push-to-trip button for maintenance and testing purposes.
    f. Indicate rated ampacity on circuit breaker handle and faceplate.
    g. Circuit Breakers with Permanent Trip Units: Listed for reverse connection without restrictive line or load markings; suitable for mounting in any position.
    h. Frame Sizes Above 125 A: Provide single magnetic trip adjustment on front of circuit breaker to simultaneously select desired trip level of all poles.
    i. Provide escutcheon with international I/O markings in addition to standard ON/OFF markings.
    j. Lugs:
        1) Listed to accept solid or stranded copper and aluminum conductors.
        2) Listed to accept 75 degree C rated wire.
        3) Bolt lug body in place; snap-in designs are not acceptable.
    k. Listed for use with the following accessories:
        1) Shunt trip.
        2) Undervoltage trip.
        3) Ground fault shunt trip.
        4) Auxiliary switch.
        5) Alarm switch.
        6) Mechanical lug kits.
        7) Compression lug kits.
        8) Handle Locking Provisions: For locking handle in ON or OFF position.
    l. Products:
        1) Schneider Electric; PowerPacT series.
        2) Substitutions: See Section 01 6000 - Product Requirements.

D. Internal Intelligent Units; I-Line Enable:
   1. Metering:
      a. Mount within panelboard, bus-connected, without use of box extension.
      b. Utilize power quality meter to provide power metering for mains.
      c. Power Quality Meters:
         1) Capable of monitoring for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting.
         2) Products:
            a) Schneider Electric; PowerLogic PM8244 Meter.
            b) Substitutions: See Section 01 6000 - Product Requirements.
      d. Support external data connection to monitoring software or application as stand-alone meter.
      e. Support communication via Modbus RTU, Modbus TCP/IP, BACnet MS/TP, BACnet/IP, or HTTP/web access.

E. Electrical Power Management System Capabilities:
   1. Provide communications connectivity and functionality to support electrical power management system (EPMS), including but not limited to:
      a. Communications connectivity via Ethernet network and protocols of EPMS and related equipment, either through communications gateway or integral interface.
      b. Compliance with recognized cybersecurity requirements.
      c. Breaker aging modeling for electronic trip circuit breakers.
      d. Remote EPMS capability for equipment configuration, electrical power monitoring, power quality monitoring, compliance, and correction; alarm monitoring with event log.
      e. Continuous thermal monitoring capabilities, including alarming, notification, and visualization.
   2. Provide factory-tested native software compatibility, including the following:
      a. Capability for pre-engineered, interactive graphical display screens to view and analyze real-time device data.
      b. Pre-mapping of registers to standard measurement names without need for additional configuration or internal device registers.
      c. Automatic collection and logging of device data by EPMS software without additional configuration.

PART 3 EXECUTION

3.1 Examination

A. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.

B. Examine for conditions detrimental to completion of work.

3.2 Installation

A. Install equipment in accordance with manufacturer's written instructions.

B. Install panelboards in accordance with NECA 1 and NEMA PB 1.1.

C. Maintain proper phasing for multi-wire branch circuits.

3.3 Field Quality Control

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
   1. Include necessary material, equipment, labor, and technical supervision.
   2. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.

C. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

D. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads within 20 percent of each other.

E. Inspect tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's written specifications.

3.4 Protection

A. Protect installed panelboards from subsequent construction operations.

3.5 Maintenance

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements relating to maintenance service.

B. See Section 26 0160.13 for additional information.

C. Provide to Owner, at no extra cost, separate contract for switchgear service plan for two years from date of Substantial Completion including, but not limited to, dedicated customer success management team, priority remote and on-site (within 100 miles of service location) expert support, discounted service rates, continuous monitoring and alarming, online training.

END OF SECTION 26 2416.23

SECTION 27 1000 - DATA & VOICE COMMUNICATIONS CABLING

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. TIA-568.0 - Generic Telecommunications Cabling for Customer Premises; 2020e, with Addendum (2022).

B. TIA-568.1 - Commercial Building Telecommunications Infrastructure Standard; 2020e, with Addendum (2023).

C. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; 2024e.

D. TIA-569 - Telecommunications Pathways and Spaces; 2015d, with Addendum (2016).

E. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2021d.

F. TIA-607 - Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2024e.

1.2 1.1 RELATED DOCUMENTS

A. A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.3 1.2 SUMMARY

A. A. This section includes the following:
1. 1. Category 6A Data & Voice Communications Cabling Standards
2. 2. Category 6A horizontal cable, jacks, faceplates and termination accessories

B. B. Related Sections: The following sections contain requirements that relate to this section:
1. 1. Division 26 Electrical Materials and Methods sections.

1.4 1.3 SUBMITTALS

A. A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. B. Product Data for the following products:
1. 1. Category 6A cable
2. 2. Category 6A data & voice jacks and faceplates
3. 3. Fire-rated pathway devices
4. 4. Field tester model and current calibration certificate

1.5 1.4 DELIVERY, STORAGE AND HANDLING

A. A. Store and handle cable and hardware to prevent damage during construction.

B. B. Store and handle device boxes and conduit to prevent damage during construction.

PART 2 PRODUCTS & MANUFACTURERS

2.1 2.1 Available Manufacturers: Subject to compliance with requirements, the following products may be incorporated in the work:

2.2 2.2 PLENUM CATEGORY 6A CABLE

A. A. 23 AWG, 4 pair, U/UTP, CMP rated, White for Voice & Data. Cable shall be third-party verified to ANSI/TIA-568.2-E Category 6A performance (500 MHz).
1. 1. CommScope SYSTIMAX GigaSPEED X10D 2091B Part # 760105940 (2091B WHT, 1000 feet reel)
2. 2. CommScope SYSTIMAX GigaSPEED X10D 2091B Part # 760107268 (2091B WHT, 1000 feet tote box)
3. 3. HITACHI (Proterial) Supra 10G-XE Part # 30303-8WH3 1000 feet reel)
4. 4. Hubbell NEXTSPEED Ascent Part # C6ASPDSW 1000 feet reel)
5. 5. Hubbell NEXTSPEED Ascent Part # C6ASRDSW 1000 feet reel-in-box)

2.3 2.3 Category 6A Data & Voice Jacks

A. A. Hubbell NEXTSPEED Ascent Part # HJ6AEI
1. 1. Category 6A, keystone mount, T568B, Electric Ivory

B. B. Or approved Equal

2.4 2.4 Faceplates for Data & Voice

A. A. Hubbell Part # IFP14EI (4 Port Plate)
1. 1. IFP PLATES SINGLE-GANG Electric Ivory

B. B. Or approved Equal

C. C. Hubbell Part # SP10GF
1. 1. Stainless steel wall phone plate, single gang, flush keystone jack, qualified to support 10GBASE-T
2. 2. Only for wall phones

D. D. Or approved Equal

2.5 2.5 Blank Dust Covers for Faceplates

A. A. Hubbell Part # SFBE10

B. B. Or approved Equal

2.6 2.6 Blank Dust Covers for Data & Voice Jacks

A. A. Hubbell Part # HXJDC25

B. B. Or approved Equal

2.7 2.7 Termination Tools

A. A. Punch Down Tool with 110 Blade, BIX Blade & 66 Blade.
1. 1. When terminating on the new Hubbell Category 6A jacks for both DATA & VOICE, the tool of choice is: 1-PUNCH TOOL, Part number - HUBBELL TX4P6A.
2. 2. Or approved Equal

2.8 2.8 Wall/Floor/Decking Penetration Fire-Rated Pathway (STI EZ-Path Series 44+)

A. A. Single Series 44+ Pathway Through Walls
1. 1. Part Number EZDP44S2
    a. a. Fire-rated pathway kit, including the pathway device with wall plates and labels.
2. 2. Part Number EZP144W
    a. a. Single wall plates and labels, for use with pathway device EZD44S2 purchased separately.
3. 3. Or approved Equal

B. B. Single Series 44+ Pathway Through Floors
1. 1. Part Number EZDP144FKS2
    a. a. Floor kit, including the pathway device with floor plate.
2. 2. Part Number EZP144F
    a. a. Split floor plate, plate only. Split plate is designed to permit use with previously installed cables.
3. 3. Or approved Equal

C. C. Multiple or Ganged Pathway Installations
1. 1. Part Number EZP544W
    a. a. Multi-gang wall plate brackets designed to allow 1 to 5 Series 44+ pathways to be installed in finished walls or as the wall is being built. Plates attach directly to studs and pathways are installed prior to application of gypsum board. Brackets are suitable for attachment to studs spaced up to 24 inch. (24.02 inch).
2. 2. Or approved Equal

D. D. Series 44+ Pathways Modular Floor Grid Systems
1. 1. Part Number EZDG444S2, Capacity: 4 Pathways
    a. a. Single bank floor grid, sold complete with four (4) pathway devices and floor frame.
2. 2. Or approved Equal

E. E. NOTE: Ordering Details
1. 1. Plate packs include plates, gaskets, set screws and labels.
2. 2. Purchase pathway devices (EZD44S2) and appropriate fasteners separately where plate-only part numbers are used.

PART 3 EXECUTION

3.1 3.1 EXAMINATION

A. A. Prior to starting work, examine condition of site and existing hardware already in place with Owner's Representative present. Check all existing lines and levels indicated. Report any discrepancies with the construction documents, in writing, to the Owner's Representative.

3.2 3.2 Contractor Qualifications and Training

A. A. The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:
1. 1. Possess those licenses/permits required to perform both Data & Telecommunications installations in the specified jurisdiction.
2. 2. Provide references of the type of installation provided in this specification.
3. 3. Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.
4. 4. Be in business a minimum of five (5) years.
5. 5. Must possess current liability insurance certificates.

3.3 3.3 INSTALLATION OF WALL/FLOOR/DECKING PENETRATION

A. A. Contractor shall provide and install approved Penetration Firestop Sleeve System. All data, video, and communications cable bundles shall utilize an enclosed fire rated pathway device wherever said cables penetrate rated walls. The fire-rated pathway shall contain a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to adjust, remove or reinstall firestop materials.

3.4 3.4 INSTALLATION OF CABLING

A. A. Contractor shall provide and install data & voice cables from device jack to specified data termination closet, where end will be rolled up for future termination by the Owner. Contractor shall terminate cables at wiring device end and clearly label both ends with Owner's numbering system.

B. B. Materials to be furnished may be subject to inspection at the factory, in the warehouse or in the field by the Owner's Representative or by qualified inspectors retained by the Owner's Representative.

C. C. Install all elements of the data & voice communications system in accordance with Division 26 Basic Materials and Methods Sections.

D. D. All Category 6A data wiring shall be installed to support IEEE 802.3an 10GBASE-T operation over the full 109.36 yard channel, and IEEE 802.3bt Power over Ethernet applications.

E. E. All Category 6A voice wiring will be installed in accordance with Telephone and Communications Industry Standards.

F. F. All UTP and fiber optic cables shall conform to ANSI/TIA-568.0-E Generic Telecommunications Cabling for Customer Premises, ANSI/TIA-568.1-E Commercial Building Telecommunications Infrastructure Standard, ANSI/TIA-568.2-E Balanced Twisted-Pair Telecommunications Cabling and Components Standard, and ISO/IEC 11801 (International) Generic Cabling for Customer Premises standard (latest amendment and including all applicable addenda). Pathways, administration and bonding shall comply with ANSI/TIA-569-E, ANSI/TIA-606-D and ANSI/TIA-607-D.

G. G. Horizontal permanent link length shall not exceed 90 meters 295 feet. Maintain a minimum cable bend radius of four (4) times the cable outside diameter, do not exceed 25 lbf pulling tension, and do not over-tighten cable ties. Use hook-and-loop cable ties for cable bundles. Untwist pairs no more than required by the jack manufacturer for termination.

H. H. All communications wiring shall be installed in a 4" square 2 1/8" deep back box with a single gang tile ring, with a 1" conduit stubbed above the ceiling, not to exceed four per conduit and four jacks per box. Any additional wiring shall require additional conduit and back boxes. Again not to exceed four wires per conduit and per back box.

3.5 3.5 LABELING FOR DATA

A. A. Each new wire should be labeled as follows; closet # - patch panel letter - port # (Example: 6131-A-001). Labels shall be located 1/4"-1" from both ends of each wire. The jack faceplate of each new wire shall be similarly labeled. The contractor shall also label the front of each patch panel port with a P-TOUCH label showing the room number of the corresponding jack. The Owner's Representative will provide the closet number, patch panel letter(s) and available patch panel port numbers.

3.6 3.6 LABELING FOR VOICE

A. A. Device outlets (FACEPLATES) are to be labeled with the closet number and followed by a hyphen then letter "V" followed by cable number. (Example: L106-V001, 2, 3, etc.)

B. B. Terminal BIX blocks in the closet are to be labeled with room number and followed by hyphen then letter "V" followed by cable number. (Example: L856-V001, 2, 3, etc.)

C. C. Wire labels shall be located 1/4"-1" from both ends of the cable with the closet number and cable number (Example: L106-V001).

3.7 3.7 TESTING FOR DATA

A. A. Each installed twisted pair cable shall be tested as a Category 6A permanent link, using a Fluke Networks DSX2-5000 or DSX2-8000 CableAnalyzer (Versiv) with permanent link adapters. When running the AUTO TEST feature the following tests shall be executed: Wire Map, Length, Propagation Delay, Delay Skew, Insertion Loss, Near-End Crosstalk (NEXT) Loss, Power Sum Near-End Crosstalk (PSNEXT) Loss, Attenuation to Crosstalk Ratio, Far-End (ACR-F), Power Sum Attenuation to Crosstalk Ratio, Far-End (PSACR-F), Return Loss, Transverse Conversion Loss (TCL), Equal Level Transverse Conversion Transfer Loss (ELTCTL) and DC Resistance Unbalance, from both ends per ANSI/TIA-568.2-E. Each circuit number will be identified using the same labeling scheme as required on the jack faceplate. Test results will be provided to the Owner's Representative in both hard copy and native electronic format (Fluke LinkWare) as specified in the Reports section. The Contractor may propose an equivalent testing method by submitting full documentation thereof for review by the Owner's Representative.

B. B. All Category 6A permanent links and channels shall be qualified for transmission performance up to 500 MHz to ensure that high-frequency voltage phase and magnitude contributions do not prove cumulative or adversely affect channel performance. Any link with a marginal (*) or failing result shall be corrected and retested.

C. C. All UTP field testers shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided for review prior to the start of testing.

D. D. Autotest settings provided in the field tester for testing the installed cabling shall be set to the default parameters for TIA Category 6A Permanent Link.

E. E. Test settings selected from options provided in the field testers shall be compatible with the installed cable under test.

3.8 3.8 TESTING FOR VOICE

A. A. Testing for voice wires will consist of wire map and continuity.

3.9 3.9 JACK TERMINATIONS

A. A. Hubbell quad wall jack plate shall be used whenever a new wire for data & voice jacks are required, unless specified otherwise. If there is an existing data & voice jack within two feet of the new jack location, the existing data & voice jack shall be upgraded to a Hubbell quad wall jack with Category 6A jacks.

B. B. Sockets 1 and 2, in that order, will normally be occupied by voice (telephone) connections. Sockets 4 and 3, in that order, will normally be the data positions on the quad jack. If 6 port single gang plate is required data will start in position 6 and work backwards. If there is no need for voice connections, positions 2 and 1, in that order, may be used for data jacks but only at the discretion of the Owner's Representative.

C. C. Data Termination
1. 1. Use RJ45 T568B Configuration
2. 2. NO SPLITTING OF PAIRS, one jack equals one cable

D. D. Voice Termination
1. 1. Use RJ45 T568B Configuration
2. 2. NO SPLITTING OF PAIRS, one jack equals one cable

PART 4 ADMINISTRATION DOCUMENTATION

4.1 4.1 Drawings

A. A. As-built drawing shall be supplied by the contractor showing the locations of and identifiers for all:
1. 1. Horizontal cable routing and terminations
2. 2. Telecommunications outlets/connectors
3. 3. Backbone cable routing and terminations

4.2 4.2 REPORTS

A. A. All wires installed in the project shall be tested and documented with the completed documentation being turned over to the Owner's Representative with all As Built Documentation.

4.3 4.3 Data Test Results

A. A. Each data wire will be tested as specified in Article 3.7. Each record must contain the identifier as specified in Article 3.5. Final results will be provided in both hard copy and native electronic format (Fluke LinkWare files) on a USB drive or approved electronic file transfer.

4.4 4.4 Voice Test Results

A. A. Each voice wire will be tested as specified in Article 3.8. Each record must contain the identifier as specified in Article 3.6. The final voice report shall be in hard copy and electronic format.

END OF SECTION 27 1000

SECTION 32 1216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Asphalt materials.
2. Aggregate materials.
3. Aggregate subbase.
4. Asphalt paving base course, binder course, and wearing course.
5. Asphalt paving overlay for existing paving.
6. Surface slurry.

B. Related Requirement:
1. Section 31 22 13 - Rough Grading: Preparation of site for paving and base.
2. Section 31 23 23 - Fill: Compacted subbase for paving.
3. Section 31 05 16 - Aggregates for Earthwork: Product requirements for aggregate for placement by this section.
4. Section 32 11 23 - Aggregate Base Courses: Compacted subbase for paving.
5. Section 32 17 13 - Parking Bumpers: Concrete bumpers.
6. Section 32 17 23 - Pavement Markings: Painted pavement markings, lines, and legends.
7. Section 33 05 13 - Manholes and Structures: Manholes including frames.

1.2 REFERENCE STANDARDS

A. Pennsylvania Department of Transportation:
1. Publication 19 – Field and Laboratory Test Methods, latest edition.
2. Publication 408 - Specifications, latest edition, as amended.

B. American Association of State Highway and Transportation Officials:
1. AASHTO M17 - Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
2. AASHTO M29 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
3. AASHTO M140 - Standard Specification for Emulsified Asphalt.
4. AASHTO M208 - Standard Specification for Cationic Emulsified Asphalt.
5. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
6. AASHTO M320 - Standard Specification for Performance-Graded Asphalt Binder.
7. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
8. AASHTO MP1a - Standard Specification for Performance-Graded Asphalt Binder.

C. Asphalt Institute:
1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
2. AI MS-19 - Basic Asphalt Emulsion Manual.
3. AI SP-2 - Superpave Mix Design.

D. ASTM International:
1. ASTM D242 - Standard Specification for Mineral Filler For Bituminous Paving Mixtures.

2. ASTM D692 - Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
3. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
4. ASTM D977 - Standard Specification for Emulsified Asphalt.
5. ASTM D1073 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
6. ASTM D1188 - Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
7. ASTM D2027 - Standard Specification for Cutback Asphalt (Medium-Curing Type).
8. ASTM D2397 - Standard Specification for Cationic Emulsified Asphalt.
9. ASTM D2726 - Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
10. ASTM D2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
11. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
12. ASTM D3515 - Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
13. ASTM D3549 - Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
14. ASTM D3910 - Standard Practices for Design, Testing, and Construction of Slurry Seal.
15. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Mixing Plant: Approved or certified by Pennsylvania Department of Transportation.

B. Obtain materials from same source throughout.

C. Perform Work in accordance with Pennsylvania Department of Transportation standard.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum 5 years documented experience.

1.6 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.

B. Do not place asphalt mixture between November 1 and March 1.

C. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

D. Place asphalt mixture when temperature is not more than 15 degrees F less than initial mixing temperature.

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

A. Asphalt Materials:
1. Asphalt Binder: AASHTO M332 except as revised in PennDOT Bulletin 25; performance grade PG 64S-22.
2. Tack Coat: In accordance with Pennsylvania Department of Transportation Publication 408 Standard Specification, Section 460.

B. Aggregate Materials:
1. Coarse Aggregate: In accordance with Pennsylvania Department of Transportation standards.
2. Fine Aggregate: In accordance with Pennsylvania Department of Transportation standards.
3. Mineral Filler: AASHTO M17; finely ground mineral particles, free of foreign matter.

C. Aggregate Subbase: Specified in Section 32 11 23.

2.2 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. Asphalt Paving Mixtures: Designed in accordance with Pennsylvania Department of Transportation standards with maximum 15 percent by weight reclaimed asphalt pavement.
1. Base Course: 25.0 mm.
2. Binder Course: 19.0 mm (Heavy Duty Pavement).
3. Wearing Course: 9.5 mm with skid resistance level L.

2.3 ACCESSORIES

A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

B. Sealant: ASTM D6690, Type II or Type III; hot applied type.

2.4 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

B. Submit proposed mix design of each class of mix for review prior to beginning of Work.

C. Test samples in accordance with PennDOT Publication 408.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 73 00 - Execution Requirements: Requirements for installation examination.

B. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.

C. Verify compacted subgrade is dry and ready to support paving and imposed loads.
1. Proof roll subbase with loaded triaxle dump truck (72,000 pounds GVW) in minimum two perpendicular passes to identify soft spots.
2. Remove soft subbase and replace with compacted fill as specified in Section 31 23 23.

D. Verify gradients and elevations of base are correct.

E. Verify drainage inlet frames, manhole frames and other embedded items are installed in correct position and elevation.

3.2 PREPARATION

A. Prepare subbase in accordance with Section 32 11 23.

3.3 DEMOLITION

A. Saw cut and notch existing paving as indicted on Drawings.

B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.

C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.4 INSTALLATION

A. Subbase:
1. Aggregate Subbase: Install as specified in Section 32 11 23. 4

B. Tack Coat:
1. Apply tack coat on asphalt and concrete surfaces over subgrade surface at uniform rate.
a. New Surfaces: 1/3 gal/sq yd.
b. Existing Surfaces: 1/2 gal/sq yd.
2. Apply tack coat to contact surfaces of curbs.
3. Coat surfaces of manhole and inlet frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

C. Asphalt Paving:
1. Place asphalt base or binder course within 4 hours of applying tack coat.
2. Place base or binder course to thickness indicated on Drawings.
3. Place wearing course within 4 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.

4. Place wearing course to thickness indicated on Drawings.
5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

D. Asphalt Paving Overlay
1. Apply tack coat to existing paving surface at rate recommended by geotextile fabric manufacturer.
2. Install geotextile fabric in accordance with manufacturer's instructions to permit asphalt saturation of fabric. Lap fabric edge and end joints 4 inches.
3. Place wearing course to thickness indicated on Drawings.
4. Compact overlay by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
5. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.5 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Flatness: Maximum variation of ¼ inch measured with 10-foot straight edge.

C. Scheduled Compacted Thickness: Within ¼ inch.

D. Variation from Indicated Elevation: Within ½ inch.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting, testing.

B. Take samples and perform tests including mat density tests in accordance with Pennsylvania Department of Transportation standards.

C. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

D. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 500 square yards compacted paving.

E. Asphalt Paving Density: ASTM D2950 nuclear method; test one location for every 250 square yards compacted paving.

3.7 PROTECTION

A. Section 01 73 00 - Execution Requirements: Requirements for protecting finished Work.

B. Immediately after placement, protect paving from mechanical injury for 24 hours or until surface temperature is less than 140 degrees F.

END OF SECTION 32 1216

SUBSTITUTION REQUEST FORM:

Project: Exeter Township
Emergency Services Facility
To: MW Studios Architecture
Beyle Constrution
Re:

Substitution Request No.: 01
From:
Date: 10/29/26
Architects Project No. 25049

Specification Title: DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM, INTERIOR LIGHTING, EXTERIOR L... Description:
Section No. 26 0923, 26 5100, 26 5600
Page No. Article

Proposed Substitution: LIGHTING FIXTURES AND CONTROLS FROM DIVERSIFIED
Manufacturer: Website URL:
Trade Name: DIVERSIFIED Model No:
Installer: Phone No.
Differences between proposed substitution and specified product:

Provide point by point comparative data on separate sheet as attachment to this form. (This is required for review of any substitution.

Reason for not providing specified item: TO ALLOW FOR COMPETITIVE BIDDING

Similar Installation:
Project: Architect:
Address: Owner:
Does proposed substitution affect other Work? [No] [Yes] (Explain)

Total Cost of Substitution: Dollars: $NO CHANGE TO COST
Cost change to contract: [Deduct] [Addition] Dollars: $NO CHANGE TO COST

Schedule Impact: [Deduct] [Addition] NO IMPACT TO SCHEDULE days.
Does Substitution Require Redesign: [No] [Yes] NO REDESIGN REQUIRED

Submitting Representative Initials: MT

THE UNDERSIGNED CERTIFIES:

- The proposed substitution has been fully investigated by the General Contractor and determined to be equal or superior in all respects to the specified materials, products, assemblies, and/or equipment as may be applicable to the substitution request.
- General Contractor acknowledges that this proposed substitution must also meet the design intent expressed in the Contact Documents, as judged by the Architect and substantiated by the materials submitted herewith.
- General Contactor will furnish the same warranty for proposed substitution as for specified material, product, assembly, and/or equipment as may be applicable to the substitution request.
- General Contractor has verified that the same level of maintenance service and similar availability of replacement parts, as applicable, is available.
- General Contractor has verified that the proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above and further broken out on supplemental data sheets where attached is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent will be waived by the General Contractor.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made by the General Contractor for changes to building design, including A/E design, detailing, and construction costs caused by this substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be completed by the General Contractor.

Submitted By (Printed Name): Mike Thompson

Signature: M. Thompson

On Behalf of (Company Name): Albarell Electric

Address: 901 W. Lehigh St. Bethlehem PA

E-mail Address: MThompson@Albarell.com

Attachments:

ARCHITECT'S REVIEW AND ACTION

_____ Substitution Approved
_____ Substitution Approved as Noted
_____ Substitution Rejected

Architect: MW Studios, Inc.
Reviewed By: _____

Signature: _____
Date: _____

END OF SUBSTITUTION REQUEST FORM