

City of East Providence

East Providence Community Center

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East Providence, RI 02914**



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ARCHITECTS**

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100% Submission

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SECTION 01012

CONTRACTOR'S USE OF THE PREMISES

PART 1 – GENERAL

1.01 DESCRIPTION:

- A. Work Included: This Section applies to situations in which the Contractor or his representatives including, but not necessarily limited to, suppliers, subcontractors, employees, and field engineers, enter upon the Owner's property.
- B. Related Work:
 - 1. Documents affecting the work of this Section include, but are not necessarily limited to, the Contract, AIA 201, and sections of Division 1 of these specifications.

1.02 QUALITY ASSURANCE:

- A. Promptly, upon award of the Contract, notify all pertinent personnel regarding requirements of this Section.
- B. Require that all personnel who enter upon the Owner's property certify their awareness of and familiarity with the requirements of this Section.
- C. The Prime Contractor and his subcontractors shall wear an appropriate form of identification, whether it is a photo ID, shirt, or jacket with company logo, etc.
- D. The Prime Contractor and his subcontractors shall park their personal vehicles in appropriate locations off the Owner's site. One company vehicle of the prime contractor may be parked on the site at any time unless otherwise authorized in writing by the Owner.

1.03 SUBMITTALS:

- A. Maintain an accurate record of the names and identification of all persons entering upon the Owner's property in connection with the work of this Contract, including times of entering and times of leaving, and submit a copy of the record to the Owner daily.

1.04 TRANSPORTATION FACILITIES:

- A. Truck and equipment access:
 - 1. To avoid traffic conflict with vehicles of the Owner's employees, fire station vehicles and the general public, and to avoid over-loading of streets and driveways elsewhere on the Owner's property, limit the access of trucks and equipment to the route provided by or directed by the Owner.
 - 2. The Prime Contractor and his subcontractors shall maintain a clear and unobstructed path of travel for emergency vehicles entering and exiting the existing apparatus bay and at the front of the fire station.
- B. Contractor's Vehicles:
 - 1. Contractor's vehicles, vehicles belonging to employees of the Contractor, and all other vehicles entering the Owner's property in performance of the work of the Contract, shall use only the access route provided by or directed by the Owner.

2. Do not permit such vehicles to park on any street or other area of the Owner's property except in the areas directed or provided by the Owner.
3. Contractor shall assume sole responsibility for all parking and traffic violation of employees, subcontractors, suppliers, etc.

1.05 SECURITY:

- A. Restrict the access of all persons entering upon the Owner's property in connection with the work to an Access Route authorized by the Owner.

1.06 GENERAL:

- A. Contain operations at site to areas permitted by:
 1. Law
 2. Ordinances
 3. Owner
 4. Contract Documents
- B. Do not unreasonably encumber site with materials or equipment.
- C. Do not load the building or building components with weight that will endanger the structures.**
- D. Assume full responsibility for protection and safekeeping of products stored on premises.
- E. Move any stored products which interfere with operations of Owner or other Contractor.
- F. Obtain and pay for use of additional storage or work areas needed for operations.

1.07 SITE UTILIZATION PLAN

- A. Refer to the Section 01330 "Submittals" for requirements regarding the preparation and submittal of a Site Utilization Plan for Owner/Architect approval.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION 01012

SECTION 01015

EXISTING CONDITIONS

PART 1- GENERAL

1.01 SUMMARY

A. EXISTING CONDITIONS SURVEY

- A. Before submitting a bid, the Contractor shall make a thorough examination of the conditions of the site, checking the requirements of the Plans and Specifications with the existing conditions.
- B. No claim for extra compensation or extension of time will be allowed on account of the Contractor's failure to estimate properly the quantities, locations and measurements of all items required to complete the work.
- C. The Contractor shall report any discrepancies to the Architect and request and interpretation before submitting a bid.
- D. The existing site will remain active to the adjacent buildings for the duration of the Contract. Contractor is to coordinate phasing of access and parking with the Owner/Architect prior to submitting the Construction Phasing Plan and Staging Plans, refer to section 01330 for additional information.
- E. Contractor shall obtain a copy of the final geotechnical report and shall follow all applicable geotechnical recommendations. Where discrepancies between this specification and the geotechnical report may exist, the contractor shall contact the Architect and OPM for clarification. The geotechnical engineer has provided, for information only, a report containing subsurface conditions.
 - a. Geotechnical design basis report, prepared by Pare Corporation, dated September 2024, thirty-nine (39) pages total.
- F. The Contractor shall remove all topsoil and organic material from beneath areas to receive pavements and structures. The Contractor assumes any risk associated with conclusions drawn from this information. If additional investigation is required, the Contractor shall contact the Engineer to obtain permission to perform site investigations prior to start of construction.
- G. Existing Utilities exist on site and are shown on the drawings for reference only. Locations shown do not relieve the Contractor from the responsibility for accurately locating and protecting utilities in place. The Contractor is responsible for repair and replacement of all utilities to remain that are damaged by his work.

- H. The Contractor will submit a field verification plan of all utilities within limit of work and submit to Engineer for review and approval.

PART 2- PRODUCTS - Not Used

PART 3- EXECUTION - Not Used

END OF SECTION 010015

GEOTECHNICAL DESIGN BASIS REPORT

Pare Project No. 24005.00

New Community Center East Providence, RI

Prepared for:

Starck Architects
1 Richmond Square, Suite 120C
Providence, RI 02906

Prepared by:

Pare Corporation
10 Lincoln Road, Suite 210
Foxboro, MA 02135

SEPTEMBER 2024

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Figure 3:	Subsurface Exploration Plan

APPENDICES

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Appendix B:	Geotechnical Limitations

1.0 BACKGROUND/SITE LOCATION

This Geotechnical Design Basis Report presents the results of the geotechnical subsurface investigations and evaluations performed by Pare Corporation (Pare) at the site of the proposed new community center on Waterman Avenue in East Providence, RI. The project site is depicted in Figure 1: Locus Plan and Figure 2: Aerial Plan. This report has been prepared in general accordance with our proposal and is subject to the Geotechnical Limitations presented in Appendix D.

1.1 Purpose and Scope

The purpose of this study was to identify the existing subsurface conditions within the area of the proposed new community center; evaluate potential implications the observed conditions may have upon the proposed structures; and provide geotechnical parameters and recommendations for use during the design of the proposed project. The scope of work was performed in general accordance with Pare's proposal.

The scope of this evaluation did not include an evaluation of the site for the presence of contamination or other environmental concerns, as those tasks are outside the scope of this geotechnical report.

1.2 Background

Pare Corporation (Pare) understands that the proposed project consists of a new, one-story, approximately 15,000 square-foot community center. According to the plan titled "East Providence Community Center" prepared by Odeh Engineers, dated August 14, 2024, the proposed new community center will be a pre-engineered metal building structure. The proposed site is located on the same parcel as the Senior and Recreation Centers, to the north of the existing parking area. The new community center is anticipated to include site improvements such as modifications to the existing parking area, walks, utilities and other site features to support the project.

1.3 Surface Conditions

The proposed site is located to the north of the parking area for the existing Senior and Recreation Centers. The site is partially developed and consists of a grassed field, a paved parking area and paved walkways. The site generally slopes from the south down towards the north at approximate elevations of El.65 feet to an approximate low of El. 62 feet. The site is presently bordered by Pawtucket Avenue to the northeast and east, paved parking for the Senior and Recreation Centers to the southwest and southeast, and residential homes and Roslyn Avenue to the northwest.

1.4 USGS Surficial/Bedrock Geology

*Surficial*¹

The RIDEM Environmental Resource Map indicates that the site is underlain by Glacial Outwash. Glacial Outwash can be described as stratified deposits of sand and gravel deposited by glacial melt/water streams.

*Bedrock*²

The United States Geological Survey (USGS) bedrock geology map of this area indicates that the site is

¹ RIDEM, *Environmental Resource Map*, RI Surficial Geology, By RIDEMGIS, 2022, <https://ridemgis.maps.arcgis.com>.

² USGS, "Bedrock Geologic Map of Rhode Island" By Quinn, A.W., 1971.

underlain by the Rhode Island Formation (Pri). The Rhode Island Formation is classified as “Greenish, gray, dark-gray to black graywacke, conglomerate, sandstone, shale, and meta-anthracite, as well as a few beds of red sandstone and shale at the northeast corner of the quadrangle.”

1.5 Previous Site Development

Available historical aerial imagery³ and aerial plans⁴ dating back to 1955 were reviewed. The following is a summary of the site history.

Since before 1955, the site appears to have been historically undeveloped and consisted of a grassed field. Between 1981 and 1985, a baseball field appears to have been constructed in the grassed area. By 2002, the baseball field appears to have been removed. From about 2003 to the existing conditions, the grassed area appears to have been used for various sports and recreation fields.

³ <https://www.historicaerials.com/viewer>

⁴ Google Earth Aerial Images

2.0 SUBSURFACE EXPLORATIONS

A subsurface exploration program consisting of five (5) borings was performed to determine the subsurface conditions at the site and provide geotechnical information to assist in the design. Logs of the soil borings were completed and are included in Appendix A. Their locations are shown on Figure 3: Subsurface Exploration Plan. The boring locations were marked out at the site by Pare personnel using handheld GPS. The surface elevation at each boring was obtained using a handheld GPS and reference NAVD88.

The soil borings were completed August 21, 2024, through August 23, 2024, performed by New England Boring Contractors of Derry, New Hampshire. The borings were observed by Pare personnel. Soil borings were performed using a truck-mounted drill rig, with safety and automatic hammers, 4-inch casing, and following wash-and-drive drilling techniques as noted on the boring logs.

Pare personnel provided field observation and coordination for the subsurface exploration program. Field personnel observed the exploration conditions, collected split spoon samples, visually identified and sampled the soil strata encountered, and took approximate groundwater measurements. The boring logs are attached, and their locations are indicated on Figure 3: Subsurface Exploration Plan.

During the exploration, subsurface soils were visually classified utilizing the Burmister Classification System. This system describes soil composition based upon the percentage of soil particle size present by weight in the sample with the major soil particle size listed first followed by other soil components described as “trace” indicating 0-10% by weight, “little” indicating 10-20% by weight, “some” indicating 20-35% by weight or “and” indicating 35-50% by weight.

2.1 Sampling Methodology

2.1.1 Borings

The sampling methodology for borings in soil consisted of obtaining disturbed samples of the deposits continuously for generally the first 10 feet, and at 5-foot intervals thereafter. The samples were obtained by advancing a 2-inch diameter, thick-walled split-spoon sampler during the performance of the Standard Penetration Test (SPT) in accordance with ASTM D-1586. The SPT is used to obtain an indication of the characteristic, relative density, and consistency of the underlying soils. The test consists of driving a 1 3/8-inch inside-diameter split-spoon sampler for 24 inches with a 140- pound hammer dropping from a height of 30 inches. The SPT value used in analysis is the number of blows (N) required to drive the sampler from 6 to 18 inches of penetration.

2.2 Field Measurement and Methodology

The locations of the soil borings were recorded using hand-held GPS equipment. The elevations of the soil borings were estimated from the plan entitled “Limited Content Boundary Survey Senior Center Property” prepared by City of East Providence – Department of Public Work – Engineering Division, dated June 23, 2021, and reference NAVD88, as noted on the boring logs.

2.3 Locations

The subsurface exploration program completed at the site included five (5) soil borings (B24-1 through B24-5) advanced to depths between 29.5 to 38.0 feet below the existing ground surface. The locations of the borings were spaced across the area of the proposed building footprint. Their locations can be found on Figure 3: Subsurface Exploration Plan.

The locations and depths of each of the borings are summarized in Table 3-1: Subsurface Exploration Summary.

3.0 SUBSURFACE CONDITIONS

The general stratigraphy for the proposed building footprint consists of TOPSOIL, overlying FILL, overlying GLACIAL OUTWASH, overlying BEDROCK.

TABLE 3-1: SUBSURFACE EXPLORATION SUMMARY

Boring	General Location	Approx. Ground Surface Elevation (Feet)	Approximate Depth to Top/Thickness of Stratum (Feet)				Depth of Exploration (Feet)	Groundwater Depth* (Feet)
			(Stratum 1) TOPSOIL	(Stratum 2) FILL	(Stratum 3) GLACIAL OUTWASH	(Stratum 4) BEDROCK		
B24-1	N: 267796.79 E: 367104.08	62.5	0.0/0.6	0.6/7.4 (EL. 61.9)	8.0/EOE ¹ (EL. 54.5)	NE ²	31.0 (EL. 31.5)	7.5 (EL. 55.0)
B24-2	N: 267932.09 E: 367169.28	61.7	0.0/0.8	0.8/7.2 (EL. 60.9)	10.0/EOE ¹ (EL. 51.7)	NE ²	29.5 (EL. 32.2)	10.0 (EL. 51.7)
B24-3	N: 267753.01 E: 367193.02	62.8	0.0/0.8	0.8/7.2 (EL. 62.0)	8.0/EOE ¹ (EL. 54.8)	NE ²	31.0 (EL. 31.8)	10.5 (EL. 52.3)
B24-4	N: 267887.42 E: 367260.12	62.2	0.0/0.5	0.5/9.0 (EL. 61.7)	9.5/EOE ¹ (EL. 52.7)	NE ²	31.0 (EL. 31.2)	12.2 (EL. 50.0)
B24-5	N: 267842.10 E: 367183.60	62.3	0.0/0.7	0.7/6.3 (EL. 61.6)	7.0/24.0 (EL. 55.3)	31.0/EOE ¹ (EL. 31.3)	38.0 (EL. 24.3)	12.9 (EL. 49.4)

1. End of Excavation

2. Not Encountered

* Groundwater depth at the end of drilling is influenced by water introduced by driller in the borehole. Native groundwater was not observed during drilling operations at these borehole locations and recovered soil samples were observed to be in a moist condition.

3.1 Soil Strata

The various soil strata encountered in the borings during the investigation are described as follows. It should be noted that the depths to, and thickness of the various soil strata will vary between and away from the exploration locations. Similarly, the nature of the various deposits will also vary between and away from the exploration locations.

Stratum 1 – TOPSOIL

TOPSOIL was encountered in all five (5) of the borings of the investigation. The topsoil varied in thickness from 6 to 10 inches and can generally be described as dark brown, fine to coarse SAND, with “little” to “some” amounts of Silt, and “trace” amounts of Roots/Organics.

Stratum 2 – FILL

FILL was encountered underlying the TOPSOIL all five (5) of the borings of the investigation. The FILL is generally described as brown to reddish brown and gray, fine to coarse grained SAND, or fine to coarse grained GRAVEL, with “trace” to “some” amounts of Silt, “trace” to “and” amounts of fine to coarse Gravel, “trace” to “and” amounts of fine to coarse Sand, and “trace” amounts of Organics. Iron staining/oxidation was encountered in FILL soils. Boulders were encountered in FILL soils in boring B24-5.

SPTs performed in Stratum 2 generally indicate a relative density of loose to very dense.

Stratum 3 – GLACIAL OUTWASH

The GLACIAL OUTWASH stratum was encountered underlying the FILL and TOPSOIL in all borings of the investigation. The GLACIAL OUTWASH is generally described as light brown to brown, and gray to dark gray, fine to coarse SAND, SILT, or fine to coarse GRAVEL, with “trace” to “and” amounts of fine to coarse Sand, “trace” to “and” amounts of fine to coarse Gravel, and/or “trace” to “and” amounts of Silt. Iron staining/oxidation was encountered in GLACIAL OUTWASH soils. Boulders were encountered in GLACIAL OUTWASH soils in borings B24-2 and B24-5.

SPTs performed in Stratum 3 generally indicate a cohesiveness of soft to stiff, and relative density of medium stiff to very dense.

Stratum 4 – BEDROCK - RHODE ISLAND FORMATION

The BEDROCK layer was encountered underlying the GLACIAL OUTWASH in one (1) of the five (5) borings of the investigation. The BEDROCK is generally described as dark gray, weak, fresh SHALE.

TABLE 3-2: ROCK CORE SUMMARY

Boring No.	Core No.	Depth (Feet)	Recovery (%)	RQD (%)	Rock Quality Description
B24-5	C-1	33-38	90	83.3	Good

3.2 Groundwater

Based on observations taken during the investigation program, groundwater varied from approximately 7.5 to 12.9 feet below the existing ground surface with elevations ranging from 55.0 feet to 49.4 feet.

It is important to note that as part of the boring activities, water was introduced into each borehole and may not have dissipated at the time that the initial or subsequent measurements were taken.

During the investigation, the drillers generally did not introduce water until they had drilled 4 feet below the existing ground surface for all five (5) boring locations. Groundwater was not encountered within the upper 4 feet. Water-bearing sand lenses may impact excavations and site dewatering should be anticipated. Please see the boring logs within Appendix A of this report for details on groundwater depths.

During the investigation, an observation well was installed in boring B24-1 to a depth of approximately 25 feet below the ground surface. The well pipe consisted of 15 feet of 2-inch PVC screen pipe and 10 feet of riser pipe. Sand was placed around the pipe to encase the 10 feet of PVC screen pipe, followed by 2 feet of bentonite chips. The remainder of the well was backfilled with sand to the existing ground surface. The well pipe was covered with a road box well cover at the existing ground surface and capped with concrete.

TABLE 3-3: OBSERVATION WELL GROUNDWATER READINGS

Location	Depth of Well (feet)	Groundwater Depth on 8/22/24 (feet)	Groundwater Depth on 8/23/24 (feet)	Groundwater Depth on 8/26/24 (feet)
B24-01 ¹	25.0 (EL.37.5)	7.5 (EL. 55.0)	8.4 (EL. 54.1)	8.6 (EL.53.9)

1. The observation well at boring B24-01 was installed on 8/22/2024.

It should be noted that groundwater levels are known to fluctuate due to local and regional factors including, but not limited to, precipitation events, seasonal changes, and periods of wet or dry weather.

4.0 IMPLICATIONS OF SUBSURFACE CONDITIONS

4.1 General

Based on the subsurface investigation program and observations made during the explorations, the following are the geotechnical issues identified that could potentially impact the development of the site as proposed:

- TOPSOIL observed across the surface of the site is not a suitable bearing stratum for footings or suitable for reuse as backfill materials in the building or pavement areas and is recommended to be removed (or used as landscaping material for TOPSOIL) and replaced with suitable material as stated herein.
- FILL observed across the site generally encountered variable densities from loose to dense and is not considered a suitable bearing stratum without ground modification/improvement. See Section 5.0 Conclusions and Recommendations for recommended alternatives to support the foundations within the FILL stratum.
- GLACIAL OUTWASH deposits consisting of very stiff to hard Silt or medium dense to very dense Sand and/or Gravel across the site are a suitable bearing stratum for the foundations. Very soft Silt and very loose to loose Sand and/or Gravel should be removed or recompacted where encountered. Due to the encountered high fines content dewatering should be anticipated for excavations within this stratum. It is recommended that a 1-foot cushion of “Sand Gravel Fill” material should be placed between the GLACIAL OUTWASH and structural elements to limit hard points developing below the footings or slabs.
- Groundwater was generally encountered near the FILL and GLACIAL OUTWASH boundary. Groundwater was observed ranging from 7.5 feet (El. 55.0) to 12.9 feet (El. 49.4). Dewatering should be anticipated.
- The BEDROCK is at depths that should not impact shallow foundations.
- For each of the strata described above it should be noted that the thicknesses and extents are likely to vary across the site.
- Dense and Very Dense FILL, GLACIAL OUTWASH deposits and BEDROCK, along with boulders were encountered in the borings. This will likely be difficult to excavate and may impede the installation of rammed aggregate piers, and similar subsurface construction, if required.
- It is likely that most excavation of overburden soils can be completed with excavators. Hammering of larger boulders to facilitate removal should be anticipated.
- Due to the high percentage of fine sand and silt sized particles in the soils present below the surface of the sites, crushed stone used under foundations, slabs, or around utilities should be wrapped with geotextile filter fabric when backfilled with existing site soils to prevent the migration of the fine particles into the voids within the crushed stone. The filter fabric specification should be designed for site specific soils.

- Reuse of on-site FILL and GLACIAL OUTWASH deposits as fill may be possible pending confirmatory grain size analyses. It is, however, likely that the material will need to be screened and/or blended in order to meet specified gradations. Organic material, construction debris, fine grained soils, cobbles, boulders, and other deleterious materials should be removed from on-site materials prior to reuse. Additional sieve tests will be needed during construction to confirm the reusability of these strata as fill material. It should be noted that not all on-site materials will be suitable for reuse, nor will all required material gradations be present on-site. *Imported materials or blending of on-site material with imported material is anticipated for this project.*
- Due to the high percentage of fine sand and silt sized particles in the GLACIAL OUTWASH present below the surface of the site, storm water infiltration rates are anticipated to be low at depth. Construction activities may be impacted by flooding from storm events that occur if proper precautions are not performed to manage runoff. *Temporary dewatering to control storm water runoff, and potential groundwater seepage into excavations is anticipated.*

4.2 Seismic Design Category and Liquefaction Evaluations

4.2.1 Site Criteria

In general accordance with the 2018 International Building Code and the Title 510 State Building Code for Rhode Island, based on the boring information the soil profile of the project site is characterized as Site Class Profile C, “Very Dense Soil and Soft Rock” (i.e. $N_{bar} > 50$)⁵

Based on the Title 510 State Building Code for Rhode Island, Table 1608.1, the maximum considered earthquake spectral response acceleration at short periods, S_s , and at 1-second periods, S_1 , are 0.200 g and 0.055 g respectively. Correcting the accelerations for the observed site profile based upon average Standard Penetrations Test N values, the following parameters are recommended by the general procedure:

- Adjusted maximum considered earthquake spectral response acceleration parameters:
 - $S_{MS} = 0.260$
 - $S_{M1} = 0.083$
- For calculating the design spectral response accelerations, utilize:
 - $S_{DS} = 0.173$
 - $S_{D1} = 0.055$
- Peak Ground Acceleration
 - $PGA_M = 0.142$

Based on the above coefficients and the 2018 International Building Code, the Seismic Design Category for the site is B with a risk category III.

⁵ “ N_{bar} ” denotes the average Standard Penetration Test N-value for the first 100 feet of soil.

4.2.2 Liquefaction Evaluation

Liquefaction is the tendency for a soil type, particularly fine sands, to lose a significant amount of strength and behave similar to a liquid in the event of an earthquake, or sufficient vibrations. Liquefaction analyses generally relate SPT N values, corrected for overburden, fines content, and measured groundwater levels to the liquefaction potential of the materials in question. In general, in order for liquefaction to occur three conditions have to be met simultaneously. These are: 1.) loose sandy soils susceptible to liquefaction, 2.) saturated soil conditions, and 3.) vibration.

The liquefaction analyses completed during the preparation of this report takes into account the soil and groundwater conditions encountered during the subsurface exploration program. It should be noted that fluctuations in groundwater levels can have a significant effect in the liquefaction potential of soils. If the groundwater is observed to change during the construction process or future explorations, Pare should be contacted as it may be necessary to re-analyze the soil for liquefaction potential.

Based upon the observed relative densities, groundwater elevation and material composition, it appears that the in-situ soils are NOT susceptible to liquefaction at this time.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Site Preparation

Given our current understanding of the project, Pare recommends that the TOPSOIL and FILL beneath the proposed structures be removed to the GLACIAL OUTWASH stratum and backfilled to proposed subgrade elevations with acceptable structural fill. Alternatively, due to the encountered groundwater elevation, anticipated depth of FILL to be removed and proposed site grading Pare recommends the consideration for either ground improvements, such as rammed aggregate piers or a limited soil correction and a lower net allowable bearing capacity. See Section 5.2.1 Limited Soil Correction Alternative 1 and Section 5.2.2 Aggregate Piers (Rammed Aggregate Piers) Alternative 2 for additional recommendations.

The following summarizes the subgrade preparation program approach to provide suitable bearing for spread footings, foundations, and pavements.

- Unsuitable in-situ soils: TOPSOIL and FILL soils, and other soils not identified in the subsurface investigation but are found to contain organic matter, roots, construction debris, and/or other deleterious materials shall be over-excavated within the influence zone of the proposed shallow foundation and slabs-on-grade to the medium dense to very dense GLACIAL OUTWASH, or other soil layers determined to be an acceptable bearing stratum as determined by a geotechnical engineer.
- Subgrades in GLACIAL OUTWASH or FILL should be over-excavated by 12 inches and backfilled with a compacted 12-inch “cushion” of “Sand Gravel Fill”, or over-excavated by 6 inches and backfilled using crushed stone.
- Boulders exposed on the surface of the subgrade larger than 6-inches should be removed and the resulting voids filled with compacted “Granular Fill.”
- Site elevations in structural areas should be raised as required using approved material meeting Gravel Borrow/Structural Fill specifications. This approved material should be compacted in lifts with a maximum loose lift thickness of 12 inches.
- All fills should be compacted under the observation of the geotechnical engineer to the minimum compaction requirements as presented in Table 5-2. Each lift of placed material shall be field density tested in accordance with project specifications. Excavations should be backfilled with approved material, compacted in lifts, to the bearing elevation of the proposed subgrade or slabs-on-grade.
- Unsuitable, disturbed, or weaving soils should be removed.
- Due to the extent of encountered FILL soils, depth to groundwater, and encountered unsuitable very soft GLACIAL OUTWASH soils near the boundary with FILL soils, dewatering efforts and excavations below the groundwater table should be anticipated for the removal and replacement of FILL soils and excavation to a suitable bearing stratum. Alternatively, consideration should be given to the use of shallow ground modifications and a lower bearing capacity Section 5.2.1 or

Section 5.2.2 ground improvements (i.e. Rammed Aggregate Piers) to densify the existing FILL and GLACIAL OUTWASH soils.

- Due to the observed site groundwater conditions a permanent perimeter drain is recommended. Special construction, vapor barriers, and waterproofing should be anticipated for proposed foundation areas requiring moisture sensitive products or coatings.

The site preparation program should be designed to provide a uniform bearing stratum meeting the capacity presented in Section 5.2, in addition to considering the effects of differential settlement across the proposed structure.

This approach will address the potential for excessive differential settlement. All organic material encountered should be stripped from within the influence zone of the proposed building, and pavement areas and stockpiled for potential on-site reuse. If on-site reuse is not feasible, the organic material should be properly disposed of off-site. The reuse of organic material as fill material within the influence zone of the proposed buildings and pavements areas should not be permitted.

5.2 Foundations

A foundation system composed of column (i.e., square) and wall (i.e., continuous) footings bearing on a minimum 12-inch-thick layer of compacted “Sand Gravel Fill” or 6-inches of crushed stone (in wet areas) placed on compacted structural “Granular Fill” or GLACIAL OUTWASH is recommended for effectively transferring the building loads to the ground.

Prior to the placement of fill to support foundations and ground bearing slabs, the TOPSOIL and FILL strata should be removed from the influence zone⁶ of the proposed building and structures footprints. To reach building subgrades, “Granular Fill” should be placed and compacted. GLACIAL OUTWASH is suitable for bearing after removal of exposed boulders and subsequent filling of voids with compacted fills and should be proof compacted in accordance with Section 6.1 of this report prior to the placement of foundation elements.

The subgrade should be proof compacted in accordance with Section 6.1 of this report. During proof compaction, if unsuitable areas of the subgrade are revealed, it is Pare’s recommendation that the unsuitable areas are excavated, the newly exposed subgrade is proof compacted, and replaced with compacted structural fill in 12-inch lifts.

It should be noted that the recommendations presented herein are based upon the currently anticipated finished floor elevation of 64.0 feet. Changes within the finished floor elevations, or locations of structures should be reviewed by the geotechnical engineer for potential impacts to these recommendations.

A maximum net allowable soil bearing pressure of 4,000 psf is recommended for spread footings bearing upon compacted structural fill placed on top of the proof compacted GLACIAL OUTWASH stratum.

Due to the high percentage of fine sand and silt sized particles present in the FILL and GLACIAL OUTWASH strata and the anticipation of wet conditions, crushed stone should be wrapped in a

⁶ “Influence Zone” is defined as the area below foundations and slabs bound by a plane extending from 2 feet outside of their outer edges, down 1 vertical, and out 1 horizontal. The influence zone also extends upward and outward from 2 feet outside of the footing outer edges up 1 vertical and out 1.5 horizontal as shown on Figure 5-1.

geotextile fabric (Mirafi 140N or equivalent). If crushed stone thicknesses exceed 6 inches (whether wet or not), it is recommended to wrap the stone in a geotextile fabric (Mirafi 140N or equivalent) to help reduce the migration of fines from the granular soils into the crushed stone. The excavations for the footings and the slabs should be over-excavated to permit the placement of this layer.

A maximum total settlement of 1 inch and a maximum differential settlement of one-half inch between foundation elements was also assumed. Foundations should not bear partially upon soil and partially upon bedrock as differential settlement may occur. Should shallow bedrock occur, over excavation of bedrock may be required to allow for 6 inches of geotextile wrapped “Crushed Stone” or 12 inches of compacted “Sand and Gravel Fill” to be placed.

Footings should be proportioned to apply no more than the net allowable bearing pressure. For footings less than 3-feet wide or greater than 12-feet wide, the net allowable bearing pressure should be reassessed and in no case should a continuous footing be less than 24-inches wide or should a column footing be less than 24-inches wide

5.2.1 Limited Soil Correction Alternative 1

A foundation system composed of column (i.e., square) and wall (i.e., continuous) footings bearing on a minimum 12-inch-thick layer of compacted “Sand Gravel Fill” or 6-inches of crushed stone (in wet areas) placed on compacted structural “Granular Fill”, proof-compacted FILL or GLACIAL OUTWASH, are recommended for effectively transferring the building loads to the ground.

Prior to the placement of fill to support foundations and ground bearing slabs, the TOPSOIL and loose FILL strata should be removed from the influence zone⁷ of the proposed building and structures footprints. To reach building subgrades, “Granular Fill” should be placed and compacted. Medium dense to very dense FILL following proof compaction in accordance with Section 6.1 is suitable for bearing after removal of exposed boulders and subsequent filling of voids with compacted fills.

The subgrade should be proof compacted in accordance with Section 6.1 of this report. During proof compaction, if unsuitable areas of the subgrade are revealed, it is Pare’s recommendation that the unsuitable areas are excavated, the newly exposed subgrade is proof compacted, and replaced with compacted structural fill in 12-inch lifts.

It should be noted that the recommendations presented herein are based upon the currently anticipated finished floor elevation of 64.0 feet. Changes within the finished floor elevations, or locations of structures should be reviewed by the geotechnical engineer for potential impacts to these recommendations.

A maximum net allowable soil bearing pressure of 1,500 psf is recommended for spread footings bearing upon the top of the proof compacted, medium dense to very dense FILL stratum following proof compaction in accordance with Section 6.1.

Due to the high percentage of fine sand and silt sized particles present in the FILL and GLACIAL OUTWASH strata and the anticipation of wet conditions, crushed stone should be wrapped in a

⁷ “Influence Zone” is defined as the area below foundations and slabs bound by a plane extending from 2 feet outside of their outer edges, down 1 vertical, and out 1 horizontal. The influence zone also extends upward and outward from 2 feet outside of the footing outer edges up 1 vertical and out 1.5 horizontal as shown on Figure 5-1.

geotextile fabric (Mirafi 140N or equivalent). If crushed stone thicknesses exceed 6 inches (whether wet or not), it is recommended to wrap the stone in a geotextile fabric (Mirafi 140N or equivalent) to help reduce the migration of fines from the granular soils into the crushed stone. The excavations for the footings and the slabs should be over-excavated to permit the placement of this layer.

A maximum total settlement of 1 inch and a maximum differential settlement of one-half inch between foundation elements was also assumed. Foundations should not bear partially upon soil and partially upon bedrock as differential settlement may occur. Should shallow bedrock occur, over excavation of bedrock may be required to allow for 6 inches of geotextile wrapped “Crushed Stone” or 12 inches of compacted “Sand and Gravel Fill” to be placed.

Footings should be proportioned to apply no more than the net allowable bearing pressure. For footings less than 3-feet wide or greater than 12-feet wide, the net allowable bearing pressure should be reassessed and in no case should a continuous footing be less than 24-inches wide or should a column footing be less than 24-inches wide

5.2.2 Aggregate Piers (Rammed Aggregate Piers) Alternative 2

Rammed Aggregate Piers in conjunction with the Shallow Foundation system can be used to densify the subgrade and provide a higher soil bearing pressure. Rammed Aggregate Pier systems are ground improvement techniques that install columns of aggregate to densify and stiffen the surrounding loose or soft soils. Rammed aggregate piers are typically installed by predrilling a hole, pouring aggregate, and tamping or ramming down lifts of material in the hole. These are accomplished usually by a specialized excavator with a ramming attachment and a loader that would pour down the aggregate into the hole in lifts. Rammed aggregate piers should be designed and installed by a licensed specialty contractor familiar with work in the project area.

Based upon observed subsurface conditions, the Rammed Aggregate Piers are anticipated to be installed through loose and very dense FILL, and very soft, stiff, very loose and loose GLACIAL OUTWASH soils to the medium dense and very dense GLACIAL OUTWASH layer approximately 20 to 25 feet below the existing grade. Installation depths may vary and are dependent upon final design of the aggregate piers.

Pare anticipates that Rammed Aggregate Piers could be designed to provide a net allowable bearing pressure of 4,000 pounds per square foot. Pare recommends the design of the rammed aggregate piers should be performed by a specialty contractor and professional engineer licensed in the State of Rhode Island.

Some advantages of using rammed aggregate piers include:

- Increased bearing capacity for shallow foundations
- More likely to be more economical than deep foundations or deep soil corrections and over excavations.
- Limits removal of possibly contaminated subgrade soils.
- Limits settlement that may result from the encountered, undocumented FILL soils on site.

Some disadvantages of rammed aggregate piers include:

- Lower load capacity than deep foundations.
- Larger equipment required for installation.

- Undocumented obstructions requiring removal.
- Significant site grade changes for equipment access.
- Undocumented FILL soils, that were encountered to contain contaminants in areas, could remain on-site.

5.2.3 Slabs on Grade

A modulus of vertical subgrade reaction (K_v) of 150 pounds per cubic inch is recommended for design of a slab on grade placed over 12 inches of compacted "Sand Gravel Fill", or 6 inches of crushed stone (after removal of exposed boulders and filling of voids). The structural engineer will need to design the slab for anticipated live and dead loads in accordance with applicable building codes. Should any of the building, mechanical, electrical, or other equipment require independent foundations, additional foundations and/or modifications to the slab may be required depending upon the actual load requirements. Stand-alone slab foundation preparation should follow recommendations set forth in Section 5.1. Structural mats should be designed to the same bearing capacities stated in the Shallow Foundations section.

5.3 Drainage

Based on observations taken during the subsurface investigation, the GLACIAL OUTWASH soils exhibit generally poor drainage and the potential for ponding at the exposed surface. Based on the current understanding of the plans, the proposed structure is anticipated to have the foundation slab constructed above the groundwater table. Please note that as part of the select boring activities, water was introduced to the noted boreholes and may not have dissipated at the time that the measurement was taken. Temporary dewatering to control groundwater inflow to the excavations is anticipated. Due to the encountered site groundwater conditions a permanent perimeter drain is recommended. Special construction, vapor barriers, and waterproofing should be anticipated for proposed foundation areas requiring moisture sensitive products or coatings. Underdrains should be designed in all slab areas where the seasonal high groundwater is within 5 feet of the finished floor elevation.

Note that shallow foundations should be prepared in the dry. Roof drainage and surface water runoff should be directed away from the structure. As water levels are anticipated to fluctuate with the seasons and precipitation events, positive drainage is also recommended in order to carry water away from the building foundation.

5.4 Underground Utilities

Underground pipes and utilities should be placed on bedding in accordance with the manufacturer's specifications and recommendations. "Granular Fill" should be placed in lifts on the sides and above the utilities. The lift thickness should be sized appropriately for the equipment being used. For hand operated compaction equipment loose lift thickness should be limited to 6-inches; for vibratory plate compactors, 8-inch loose lifts; and for vibratory drum roller or sheep's foot trench roller, 12-inch loose lifts.

5.5 Construction Materials

Fill materials should be friable soil, free from trash, ice, snow, frozen soils, tree stumps, roots, and other organic matter and deleterious materials. Pare recommends the following soil gradations for imported fill, conforming to the Rhode Island Department of Transportation *Standard Specifications for Road and Bridge Construction Amended 2018* (State Standards).

- Gravel Borrow utilized as “Sand Gravel Fill” below structures and under pavement should conform to M.01.02 of the State Standards and conforming to the material gradation in M.01.09 Table I column Ib of the State Standards.
- All other Gravel Borrow material utilized as “Granular Fill” below structures and for material utilized in regrading areas, trench backfill, backfill against below-grade walls as “Granular Fill” should conform to M.01.02 of the State Standards and conforming to the material gradation in M.01.09 Table I column Ia of the State Standards.
- Crushed Stone Bedding Material should be imported material conforming to “Crushed Stone or Crushed Gravel” in M.01.09 table I type II of the State Standards.

5.6 Flexible and Rigid Pavement Recommendations

All TOPSOIL should be stripped prior to subgrade preparation. The subgrade should be proof rolled with a minimum 4-6 passes of a vibratory roller with a static weight of 10,000 pounds and a dynamic weight of 20,000 pounds. Caution should be used when compacting the subgrade, if wet, to avoid weaving and disturbance from vibrations.

Table 5-1 presents recommended pavement layer thickness based upon standard AASHTO design procedures for both "Standard Duty" and "Heavy Duty" pavement. "Standard Duty" pavement is applicable for up to 50,000 Equivalent Single 18-kip Axle Loads (ESAL's) while "Heavy Duty" pavement is applicable up to 350,000 ESAL's. The recommended base and subbase courses for both "Standard Duty" and "Heavy Duty" areas are as listed below.

TABLE 5-1: RECOMMENDED FLEXIBLE PAVEMENT LAYER THICKNESS

Pavement Section	Standard Duty	Heavy Duty
Finish Course	1-1/2 inches	2 inches
Binder Course	1-1/2 inches	2-inches
Base Course	6-inches	6-inches
Subbase Course	8-inches	12-inches

Should the actual loading conditions be greater or less than those stated within the design criteria, the pavement sections will need to be re-analyzed for the actual conditions. This may result in a thicker or thinner pavement section being required.

Geo-grid type reinforcement may be used to extend the serviceability of the pavement or to reduce the required thickness of sub-base material. Additional design and a cost-benefit analysis is required to assess the potential advantages of incorporating geo-grid reinforcement into the construction.

Pavement construction should be in accordance with the requirements of the project's specifications/design. In areas where concrete and asphalt paving meet, it would be advantageous to provide a strip of free draining soil below the concrete and bituminous interface. The free draining strip should consist of a twenty-four (24) inch thick layer of "Sand Gravel Fill" extending a minimum of 4 feet laterally below the concrete apron and asphalt paving. This should control minor frost heaving that may occur if water enters the subgrade through this joint.

Base and Subbase course materials should meet the criteria for "Sand Gravel Fill" and "Granular Fill", respectively, as listed above. Subbase and base courses should be compacted in 1-foot (maximum loose

lift thickness) lifts to 95% of the maximum dry density as determined in accordance with ASTM D1557 (modified Proctor test). Fill below the subbase should be compacted to at least 95% of the maximum dry density as determined in accordance with ASTM D1557 (modified Proctor test).

For areas to be paved with Portland cement-based concrete, a 4-inch-thick slab on grade is recommended. The concrete should have a minimum unconfined compressive strength of 4,000 pounds per square inch, with air entrainment of 4 to 6 percent. The thickness is based upon the AASHTO Low Volume Road Design procedure and a modulus of subgrade reaction of 150 pounds per cubic inch. Welded wire fabric reinforcement (6 x 6, W2.0 x W2.0) is recommended as a minimum to minimize crack opening.

The concrete paving should be graded to induce runoff. All joints and cracks should be sealed and/or filled on a regular basis as part of a routine maintenance item. If the joints and cracks are not kept sealed, significant frost heaving may occur during the winter months.

Concrete pavement should have expansion joints at a spacing of 45 feet with a joint filler thickness based on thermal expansion. All expansion joints should be sealed with an AASHTO-approved elastomeric joint sealer. Contraction (crack control) joints should be constructed at a spacing of 15 feet. Load transfer between slabs should be provided by epoxy coated #6 dowels, 18-inches long at a spacing of 12 inches. Concrete pavement base and subbase courses should consist of 6 inches of "Sand Gravel Fill".

High silt content will be susceptible to frost heaves unless the FILL and GLACIAL OUTWASH within is removed to the full frost depth, or the grades are raised with compacted "Granular Fill," or other free draining material.

Underdrains should be designed in all pavement areas where the groundwater is within 4 feet of the pavement surface, or where the high silt content FILL and GLACIAL OUTWASH has been removed to the full frost depth.

5.7 Reuse of On-Site Soils

Based on the visual classifications, the onsite TOPSOIL encountered may be suitable for reuse as loam in landscape area. All pavement material should be disposed of off-site in accordance with local, state, and federal laws.

Due to the high percentage of silt and fine sand, it is recommended to modify the excavated FILL and GLACIAL OUTWASH before placing and recompacting. It is recommended that the existing FILL and GLACIAL OUTWASH are amended to meet the specifications. To amend the FILL and GLACIAL OUTWASH materials, it may be required to blend the materials with an imported material, to remove unsuitable materials (organics, silt, clay, contaminants, and waste as needed) as well as remove boulders and cobbles greater than 3 inches, or a combination of blending and removal. Fill material should not contain oil and/or hazardous material. After amending the material, confirmatory grain size analysis will be needed to confirm that the blending/screening methodology achieves the desired results and can be reproduced on-site.

It is possible to reuse the material without modification and will likely perform adequately, however there is the possibility that the material will not compact adequately, and settlement could develop. The client should be apprised of this risk if unmodified fill is used at the site.

5.8 Soils Prone to Disturbance from Rain and Frost

Silty or fine sandy soils are prone to disturbance when saturated from rainfall events, will be easily disturbed by construction equipment traversing the site, are difficult to compact, and prone to frost heaves during freeze thaw cycles. If the construction is performed during the late fall, winter, or spring months, wet conditions and freeze thaw cycles should be expected to prevail. Soils becoming saturated or allowed to freeze will require re-compaction and retesting prior to placing additional fill material or structural components. Delays caused by wet/freezing soil conditions may be a factor that affects the construction schedule. Consideration should be made to extend construction access roads, consisting of crushed stone and geogrid, through heavily trafficked areas of the construction site to minimize rutting of the subgrade and improve site access during and after rain events. Should the subgrade become disturbed, the disturbed material should be over-excavated and replaced with compacted “Granular Fill” as recommended in Section 6.0.

Soils with a silt content of greater than about 8% have the potential to heave when subjected to freezing conditions. The risk of heaving increases with increasing silt content, although soils with a silt content of less than about 15% silt is considered within the construction industry to be an acceptable risk. High silt content soils are not recommended for use in frost zones below structures, pavements, or within the influence zone of foundation walls due to their susceptibility to frost heave. Prior to reusing these materials, confirmatory sieve analyses for each type of on-site material proposed for reuse should be completed by the Contractor and submitted to the Engineer for approval.

5.9 Compaction

The approved FILL or GLACIAL OUTWASH subgrade to accept backfill and foundations should be compacted by proof compaction with at least six (6) passes of a 10-ton vibratory roller performed in perpendicular directions. In GLACIAL OUTWASH materials with a higher percentage of fine sand and silt sized particles, where vibratory proof compacting is observed by a geotechnical engineer to pump moisture to the surface, static rolling may be used in place of vibratory rolling with a piece of equipment meeting the aforementioned weight requirements. It is anticipated that extensive dewatering efforts of GLACIAL OUTWASH materials will be required prior to proofrolling.

Lift thicknesses of placed material should be limited to a loose lift thickness of 12 inches. Compaction of this material should be performed with adequately sized equipment to yield the recommended amount of relative compaction.

The fill materials should be compacted as outlined below.

TABLE 5-2: RECOMMENDED MINIMUM COMPACTION REQUIREMENTS

Location	Percent of Maximum Dry Density ¹
Backfill below foundations ²	95
Backfill for foundation and retaining walls	95
Backfill within pavement base and subbase layers	95
Backfill below pavement subbase layers	95
Around and above utilities within structure areas	95
Around and above utilities in paved areas	92
Backfill behind retaining walls	95 ³
Backfill within landscaped areas	85

¹ Maximum dry density as determined by the Modified Proctor test (ASTM D 1557)

² Described as an area extending downward and outward from 2 feet outside of the outside edge of the foundation at a 1H:1V slope.

³ During compaction of fill placed behind retaining walls, care should be taken so as to maintain uniform elevation along both sides within the embedded areas, and to not overstress the wall by applying excessive compactive energy at the top of the wall.

5.10 Frost Depth Recommendations

In conformance with Rhode Island State Building Code, in East Providence, RI exterior footings founded over soils should be placed at a minimum depth of 40 inches below the finished grade in order to provide for frost protection. Preparation for slabs and paved areas should consider the frost heave susceptibility of subgrade soils. If foundations are placed directly on rock or on crushed stone (i.e. completely drained), then frost protection is not necessary. If structural fill is used or the crushed stone is not drained, then the foundation should be placed at a minimum of 4 feet below proposed grade for frost protection.

5.11 Lateral Earth Pressures and Retaining Wall Design

For the design of retaining walls with level backfill, recommended lateral earth pressure coefficients are indicated in Table 5-3. A moist unit weight of 125 pounds per cubic foot (pcf) and a minimum internal friction angle (ϕ) of 35° for imported free draining “Granular Fill” is recommended. The lateral earth pressure coefficient should be increased where the ground surface slopes up behind the wall. The retaining walls should be designed to withstand surcharge loading which may be present over the life of the structure. These would include traffic loads, as well as loads from storage, fill or construction equipment which may be placed adjacent to the wall. The influence zone behind the wall can be defined by a 1.5 horizontal to 1 vertical line extending upward from the bottom outside edge of the wall footing.

The magnitude of lateral earth pressure against retaining walls is dependent upon the type of backfill, method of fill placement, drainage provisions, and the amount of displacement the wall is permitted to undergo after the placement of the backfill. Pare recommends that the retaining walls be backfilled with a free draining compacted “Granular Fill”, as defined herein.

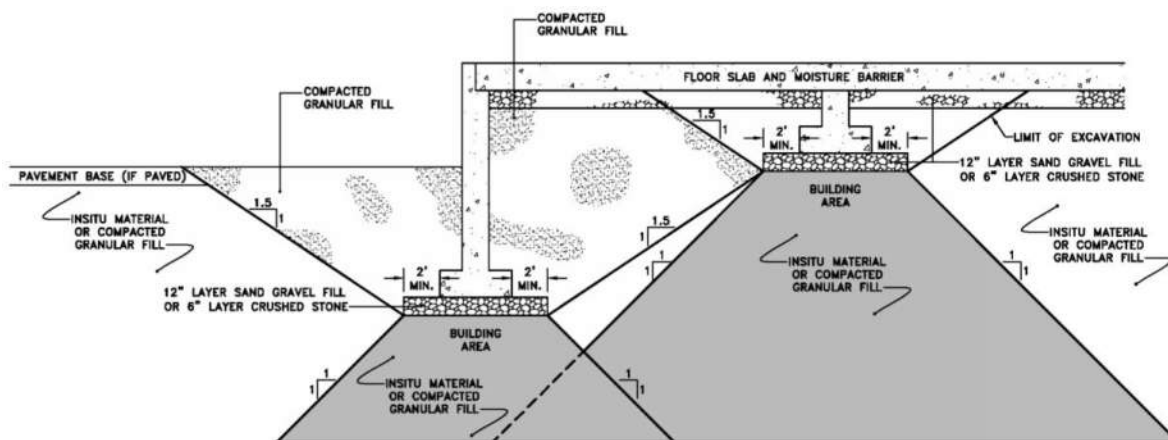
The lateral earth pressure distribution against the retaining wall should be computed using the appropriate value of K, the coefficient of lateral earth pressure. Recommended values of K are presented in the table below. Friction factors are also presented for use in checking resistance to unbalanced forces on the walls.

TABLE 5-3: RECOMMENDED EARTH PRESSURE AND FRICTION COEFFICIENTS

Material	At-Rest Coefficient (K_0)	Active Coefficient (K_a)	Passive Coefficient (K_p)
Glacial Outwash ($\Phi = 38^\circ$)	0.38	0.24	4.20
Imported "Granular Fill" ($\Phi = 35^\circ$)	0.43	0.27	3.69
FRICTION COEFFICIENTS			
Concrete Poured on Imported Sand Gravel Fill			$\tan \delta = 0.45$
Precast Concrete on Imported Sand Gravel Fill			$\tan \delta = 0.30$

In order to attain either the active or passive condition, displacement of the wall is necessary. To attain the active condition in a sand material, the horizontal movement required ranges from $0.001H$ to $0.004H$ depending on the density of the material. The horizontal movement required to attain the passive condition in a sand material ranges from $0.02H$ to $0.06H$, where H is the wall height.

Traffic loads and other anticipated loadings that could occur behind the walls should be considered. In addition, the effect of adjacent footings on lateral walls should be accounted for during design. A minimum of 250 psf should be used to account for compaction equipment within 5 feet of the wall.

Figure 5-1: Typical Profile Below Footings

6.0 CONSTRUCTION CONSIDERATIONS

This section presents construction considerations and recommendations including excavation, backfilling, utility installation, dewatering, lateral earth support, and construction monitoring.

6.1 Excavation

6.1.1 Site Preparation

After rough grades have been established, but before placement of compacted “Granular Fill”, exposed surfaces should be visually inspected and probed. Frozen, wet, or loose soils and other undesirable materials should be removed.

Subgrades should be proof compacted with a minimum 6 passes of a vibratory roller with a static weight of 10,000 pounds and a dynamic weight of 20,000 pounds. Caution should be used when compacting the subgrade, if wet, to avoid weaving and disturbance from vibrations. In GLACIAL OUTWASH materials with a higher percentage of fine sand and silt sized particles, where vibratory proof compacting is observed by a geotechnical engineer to pump moisture to the surface, static rolling may be used in place of vibratory rolling with a piece of equipment meeting the aforementioned weight requirements. Any unsuitable, disturbed, or weaving areas should be removed. It is anticipated that extensive dewatering efforts of GLACIAL OUTWASH materials will be required prior to proofrolling.

The area of the proposed building will need to be stripped of all surface material, trees and grubbed of all stumps, vegetation, TOPSOIL, and root mat. Debris from grubbing and stripping activities should be removed and properly disposed of in accordance with current regulations. Should the material contain solid wastes, such material should be segregated and disposed of in a manner consistent with local, state, and federal regulations.

Should the subgrade become disturbed during excavation and/or construction, all disturbed material should be over-excavated to firm or native soil and replaced with a minimum of one foot of compacted “Granular Fill” or “Crushed Stone” wrapped in geotextile filter fabric.

Consideration should be made to extend construction access roads, consisting of crushed stone and geogrid, through heavily trafficked areas of the construction site to minimize rutting of the subgrade and improve site access during and after rain events.

Parking and Paved Roadway Surfaces: All TOPSOIL including the root mat should be stripped prior to filling. The subgrade should be proof rolled with a minimum of 4-6 passes of a vibratory roller with a static weight of 10,000 pounds and a dynamic weight of 20,000 pounds. Caution should be used when compacting the subgrade, if wet, to avoid weaving and disturbance from vibrations.

6.1.2 Rock Removal

Boulders/cobbles up to 24-inches in diameter were encountered during the subsurface investigation. Hammering to downsize large boulders may be required to facilitate removal.

Voids from removed boulders larger than 12 inches in diameter excavated below the building foundation should be graded away from the building footprint to reduce the likelihood of water pooling within “tub-like” forms.

The BEDROCK is at depths that are not anticipated impact shallow foundations. However, due to the limited subsurface investigation and variable existing site grade, areas of competent rock at high elevations may be encountered and require hammering or alternative techniques to remove.

6.2 Backfilling

6.2.1 Gravel Borrow

Pare recommends that footings, foundation walls, and areas requiring fill below the floor slab be backfilled to within 12 inches of proposed grade with compacted “Granular Fill” if “Sand Gravel Fill” is utilized, or within 6 inches of proposed grade if crushed stone is utilized. Compacted “Granular Fill” should be free draining friable soil free from trash, ice, snow, tree stumps, roots, other organic matter, deleterious materials, and conform to the specified requirements.

In general, compaction should be accomplished by placing fill in 8 to 12 inch loose horizontal lifts and mechanically compact each lift to the specified dry density. Thinner lifts may be required in certain instances depending on the type of mechanical compaction equipment utilized. Recommended minimum compaction requirements are described in Section 6.3.

6.2.2 Sand Gravel Fill / Crushed Stone

“Sand Gravel Fill” should be placed for the final 12 inches below footings, slabs and as pavement base course layers. This material should be placed in 8 to 12 inch loose horizontal lifts and mechanically compacted to the specified dry density. In areas where wet conditions are encountered, “Crushed Stone” (wrapped in Geotextile Fabric) could be used under footings instead of the “Sand Gravel Fill”. The “Crushed Stone” should be proof compacted with 1 pass in each direction with a vibratory compactor.

6.2.3 Excavation Backfill

When backfilling against excavated slopes or trench walls the Contractor should take care to bench the lift into the excavated slope wall. Compaction equipment should be operated in such a manner to achieve adequate bonding and compaction of the placed lift and existing excavation wall.

6.3 Utility Installation

Excavations for installation of underground utilities should be made to comply with all OSHA, federal, state, and local regulations. At a minimum, excavations should be wide enough to accommodate the utility to be installed with clearance on each side of the utility to provide space for operating compaction equipment for backfilling of the utility in lifts without damaging the utility. The base of the excavation and

bedding layer should be formed to properly support all components of the utility, including pipe bells, and manholes to prevent damage during installation. During backfilling operations, care should be taken to provide properly compacted fill along the length of the utility being installed. All fill material in excess of 3 inches (including cobbles and boulders within the native deposits) should be removed from the fill within 12 inches of the utility to prevent damage to the utility during compaction.

Utility installations should anticipate groundwater infiltration and/or pooling water during construction and after installation. These conditions should be accounted for in design and construction planning.

6.4 Dewatering

During construction, temporary dewatering is anticipated to be required to control ponded water resulting from rain and surface runoff and potential groundwater seepage into excavations. Based on measurements taken during the subsurface investigation, groundwater may be encountered within the proposed excavation depths. The Contractor should provide for proper drainage of surface water away from any excavations, and away from the existing building. All excavations should be conducted in the dry. The contractor should also consider the implications of groundwater drawdown in the excavations and provide mitigation measures as required.

Due to the observed groundwater conditions and high percentage of fine sand and silt sized particles in the soils present below the surface of the site, storm water infiltration rates are anticipated to be low within the GLACIAL OUTWASH soils. Construction activities may be impacted by flooding from storm events that occur if proper precautions are not performed to manage runoff. Additionally, areas of over excavation into the GLACIAL OUTWASH soils, due to boulders or unsuitable soils, should be graded away from the building foundation to limit the likelihood of water pooling in “tub-like” structures below the building footprint.

It should be noted that groundwater levels may fluctuate over time due to variations in rainfall and other factors different from those prevailing at the time the explorations were performed.

6.5 Lateral Support

Several excavations are expected within the footprint of the proposed structures for installation of permanent retaining structures, footings, utilities, and below-grade walls. Temporary support systems are not anticipated to be required at some locations to retain the surrounding soil and maintain a near-vertical excavation face where it will be necessary to protect the pavement or underground utilities. In areas where an open cut is possible without a temporary support system, the final side slopes should conform to local, state, and federal safety requirements.

6.6 Construction Monitoring

The site preparation, excavation and backfill, compaction, and foundation installation should be observed by our geotechnical field engineer(s) under the direction of one of our registered professional engineers experienced in geotechnical engineering. While onsite, our engineer(s) could provide field density testing, verification of bearing layers, and assistance in general interpretation of the geotechnical requirements during construction. This would provide an accurate record of construction, alert the designer to changed conditions, and make useful data available for upcoming construction.

Foundation excavations should be observed to confirm that all loose, soft, and undesirable material (i.e. organic matter, roots, and other deleterious materials) is removed and that the foundations will bear on a satisfactory material. Excavation subgrade observations should include hand auger borings or hand probing.

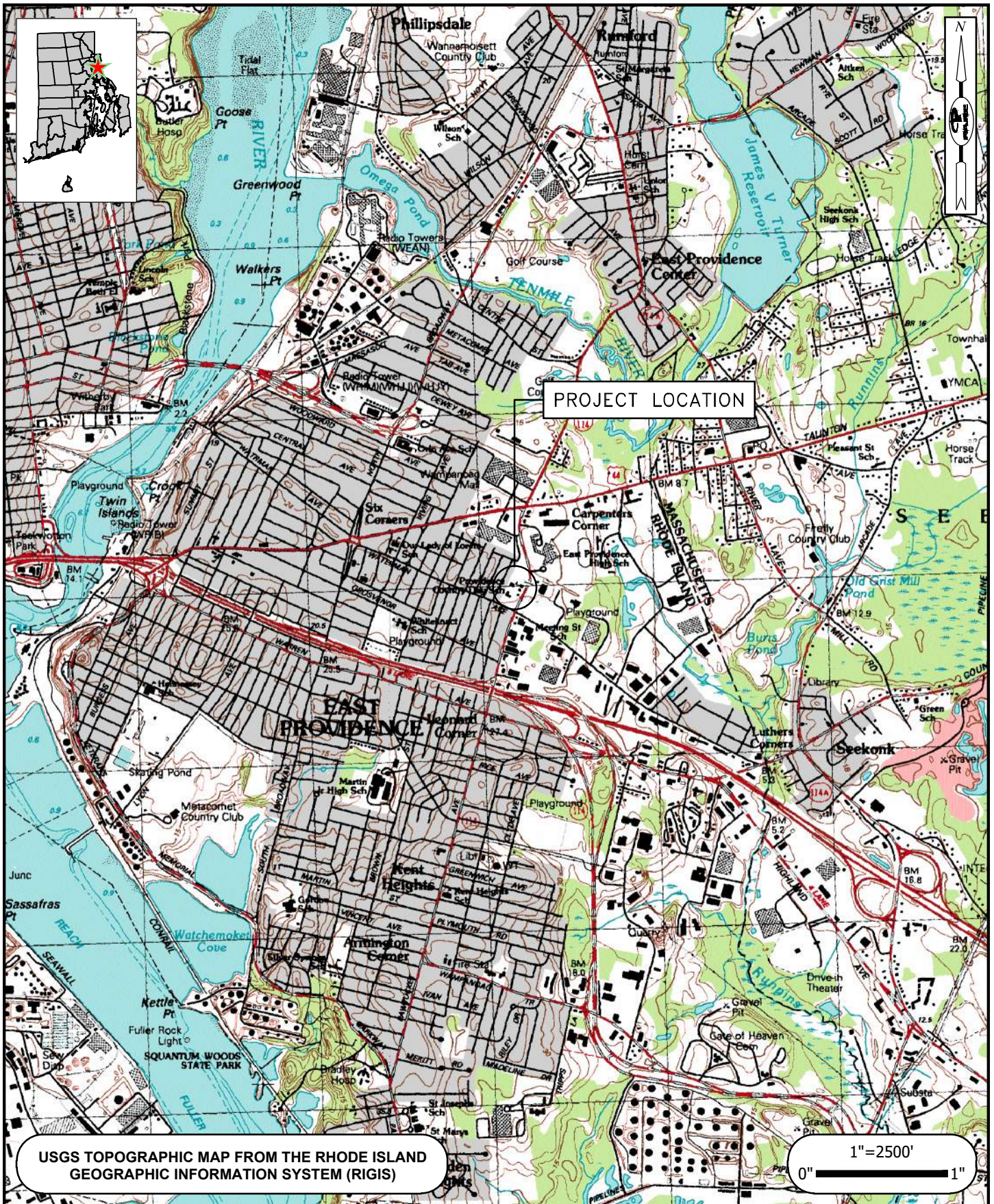
As mentioned, compaction criteria for the various imported materials should be developed and included in the specifications. Field density testing should be performed using a nuclear density gauge to confirm that adequate compaction is being achieved. During construction, representative samples of all materials to be used as backfill should also be tested for conformance with the specified material properties.

REFERENCES

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NEW COMMUNITY CENTER
East Providence, RI

FIGURES

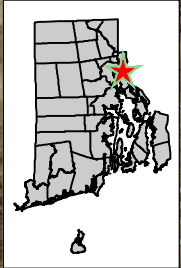


**EAST PROVIDENCE
COMMUNITY CENTER**
610 WATERMAN AVENUE
ASSESSOR'S MAP 406 / BLOCK 5 / PARCEL 1
EAST PROVIDENCE, RHODE ISLAND

LOCUS PLAN

AUGUST 2024

FIGURE 1



SCALE: 1"=500'

PROJECT LOCATION

USGS TOPOGRAPHIC MAP FROM THE RHODE ISLAND
GEOGRAPHIC INFORMATION SYSTEM (RIGIS)

1"=900'
0" 1"

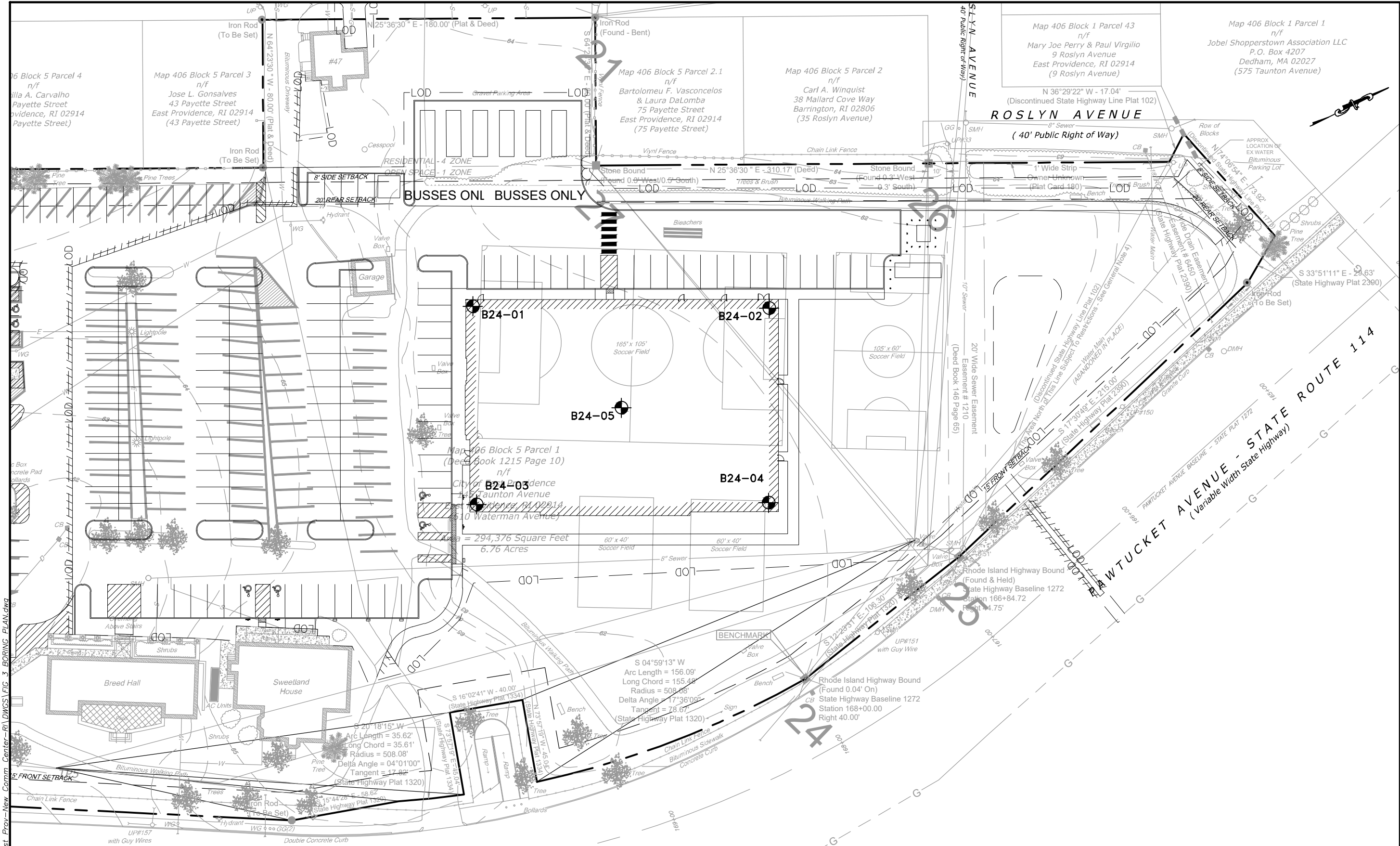


EAST PROVIDENCE
COMMUNITY CENTER
610 WATERMAN AVENUE
ASSESSOR'S MAP 406 / BLOCK 5 / PARCEL 1
EAST PROVIDENCE, RHODE ISLAND

AERIAL PLAN

AUGUST 2024

FIGURE 2



LEGEND

B24-01 BORINGS COMPLETED BY NEW ENGLAND BORING CONTRACTORS, INC. ON AUGUST 21-23, 2024. BORINGS WERE OBSERVED BY PARE CORPORATION PERSONNEL.

SUBSURFACE EXPLORATION PLAN

SCALE: 1"=50'±

PARE CORPORATION
ENGINEERS • SCIENTISTS • PLANNERS
10 BLACKSTONE VALLEY PLACE SUITE 210
LINCOLN, RI 02865 FARMINGTON, MA 02035
401-334-0090 508-533-1755
14 BOBAILA ROAD, SUITE 2B
HOUSTON, TX 77060 813-507-5466

SCALE ADJUSTMENT GUIDE

0" 1"

BAR IS ONE INCH ON ORIGINAL DRAWING.

**EAST PROVIDENCE
COMMUNITY CENTER**
610 WATERMAN AVENUE
ASSESSOR'S MAP 406 / BLOCK 5 / PARCEL 1
EAST PROVIDENCE, RHODE ISLAND

REVISIONS:	

PROJECT NO.: 24005.00
DATE: AUGUST 2024
SCALE: AS NOTED
DESIGNED BY: SM
CHECKED BY: BN
DRAWN BY: LMC
APPROVED BY: ARO

**SUBSURFACE
EXPLORATION
PLAN**

FIGURE NO.: 3

NEW COMMUNITY CENTER
East Providence, RI

APPENDIX A
BORING LOGS

CLIENT Starck Architects

PROJECT NAME East Providence Community Center

PROJECT NUMBER 24005.00

PROJECT LOCATION East Providence, RI

DATE STARTED 8/22/2024 **COMPLETED** 8/22/2024

GROUND ELEVATION 62.5 ft **NAVD88** **HOLE SIZE** 4 in.

DRILLING CONTRACTOR New England Boring Contractors, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Wash & Drive

▽ AT TIME OF DRILLING 4.0 ft / Elev 58.5 ft (Driller Introduced)

LOGGED BY SM **CHECKED BY** BCN

▼ **AT END OF DRILLING** 7.5 ft / Elev 55.0 ft

BORING LOCATION SEE BORING PLAN

N: 267796.79 **E:** 367104.08

DEPTH (ft)	ELEVATION (ft)	CASING (bl/ft)	SAMPLE TYPE NUMBER	RECOVERY/PEN. (in/in)	DEPTH (ft)	BLOW COUNTS/6"	MIN/FT	GRAPHIC LOG	SAMPLE DESCRIPTION	STRATUM DESCRIPTION
0	62.5									
			S-1	12 / 24	0 - 2	2-2-12-22 (14)			1A: (Top 7") Moist, loose, dark brown, fine to medium SAND, some Silt, trace Roots/Organics. 1B: (Bottom 17") Moist, medium dense, brown, fine to medium SAND, some fine to medium Gravel, little Silt.	7" TOPSOIL
			S-2	18 / 24	2 - 4	27-20-18-19 (38)			2A: (Top 12") Moist, dense, brown, fine to medium GRAVEL and fine to coarse SAND, little Silt.	FILL
5	57.5		S-3	14 / 24	4 - 6	15-27-34-30 (61)			2B: (Bottom 12") Moist, medium dense, brown, fine to coarse SAND, little Silt.	
			S-4	19 / 24	6 - 8	33-23-29-25 (52)			Moist to wet, very dense, brown to dark brown, fine to coarse SAND, some fine to medium Gravel, some Silt, trace Organics.	
			S-5	11 / 24	8 - 10	5-3-3-2 (6)			4A: (Top 12") Moist to wet, very dense, brown to gray, fine to medium GRAVEL and fine to coarse SAND, little Silt.	GLACIAL OUTWASH
10	52.5							4B: (Bottom 12") Moist, very dense, brown, fine to coarse SAND, trace Silt. Wet, loose, brown, fine SAND, little Silt.		
15	47.5		S-6	10 / 24	14 - 16	17-33-26-15 (59)		Moist to wet, very dense, brown to dark gray, fine to medium GRAVEL and fine to medium SAND, some Silt.		
20	42.5		S-7	7 / 24	19 - 21	6-8-4-7 (12)			Wet, medium dense, gray, fine to medium SAND, some Silt, trace medium Gravel.	GLACIAL OUTWASH
25	37.5		S-8	7 / 24	24 - 26	16-16-19-22 (35)		Wet, dense, gray, fine to medium GRAVEL, some fine to coarse Sand, little Silt.		
30	32.5		S-9	17 / 22	29 - 31	74-58-53-50/4"			Moist to wet, very dense, gray, fine to coarse SAND, some fine to medium Gravel, little Silt.	GLACIAL OUTWASH
									Bottom of borehole at 31.0 feet.	

<u>GRANULAR SOILS</u>		<u>COHESIVE SOILS</u>		<u>REMARKS:</u> 1. Water introduced by driller at 4 feet (casing installed). 2. Ground water monitoring well installed 25-feet below ground surface with 15-feet of screen.	<u>BURMISTER CLASSIFICATION</u>	
<u>BLOWS/FT</u>	<u>DENSITY</u>	<u>BLOWS/FT</u>	<u>CONSIST.</u>			
0 - 4	V. LOOSE	<2	V. SOFT		TRACE	0 - 10%
4 - 10	LOOSE	2 - 4	SOFT		LITTLE	10 - 20%
10 - 30	M. DENSE	4 - 8	M. STIFF		SOME	20 - 35%
30 - 50	DENSE	8 - 15	STIFF		AND	35 - 50%
>50	V. DENSE	15 - 30	V. STIFF		PERCENT BY WEIGHT	
		>30	HARD			

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

2024-09-11 13:24:00 US LAB GDT - Z:\JOBS\24 JOBS\24005.00 EAST PROV-NEW COMM CENTER-R\GEO\DATA\BORING LOGS\24005.00 BORING LOGS.GPJ



Pare Corporation
10 Lincoln Road, Suite 210
Foxboro, MA 02035
508-543-1755

BORING NUMBER B24-2

PAGE 1 OF 1

CLIENT	Starck Architects	PROJECT NAME	East Providence Community Center
PROJECT NUMBER	24005.00	PROJECT LOCATION	East Providence, RI
DATE STARTED	8/22/2024	COMPLETED	8/22/2024
DRILLING CONTRACTOR	New England Boring Contractors, Inc.	GROUND ELEVATION	61.7 ft NAVD88
DRILLING METHOD	Wash & Drive	HOLE SIZE	4 in.
LOGGED BY	SM	CHECKED BY	BCN
BORING LOCATION	SEE BORING PLAN	N:	267932.09
		E:	367169.28

GROUND WATER LEVELS:	
▽ AT TIME OF DRILLING	4.0 ft / Elev 57.7 ft (Driller Introduced)
▼ AT END OF DRILLING	10.0 ft / Elev 51.7 ft

PARE BORING LOG - GINT STD US LAB GDT - 9/11/24 13:24 - Z:\JOBS\24 JOBS\24005.00 EAST PROV-NEW COMM CENTER-RIGTECHDATA\BORING LOGS\24005.00 BORING LOGS.GPJ

DEPTH (ft)	ELEVATION (ft)	CASING (bl/ft)	SAMPLE TYPE NUMBER	RECOVERY/PEN. (in/in)	DEPTH (ft)	BLOW COUNTS/6"	MIN/FT	GRAPHIC LOG	SAMPLE DESCRIPTION	STRATUM DESCRIPTION
0	61.7									
			S-1	11 / 24	0 - 2	1-2-3-2 (5)			1A: (Top 10") Moist, loose, dark brown, fine to medium SAND, little Silt, trace Roots/Organics.	10" TOPSOIL
			S-2	14 / 24	2 - 4	5-7-14-16 (21)			1B: (Bottom 14") Moist, loose, brown to reddish brown, fine to coarse SAND, little fine to coarse Gravel, little Silt.	
5	56.7		S-3	11 / 24	4 - 6	14-26-37-30 (63)			Moist, medium dense, brown to reddish brown, fine to coarse SAND, some fine to coarse Gravel, little Silt, Iron staining.	FILL
			S-4	11 / 24	6 - 8	21-32-27-30 (59)			Moist, very dense, brown to reddish brown, fine to coarse SAND and fine to medium GRAVEL, little Silt, Iron staining.	
10	51.7		S-5	10 / 24	8 - 10	19-25-24-18 (49)			Moist to wet, dense, brown to reddish brown, fine to coarse GRAVEL and fine to coarse SAND, little Silt.	
										GLACIAL OUTWASH
15	46.7		S-6	12 / 24	14 - 16	2-4-7-17 (11)			Wet, stiff, gray SILT, little fine to coarse Sand.	
										BOULDERS
20	41.7		S-7	9 / 24	19 - 21	9-5-11-51 (16)			Wet, medium dense, gray, fine to coarse SAND, some Silt, little fine to coarse Gravel.	GLACIAL OUTWASH
										BOULDERS
25	36.7		S-8	8 / 24	24 - 26	14-15-14-9 (29)			Wet, medium dense, gray, fine to coarse GRAVEL and fine to coarse SAND, little Silt.	GLACIAL OUTWASH
30			S-9	5 / 5	29 - 29.5	52/5"			Wet, very dense, gray, fine to coarse GRAVEL, some fine to coarse Sand little Silt.	
									Bottom of borehole at 29.5 feet.	
35										

GRANULAR SOILS		COHESIVE SOILS		REMARKS:	BURMISTER CLASSIFICATION
BLOWS/FT	DENSITY	BLOWS/FT	CONSIST.		
0 - 4	V. LOOSE	<2	V. SOFT		
4 - 10	LOOSE	2 - 4	SOFT		
10 - 30	M. DENSE	4 - 8	M. STIFF		
30 - 50	DENSE	8 - 15	STIFF		
>50	V. DENSE	15 - 30	V. STIFF		
		>30	HARD		

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.



Pare Corporation
10 Lincoln Road, Suite 210
Foxboro, MA 02035
508-543-1755

BORING NUMBER B24-3

PAGE 1 OF 1

CLIENT	Starck Architects	PROJECT NAME	East Providence Community Center
PROJECT NUMBER	24005.00	PROJECT LOCATION	East Providence, RI
DATE STARTED	8/22/2024	COMPLETED	8/23/2024
DRILLING CONTRACTOR	New England Boring Contractors, Inc.	GROUND ELEVATION	62.8 ft NAVD88
DRILLING METHOD	Wash & Drive	HOLE SIZE	4 in.
LOGGED BY	SM	CHECKED BY	BCN
BORING LOCATION	SEE BORING PLAN	N:	267753.01
		E:	367193.02

GROUND WATER LEVELS:

▽ AT TIME OF DRILLING 4.0 ft / Elev 58.8 ft (Driller Introduced)

▼ AT END OF DRILLING 10.5 ft / Elev 52.3 ft

PARE BORING LOG - GINT STD US LAB GDT - 9/11/24 13:24 - Z:\JOBS\24 JOBS\24005.00 EAST PROV-NEW COMM CENTER-RIGEOTECH\DATA\BORING LOGS\24005.00 BORING LOGS.GPJ

DEPTH (ft)	ELEVATION (ft)	CASING (bl/ft)	SAMPLE TYPE NUMBER	RECOVERY/PEN. (in/in)	DEPTH (ft)	BLOW COUNTS/6"	MIN/FT	GRAPHIC LOG	SAMPLE DESCRIPTION	STRATUM DESCRIPTION
0	62.8									
			S-1	15 / 24	0 - 2	1-4-7-11 (11)			1A: (Top 9") Moist, loose, dark brown, fine to medium SAND, some Silt, trace Roots/Organics.	9" TOPSOIL
			S-2	16 / 24	2 - 4	16-18-23-24 (41)			1B: (Bottom 15") Moist, medium dense, brown, fine to coarse SAND, little Silt.	
5	57.8		S-3	10 / 24	4 - 6	18-20-28-38 (48)			Moist, dense, brown to gray, fine to coarse SAND, some fine to medium Gravel, little Silt.	FILL
			S-4	5 / 24	6 - 8	11-21-17-17 (38)			Moist, dense, brown to gray, fine to coarse GRAVEL, some fine to coarse Sand, little Silt.	
			S-5	13 / 24	8 - 10	7-5-4-7 (9)			Moist to wet, dense, brown to gray, fine to coarse GRAVEL, some fine to coarse Sand, trace Silt.	
10	52.8								Wet, loose, brown, fine to medium SAND, little Silt.	
15	47.8		S-6	18 / 24	14 - 16	2-2-1-2 (3)			Wet, soft, gray SILT, little fine Sand.	
			S-7	18 / 24	16 - 18	3-4-5-11 (9)			Wet, stiff, gray SILT, some fine Sand.	
20	42.8		S-8	6 / 24	19 - 21	12-5-7-11 (12)			8A: (Top 18") Wet, stiff, gray SILT and fine SAND.	GLACIAL OUTWASH
									8B: (Bottom 6") Wet, medium dense, gray GRAVEL and SILT, little fine Sand.	
25	37.8		S-9	6 / 24	24 - 26	18-28-13-8 (41)			Moist to wet, dense, gray, fine to coarse SAND, some fine to medium Gravel, little Silt.	
30	32.8		S-10	12 / 24	29 - 31	33-17-20-40 (37)			Wet, dense, gray, fine to coarse GRAVEL, some fine to coarse Sand, little Silt.	
35									Bottom of borehole at 31.0 feet.	

GRANULAR SOILS		COHESIVE SOILS		REMARKS: 1. Water introduced by driller at 4 feet (casing installed).	BURMISTER CLASSIFICATION
BLOWS/FT	DENSITY	BLOWS/FT	CONSIST.		
0 - 4	V. LOOSE	<2	V. SOFT		
4 - 10	LOOSE	2 - 4	SOFT		
10 - 30	M. DENSE	4 - 8	M. STIFF		
30 - 50	DENSE	8 - 15	STIFF		
>50	V. DENSE	15 - 30	V. STIFF		
		>30	HARD		

PERCENT BY WEIGHT

TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

CLIENT Starck Architects

PROJECT NAME East Providence Community Center

PROJECT NUMBER 24005.00

PROJECT LOCATION East Providence, RI

DATE STARTED 8/23/2024 **COMPLETED** 8/23/2024

GROUND ELEVATION 62.2 ft **NAVD88** **HOLE SIZE** 4 in.

DRILLING CONTRACTOR New England Boring Contractors, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Wash & Drive

▽ AT TIME OF DRILLING 4.0 ft / Elev 58.2 ft (Driller Introduced)

LOGGED BY SM **CHECKED BY** BCN

▼ **AT END OF DRILLING** 12.2 ft / Elev 50.0 ft

BORING LOCATION SEE BORING PLAN

N: 267887.42 **E:** 367260.12

[illegible]

<u>GRANULAR SOILS</u>		<u>COHESIVE SOILS</u>		<u>REMARKS:</u> 1. Water introduced by driller at 4 feet (casing installed).	<u>BURMISTER CLASSIFICATION</u>	
<u>BLOWS/FT</u>	<u>DENSITY</u>	<u>BLOWS/FT</u>	<u>CONSIST.</u>			
0 - 4	V. LOOSE	<2	V. SOFT		TRACE	0 -10%
4 - 10	LOOSE	2 - 4	SOFT		LITTLE	10 - 20%
10 - 30	M. DENSE	4 - 8	M. STIFF		SOME	20 - 35%
30 - 50	DENSE	8 - 15	STIFF		AND	35 - 50%
>50	V. DENSE	15 - 30	V. STIFF		PERCENT BY WEIGHT	
		>30	HARD			

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

2024-09-11 13:24:00 US LAB GDT - Z:\JOBS\24 JOBS\24005.00 EAST PROV-NEW COMM CENTER-R\GEO\DATA\BORING LOGS\24005.00 BORING LOGS.GPJ

CLIENT Starck Architects **PROJECT NAME** East Providence Community Center

PROJECT NUMBER 24005.00 **PROJECT LOCATION** East Providence, RI

DATE STARTED 8/28/2024 **COMPLETED** **GROUND ELEVATION** 62.3 ft **NAVD88** **HOLE SIZE** 4 in.

DRILLING CONTRACTOR New England Boring Contractors, Inc. **GROUND WATER LEVELS:**

DRILLING METHOD Wash & Drive **AT TIME OF DRILLING** 4.0 ft / Elev 58.3 ft Wash & Drive

LOGGED BY SM **CHECKED BY** BCN **AT END OF DRILLING** 12.9 ft / Elev 49.4 ft

BORING LOCATION SEE BORING PLAN **N:** 267842.1 **E:** 367183.6

PARE BORING LOG - GINT STD US LAB GDT - 9/11/24 13:24 - Z:\JOBS\24 JOBS\24005.00 EAST PROV-NEW COMM CENTER-RIGTECH\DATA\BORING LOGS\24005.00 BORING LOGS.GPJ

DEPTH (ft)	ELEVATION (ft)	CASING (bl/ft)	SAMPLE TYPE NUMBER	RECOVERY/PEN. (in/in)	DEPTH (ft)	BLOW COUNTS/6"	MIN/FT	GRAPHIC LOG	SAMPLE DESCRIPTION	STRATUM DESCRIPTION
0	62.3									
			S-1	14 / 24	0 - 2	1-3-4-6 (7)			1A: (Top 8") Moist, loose, dark brown, fine to medium SAND, some Silt, trace Roots/Organics.	8" TOPSOIL
			S-2	12 / 24	2 - 4	8-9-23-26 (32)			1B: (Bottom 16") Moist, loose, brown, fine to coarse SAND, little Silt, trace fine Gravel.	FILL
5	57.3		S-3	10 / 24	4 - 6	29-19-16-15 (35)			2A: (Top 12") Moist, dense, brown, fine to coarse SAND, little Silt, trace fine Gravel.	POSSIBLE BOULDER
			S-4	11 / 24	6 - 8	20-13-14-15 (27)			2B: (Bottom 12") Dry to moist, dense, gray, fine to coarse GRAVEL, trace fine to coarse Sand, trace Silt, possible Boulder.	FILL
			S-5	13 / 24	8 - 10	8-11-12-12 (23)			Moist, dense, brown, fine to coarse SAND, little Silt, little fine Gravel.	
10	52.3								4A: (Top 12") Moist, dense, brown, fine to coarse SAND, trace Silt.	
									4B: (Bottom 12") Moist, medium dense, light brown to gray, fine to medium SAND and SILT, trace fine Gravel, Iron staining.	
									Wet, medium dense, brown, fine to medium SAND, little Silt.	
										GLACIAL OUTWASH
15	47.3		S-6	18 / 24	14 - 16	1-2-4-6 (6)			Wet, loose, light brown to gray SILT, little fine to medium Sand, trace fine Gravel, Iron staining.	
20	42.3		S-7	0 / 24	18.5 - 20.5	34-7-9-8 (16)			No Recovery	BOULDER
25	37.3		S-8	6 / 24	24 - 26	11-11-20-14 (31)			Wet, dense, gray, fine to coarse GRAVEL, some fine to coarse Sand, trace Silt.	GLACIAL OUTWASH
30	32.3		S-9	15 / 24	29 - 31	42-38-61-64 (99)			Wet, very dense, gray, fine to coarse SAND and fine to coarse GRAVEL, trace Silt.	
35	27.3						7 4		Good, weak, dark gray SHALE (RI Formation), fresh. REC: 54/60 = 90% RQD: 50/60 = 83.3%	BEDROCK (RI FORMATION)

GRANULAR SOILS	
BLOWS/FT	DENSITY
0 - 4	V. LOOSE
4 - 10	LOOSE
10 - 30	M. DENSE
30 - 50	DENSE
>50	V. DENSE

COHESIVE SOILS	
BLOWS/FT	CONSIST.
<2	V. SOFT
2 - 4	SOFT
4 - 8	M. STIFF
8 - 15	STIFF
15 - 30	V. STIFF
>30	HARD

REMARKS:
1. Water introduced by driller at 4 feet (casing installed).
2. S-4A: 1 inch seam of weathered rock (organics) at 6 feet.
3. 18 feet hit boulder, confirmed with cuttings.

BURMISTER CLASSIFICATION	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%
PERCENT BY WEIGHT	

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

(Continued Next Page)



Pare Corporation
10 Lincoln Road, Suite 210
Foxboro, MA 02035
508-543-1755

BORING NUMBER B24-5

PAGE 2 OF 2

CLIENT Starck Architects

PROJECT NAME East Providence Community Center

PROJECT NUMBER 24005.00

PROJECT LOCATION East Providence, RI

DEPTH (ft)	ELEVATION (ft)	CASING (bl/ft)	SAMPLE TYPE NUMBER	RECOVERY/PEN. (in/in)	DEPTH (ft)	BLOW COUNTS/6"	MIN/FT	GRAPHIC LOG	SAMPLE DESCRIPTION	STRATUM DESCRIPTION
35	27.3		C-1	54 / 60	33 - 38		5.5		Good, weak, dark gray SHALE (RI Formation), fresh.	
							5.5		REC: 54/60 = 90%	
							4.5		RQD: 50/60 = 83.3% (continued)	BEDROCK (RI FORMATION)

Bottom of borehole at 38.0 feet.

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NEW COMMUNITY CENTER
East Providence, RI

APPENDIX B
GEOTECHNICAL LIMITATIONS



GEOTECHNICAL LIMITATIONS

Explorations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, Pare Corporation (Pare) should be asked to reevaluate the recommendations of this report.
2. The generalized soil profile described in the text is intended to convey trends in the subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.
3. Water level readings have been made in the drill holes at the times and under the conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, and other factors occurring since the time the measurements were made.

Review

1. In the event that any changes in the nature or location of the proposed structure are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified in writing by Pare. Pare should also be provided with the opportunity for a general review of the final design and specifications in order that the earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Construction

1. Pare should be retained to provide soil engineering services during construction of the excavation and foundation phases of work in order to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those indicated prior to the start of construction.

Use of Report

1. This report has been prepared for the exclusive use of Starck Architects for specific application to the proposed New Community Center in East Providence, Rhode Island in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made.
2. This engineering report has been prepared for this project by Pare. This report is for design purposes only and is not necessarily sufficient to prepare an accurate bid. Contractors wishing a copy of this report may secure it with the understanding that its scope is limited to design considerations only.

SECTION 01016
COORDINATION AND
PROJECT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. All of the Contract Documents, including AIA 201, and other Division 1 - General Requirements, apply to the work of this section.
- B. This section contains general information that applies to all work performed under the Contract and is inherently made a part of each specification section.

1.02 PROJECTION COORDINATION AND COORDINATION DRAWINGS

- A. **Coordination:** Be fully responsible for coordinating all trades, coordinating construction sequences and schedules, and coordinating the actual installed location and interface of all work. Coordinate the locations and routing of pipe, ductwork, conduit, and other systems, utilities, services, equipment, and work with respect to structural members, architectural finishes, headroom conditions, door swings, door and window openings, chases and other features of the project. The Contractor selected to complete work specified herein shall also be responsible for coordinating the work of other trades. All work or portions thereof shall be completed simultaneously.
- B. **Sequence and Scheduling of Work:** Plan ahead and anticipate later work. Schedule, deliver, and install items of work in the optimum sequence to ensure the complete and correct interface of all work, to avoid cutting and patching, and to avoid damage to finished work. Ensure that all blocking, anchors, sleeves, inserts, clips, brackets, braces, hangers, bolts, supports, conduits, pipes and other items are correctly located prior to completing, enclosing, or concealing work.
- C. **Coordinate Modifications to the Work:** Fully and completely coordinate all modifications to the work including, without limitation:
 - 1. Changes which affect Contract Price
 - 2. Changes which do not affect Contract Price
 - 3. Substitutions
 - 4. Contractor's selection when given optional choices
 - 5. Other modifications and changes.

Coordinate and provide all other work required to implement the modification at no additional cost to Owner.

- D. **Coordination Drawings:** Before materials are fabricated or the work begun, the Contractor shall supervise and direct the creation of one complete set of Coordination Drawings showing the complete three-dimensional coordination and integration of all work of this project including, but not limited to, structural, civil, architectural, mechanical, plumbing, electrical sprinkler, and telecommunication disciplines.
 - 1. **Intent:** Coordination Drawings are intended to assist the Contractor during construction, to avoid and prevent conflicts, and to verify that adequate equipment movement paths are available for both installation and future equipment repair or replacement. Do not

use Coordination Drawings for "shop drawings", "record drawings", or any other required submittal.

2. Base Sheets: The Contractor shall prepare and provide one accurately drawn to scale set of building coordination drawing "base sheets" on reproducible transparencies showing all architectural and structural work including, without limitation, miscellaneous metal framing and supports located in ceiling spaces, room layouts, special graphic highlighting of all fire-rated and smoke partitions and assemblies and ceiling layout.
 - a) Scale: Provide minimum 1/8-inch scale base sheets, except provide minimum 1/4-inch scale at congested areas, shafts and sections.
3. Contractor Review and Submission: The Contractor shall carefully review, modify, and approve the Coordination Drawings in cooperation with the subcontractors to assure that conflicts, if any, are resolved before work in the field is begun and to ensure that the location of work exposed to view is as indicated or as approved by Architect. The Contractor shall stamp, sign and submit the coordination drawing originals to the Architect for review, in compliance with the specified procedures and policies for "Submittals".
4. Architect Notification and Permission Required: If at any time during the coordination process, the Contractor cannot resolve a conflict without changing ceiling heights, wall locations, or other indicated relationships and dimensions, the Contractor shall immediately notify the Architect and request instructions. The Contractor shall not move or adjust any dimension, location, or relationship indicated in the Contract Documents without first having received the Architect's written permission.
5. Contractor's Responsibilities: As part of the Contractor's responsibility to coordinate and conduct the work, the Contractor shall be solely responsible for commencing, diligently pursuing, and completing the coordination process. The Contractor shall provide on-going coordination services throughout the project and shall resolve conflicts. The Contractor shall be solely responsible for delays and defects in the work resulting from improper coordination. The Architect's review of coordination drawings shall not relieve the Contractor from his responsibility for coordination of all work performed under the Contract.

1.03 PROJECT PROCEDURES

- A. Layout of Work: Establish and be responsible for all lines, elevations, and measurements of the work executed under the Contract. Establish the actual lines needed to accurately layout and construct the work for all trades.
 1. Layout Personnel: Employ an experienced, competent person to layout the work.
 2. Temporary Working Points: Provide and maintain stakes, lines, benchmarks, batterboards, and other temporary working points, lines and levels. Construct temporary working points to be "permanent" during construction. Remove working points when they are no longer needed after obtaining Architect's approval of removal prior to removal.
 3. Deviations: Do not deviate from indicated lines and grades without the Architect's written prior approval.

- B. Field Measurements and Discrepancies Between Field Conditions and Contract Documents: Before ordering materials and fabricated components, and before beginning work, verify actual field dimensions and locations. Take field measurements and ensure the complete and proper interface of all work.
1. Notification Required: If there are any discrepancies between the Contract Documents and the actual field conditions, notify the Architect immediately in writing describing the discrepancy. Do not proceed until the discrepancy is resolved to the satisfaction of the Architect.
 - a) The time required to verify and clarify discrepancies shall not be a valid basis for any claims by the Contractor.
 2. Adjustment: If approved by the Architect, adjust work to actual field dimensions and conditions, and adjust work to ensure the complete and proper interface of all work at no change in Contract Amount.
 3. Cost of Adjustment: The Contractor shall be responsible for all costs associated with adjusting and correcting ill-fitting work. The Contractor may apportion the cost amount to its subcontractors as determined by the Contractor and its subcontractors, except for Field Sub-Bid Subcontractors who shall be solely responsible for all costs associated with adjusting and correcting work which fits improperly or incorrectly due to the Filed Sub-Bid Subcontractor's work or failure to coordinate or failure to take field measurements.
- C. Review and Inspection by Contractor: The Contractor shall frequently review and inspect work to ensure compliance with Contract Document requirements and to verify construction tolerances.
1. Certification Required: At major milestones such as completion of primary structure, completion of secondary structure, completion of interior framing and other logical milestones, the Contractor shall thoroughly check and verify the work completed and installed to date of the certification complies with the Contract Document requirements, is correct and within specified tolerances including, without limitation, tolerances, plumb, level and alignment.
 2. Construction Tolerances: At any time during the work, if construction tolerances are determined to be in excess of limits and tolerances specified in the Contract Documents, the Contractor shall correct the work or cause the work to be corrected to comply with the specified requirements. Improper or non-conforming previous work or substrates is not an acceptable reason for deviating from the Contract Requirements or exceeding specified tolerances.
- D. Installer's Acceptance of Conditions: All installers shall inspect previous work, substrates, related work, and conditions under which work is to be executed and shall report in writing to the Contractor, all deficiencies, and conditions detrimental to the proper execution and completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means the installer accepts previous work, substrates, related work and conditions.
- E. Observation: Notify the Architect at least 72 hours in advance of concealing any work. Comply with requirements of authorities having jurisdiction for notice before concealing work.
- F. Work Hours: Working hours shall be Monday through Friday, 7:00am until 3:30pm. No work outside of these days and hours shall be permitted without prior written approval from the OPM, Architect and Owner.

- G. Traffic Control and Parking: Limit site traffic to one access and egress point approved by the Owner, Architect and authorities having jurisdiction to the greatest extent possible. Control traffic and provide flag persons to minimize damage to surrounding areas and danger to the public. Contractor's use of site areas outside the work limits is subject to the Owner's approval at all times.
1. Parking: Control parking on the site and cooperate with the Owner and local authorities. Do not obstruct streets, public ways, driveways and sidewalks. Comply with local ordinances and requirements of authorities having jurisdiction.
 2. Vehicle Security: Lock all unattended vehicles including construction machinery and equipment. Never leave vehicles or equipment unattended with the motor running or keys easily accessible.
 3. Emergency Vehicles: Do not obstruct emergency vehicles at any time. Maintain clear access to fire hydrants and other locations as directed by authorities having jurisdiction.
 4. Other Requirements: Comply with other applicable requirements herein, whichever is most stringent.
- H. Superintendent: Employ an experienced full-time Project Superintendent to provide supervision and management on site whenever work is in progress, except for reasonable absences such as personal vacations and illness.
1. Owner's Approval Required: Employ a Project Superintendent approved by the Owner. Do not reassign or replace the Project Superintendent during the entire duration of the Project without the Owner's written consent. Reassigning or replacing the project Superintendent during the duration of the Project without the owner's written consent shall be a breach of the Contract.
 2. Reassignment and Replacement: If requested by the Owner and at no increase in Contract Amount, the Contractor shall reassign the Project Superintendent to another project and shall provide a replacement Project Superintendent to whom the Owner has no objection.
 3. Project Superintendent's Limitations: The Project Superintendent shall not have dual responsibilities and shall not work with tools. The Project Superintendent's sole job shall be on site supervision and management, and not direct construction.
 4. Other Requirements: Comply with other applicable requirements herein, whichever is most stringent.
- I. Project Manager: Employ an experienced Project Manager to provide supervision and management from the Contractor's base office.
1. Owner's Approval Required: Employ a Project Manager approved by the Owner. Do not reassign or replace the project Manager during the entire duration of the Project without the Owner's written consent. Reassigning or replacing the project manager during the duration of the project without the Owner's written consent shall be a breach of the Contract.
 2. Reassignment and Replacement: If requested by the Owner and at no increase in Contract Amount, the Contractor shall reassign the project Manager to another project and shall provide a replacement Project Manager to whom the Owner has no objection.

3. Other Requirements: Comply with other applicable requirements herein, whichever is most stringent.
- J. Testing and Inspections: The General Contractor shall be fully and solely responsible for arranging, scheduling, and coordinating all testing and inspections made by authorities having jurisdiction and independent testing agencies, including testing agencies employed or paid by the Owner. Coordinate Owner paid testing with the on-site Owner's representative.
1. Notification: Notify testing agencies, Architect and Owner's representative at least 48 hours prior to testing.
 2. Contractor's Work: Provide safe access to the work. Provide incidental labor required to obtain samples and make tests. Provide water and power as needed to support sampling and testing.
 3. Satisfactory Tests Do Not Mean Acceptance: Successful testing does not in itself mean the work is acceptable since all criteria for acceptance may not have been tested. Work which has been tested successfully may be rejected if non-conforming with all Contract Requirements.
 4. Other Requirements: Comply with other applicable requirements herein, whichever is most stringent.
- K. In-Place Samples: Individual specification sections may require "In-Place Samples". In-Place Samples are samples of actual completed work which accurately represent the remaining work to be completed. The intent of In-Place Samples is to permit the Owner and Architect to evaluate samples of the completed work and to resolve problems, if any, before the Contractor proceeds with the work.
1. Lighting: Provide final lighting or accurate simulation of final lighting for Owner's and Architect's review of In-Place Samples. The Owner and Architect will review In-Place Samples only under final lighting conditions.
 2. Evaluation Limitations: In-Place Sample evaluations by the Owner and Architect are for visual appearance characteristics only. Approval of an In-Place Sample does not mean approval of the material, construction, thickness, gauge, surface preparation, installation method, or any other Contract requirement.
 3. Rejected In-Place Samples: The Owner or Architect may reject In-Place Samples for any reason including subjective decisions about color and visual appearance. The Owner and Architect may reject In-Place Samples even if smaller "selection samples" or "verification samples" have been previously approved. The Contractor shall remove and replace rejected In-Place Samples at no additional cost to the Owner. There is no limit on the number of rejections and replacement of In-Place Samples required.
 4. Scheduling of In-Place Samples: The Contractor shall provide In-Place Samples for the Owner's and Architect's evaluation at the earliest possible time.
 5. Material Ordering: Since evaluation of In-Place Samples may result in rejection for subjective visual reasons, the Contractor shall purchase materials only after In-Place Samples have been approved by the Owner and Architect. The Contractor shall assume sole risk for premature material orders and purchases.
- L. Advertisement: No mention of the Owner's name or this Project shall be made in any advertising or articles in any publication relating to the project, without the approval of the copy and written permission of the Owner. Whenever the project is permitted to be published

or advertised, the Architect's name shall be clearly stated, only when authorized by the Architect, in writing.

M. Reports: Comply with requirements specified in Section 01300 - Submittals.

1.04 PROJECT ENVIRONMENTAL CONTROLS

A. Regular Clean-Up: Daily clean-up all waste, remove from site regularly, and legally dispose off-site. Keep premises clean, neat, orderly, and safe with proper working conditions at all times. Frequency of waste removal shall be as approved by the Owner and authorities having jurisdiction.

1. Adjacent Areas: Keep adjacent areas, neighboring properties, streets, public ways, and all areas clean, safe, and free of construction debris and dirt including wind-blown debris. Comply with local ordinances and requirements of authorities having jurisdiction.

2. Trucking: Do not overload trucks and dumpsters. Cover open trucks and dumpsters to control wind-blown dust and debris.

3. Dust Control: Effectively control dust.

a) Effectively prevent dust from entering the ventilation system. Effectively cover, seal and protect ventilation supply and return air ducts, diffusers, grilles, louvers, and vents.

b) Wet travel areas, debris stockpiles, and other work to control windblown dust. Do not create ice hazards in cold weather.

c) Cover stockpiles with weighted, dustproof tarpaulins.

4. Intentional Burning on Site: NOT PERMITTED

5. Subcontracting Information: For Non-Filed Sub-Bid Subcontractors, the responsibility for cleaning shall be as agreed between Contractor and Subcontractor. Filed Sub-Bid Subcontractors shall each clean-up and remove their own rubbish and debris such as shipping cartons and waste materials due to their work. Filed Sub-Bid Subcontractors shall not provide general cleaning such as sweeping nor dumpsters nor dumpster service, which shall all be provided by the General Contractor.

B. Hazardous Materials: Hazardous materials may not be brought to the site unless approved in advance and in writing by the Owner. Do not bring materials to the site which are objectionable to the Owner.

1. Definition: "Hazardous materials" is any substance regulated under OSHA Hazard Communication Standard, 29 CFR 1910.1200.

2. Labeling: Only materials with original factory labels may be brought to the site.

3. MSD Sheets: Provide Material Safety Data Sheets for each material and product used at the site.

4. Storage and Handling: Store and handle hazardous materials to prevent objectionable odors, to prevent fire and explosion, and to control exposure of workers, the public and the environment.

C. Pollution Control: Strictly comply with all pollution control requirements of authorities having jurisdiction.

1. Liquid Waste: Do not dispose of liquid waste into storm sewers, sanitary sewers, or into the ground.
 2. Flammable and Volatile Waste: Store and dispose of volatile waste in metal containers which have been approved by authorities having jurisdiction.
 3. Atmospheric Pollution: Do not release harmful or annoying fumes, odors, or pollutants into the atmosphere. Do not create a nuisance.
 4. Contaminated Soil: If soil is contaminated by any work of this project, test and evaluate soil to determine extent of contamination and, after obtaining Owner's and Architect's approval, remove soil from the site and dispose of in a legal manner. Fill, compact and restore areas of contamination and excavation to original condition in compliance with pertinent portions of this project manual.
- D. Noise: Strictly comply with noise control regulations and requirements of authorities having jurisdiction. Abide by local ordinances regarding limitation of noise. Use properly muffled equipment. Use rubber-tired equipment instead of metal track equipment to the greatest extent possible.
- E. Water Damage: Effectively protect porous materials including, without limitation, gypsum board, insulation, and ceiling tiles and panels, from becoming wet. At no increase cost to the Owner, remove and replace work which is water damaged, and remove and replace work which shows visible evidence of biological growth due to wetting.

1.05 COOPERATION WITH CLERK OF THE WORKS

- A. Clerk of the Works: The Owner may employ a Clerk of the Works to monitor the progress of the work. If so, fully, and completely cooperate with the Clerk of the Works.
1. Personnel and Staffing Information: Provide the Clerk of the Works with information on personnel currently working on the project and identify for the Clerk of Works all the people at the site, both workers and visitors.
 2. Work Expected: At least every Monday morning, inform the Clerk of the Works about the work expected to be done during the week.
 3. Unusual Conditions and Occurrences: Immediately notify the Clerk of the Works about all unusual conditions and occurrences at the site.
 4. Construction Means, Methods and Techniques: Means, methods, and techniques used in the work are the sole responsibility of the Contractor. If the Clerk of the Works determines that the means, methods, techniques, and materials used results in work which does not conform to the Contract Documents, the Clerk of the Works will notify the Contractor. The Contractor shall maintain an accurate and up-to-date log of all such notifications from the Clerk and shall record the corrective action taken and the date and time when the Architect was consulted for additional clarification or direction. If the Contractor does not acknowledge and correct the deficiency, the Clerk will notify the Owner and Architect.
 5. Non-Standard Work Hours: No non-standard worker hours shall be permitted.
 6. Owner's Overtime: If the Owner provides the services of the Clerk of the Works to support the Contractor's overtime or premium time work, then the Contractor shall bear

all costs related to the Owner's Clerk of the Works overtime at a rate of \$150.00 per hour and shall reimburse the Owner in full.

1.06 ENGINEERING BY CONTRACTOR

- A. Engineering By Contractor: Certain technical specifications require engineering of construction assemblies by the Contractor.
1. Engineer Qualifications: The Contractor shall employ a Professional Engineer registered in the State in which the project is located and experienced in the type of engineering required by the Contract Documents. The Professional Engineer shall be subject to acceptance and approval by the Owner and Architect.
 2. Engineering Minimums: Contract Specifications which require engineering by the Contractor include "performance requirements" or "minimum requirements" or both. The Contractor shall satisfy all specified performance requirements and shall meet or exceed all specified minimum requirements. Minimum requirements establish the minimum level of acceptance, and no lower requirements is acceptable, even if the Contractor's engineer determines that lower requirements satisfy the performance requirement or project requirements.
 3. Engineer's Responsibilities: The registered Professional Engineer employed by the Contractor shall:
 - a) Engineer the work to the highest standards of the engineering profession.
 - b) Assume complete and sole professional responsibility for the engineered work.
 - c) Certify that the engineered work meets or exceeds:
 - 1) Specified performance requirements.
 - 2) Specified minimum requirements.
 - 3) Other Contract requirements.
 - 4) All applicable building codes and requirements of authorities having jurisdiction.
 - 5) Applicable industry standards.
 - d) Certify that the engineered work is suitable for the application and intent indicated in the Contract Documents.
 4. Substitutions: For work engineered by the Contractor which deviates in any way from dimensions, details, concepts, standards, or requirements of the Contract Documents, the Contractor shall submit the proposed engineered work as a "substitution" and shall comply with all specified procedures for "substitutions".

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01016

SECTION 01070

ARCHITECTURAL ABBREVIATIONS AND SYMBOLS

- 1.01 Reference to a technical society, institution, association, or governmental authority is made in the Specifications in accordance with the following abbreviations:

AAMA	Architectural Aluminum Manufacturers Association
AASHO	American Association of State Highway Officials
AC OR ACOUS	Acoustical
ACI	American Concrete Institute
ADJ	Adjustable
A/E	Architect/Engineer
A.F.F.	Above Finish Floor
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AL or ALUM	Aluminum
ALS	American Lumber Standards
ALT	Alternate
A.P.	Access Panel
APA	American Plywood Association
APPROX.	Approximate
ARCH	Architectural
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
@	At
ATI	Asphalt Tile Institute
A/V	Audio Visual
AWI	Architectural Woodwork Institute
AWPA	American Wood Preserver's Association
AWPI	American Wood Preserver's Institute
AWS	American Welding Society
B.C.I.	Background Criminal Investigation
BD.	Board
BLK'G.	Blocking
BM.	Beam
BOTT. or BOT.	Bottom
BRK	Brick
BS or BACKSP.	Back Splash
BULL.BD.	Bulletin Board
CAB.	Cabinet
CARP.	Carpet
C.B.	Catch Basin
CEIL'G or CLG.	Ceiling
CHBD.	Chalkboard
CHEM.	Chemical or Chemistry
C.J.	Control Joint
CLOS.	Closet
C.M.U.	Concrete Masonry Units
COL.	Column
COMP.	Computer
CONC.	Concrete
CONC.BLK.	Concrete Block
CONF.	Conference

CONT. or CONTIN.	Continuous
CONTR.	Contractor
COV'RD.	Covered
CR.	Classroom
C.S.	Commercial Standard U.S. Department of Commerce
C.S.I.	Construction Specifications Institute
C.T.	Ceramic Tile
DEPT.	Department
DET.	Detail
D.F.	Drinking Fountain
DIM.	Dimension
DISP.	Dispenser
DR.	Door
D.S.	Drench Shower or Downspout (use applicable)
D.W.	Dish Washer
DWG.	Drawing
EL. or ELEV.	Elevation
ELEC.	Electrical
ELEV.	Elevator
ENT. or ENTR.	Entrance
EP. RES.	Epoxy Resin
EQ.	Equal
EQUIP.	Equipment
EXIST. or	
EXIST'G or E.	Existing
EXP.	Exposed
EXP. JT.	Expansion Joint
EXP. STR.	Exposed Structure
F.A.	Fresh Air
F.B.	Fiber Board
F.D.	Floor Drain
F.E.	Fire Extinguisher
FGJA	Flat Glass Jobbers Association
FIN	Finish(ed)
FL. or FLR.	Floor (ing)
FLG.	Flashing
F.M.	Factory Mutual
F.N.D.	Feminine Napkin Disposal
F.O.	Face Of
F.O.B.	Face Of Brick
F.O.S.	Face Of Stud
F.P.	Fireproofing
FS	Federal Specification
G.A.	Gypsum Association
GALV.	Galvanized
G.B.	Glazed Block or Grab Bar
G.C.	General Contractor
GEN.	General
GL.	Glass
G.P.D.W.	Gypsum Drywall
G.W.B.	Gypsum Wallboard
GYP.	Gypsum
GYP. BD.	Gypsum Board
H.C.	Handicap
H.M.	Hollow Metal
H.M.U.	Hollow Masonry Unit
HT. or HGT.	Height
HVAC	Heating, Ventilating and Air Conditioning

ICBO	Uniform Building Code
IES	Illuminating Engineering Society
INSUL.	Insulation or Insulated
J. or JAN.	Janitor
KIT.	Kitchen
LAB.	Laboratory
LAD.	Ladder
L.A.R.R.	Liquid Applied Rubber Roofing
L.C.C.	Lead Coated Copper
L.W.S.	Liquid Writing Surface
M.	Man
MAN.	Manual
MAS. or MSRY.	Masonry
MAX.	Maximum
MECH.	Mechanical
MED.	Medium
MFGR. or MANF.	Manufacturer
MIA	Marble Institute of America
MIN.	Minimum
M. or MIR.	Mirror
MLMA	Metal Lath Manufacturers Association
M.O.	Masonry Opening
MOD.	Modular
MS	Military Specification
MSTD	Military Standard
MTD.	Mounted
MTL. or MET.	Metal
NAAMM	National Association for Architectural Metal Manufacturers
NAT.	Natural
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards'
NEC	National Electrical Code of NBFU
NFPA	National Fire Protection Association
N.F.R.	Nonwoven Fiberglass-Reinforced
NHLA	National Hardwood Lumber Association
N.I.C.	Not In Contract
NLMA	National Lumber Manufacturers Association
NO. or #	Number
NTMA	National Terrazzo and Mosaic Association, Inc.
N.T.S.	Not To Scale
NWMA	National Woodwork Manufacturers Association
O.C.	On Center
O. D.	Outside Diameter
OFF.	Office
O.H.	Overhead
O.I.	Owner's Insurance
OPM	Owner's Project Manager
OPP. HAND.	Opposite Hand
ORIG.	Original
OZ.	Ounce
PASS.	Passage
P.E.P.	Polyester Epoxy Paint
PL.	Plate
P.LAM.	Plastic Laminate
PLYD. or PWD.	Plywood
PNL.	Panel
PORT.	Portable
P.P.	Pitch Pocket

PREP.	Preparation
PROJ.	Project(ion)
PTD. or PT.	Painted
P.T.	Pressure Treated
P.T.D.	Paper Towel Dispenser
P.T.H.	Paper Towel Holder
PTN. or PART.	Partition
R.	Riser
R.B.	Rubber Base
R.D.	Roof Drain
REF.	Reference
REFRIG.	Refrigerator
REFIN.	Refinish
REQ'D or REQ.	Required
REINF.	Reinforced(ing)
RESIS.	Resistant
R.H.	Roof Hatch
R.L. or R.W.L.	Rainwater Leader
RM.	Room
R.T.U.	Roof Top Unit
RUB.	Rubber
R.V.	Roof Vent
R.V.T.	Reinforced Vinyl Tile
S.	Sink
SAN.	Sanitary
S.A.T.	Suspended Acoustical Tile
S.B.C.C.I.	Standard (Southern) Building Code
S.C.	Solid Core
SCHED.	Schedule
SCPI	Structural Clay Products Institutes
S.D.	Standard Detail or Soap Dispenser
SDI	Steel Deck Institute
SECT.	Section
SH. or SHLV.	Shelf - Shelving
SHT.	Sheet
SHWR.	Shower
SIM.	Similar
SMACNA	Sheet Metal and Air Conditioning Contractors National Association Inc.
S.N.D.	Sanitary Napkin Dispenser
SPEC.	Specification
SPR	Simplified Practice Recommendation, U.S. Department of Commerce
SSPC	Steel Structures Painting Council
STL. or ST.	Steel
STN. STL. or S.S.	Stainless Steel
STOR.	Storage
STRUCT.	Structural
SUPP.	Supplementary
SUSP.	Suspended
T. or TOIL.	Toilet
T.B. or TKBD.	Tackboard
TCA	Tile Council of America
TEL.	Telephone
TEMP.	Tempered
THK.	Thickness
TKS.	Thickness
T.M.	Tilt Mirror
T.O.S.	Top of Steel
TYP.	Typical

U.L.	Underwriter's Laboratories, Inc.
ULC	Underwriter's Laboratories of Canada
USA	U.S. of America Standards Association
U.V.	Unit Ventilator
VAR.	Varnish
V.A.T.	Vinyl Asbestos Tile
V.C.B.	Vinyl Cover Base
V.B.	Vinyl Base
VEST.	Vestibule
VERT.	Vertical
W.	Women
W/	With
WD.	Wood
WDW. or WIN.	Window
W.H.	Wall Hung
W.R.	Wall Receptacle
W.W.F.	Welded Wire Fabric

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION 01070

SECTION 01072

DEFINITIONS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. The General Conditions and applicable portions of Division 1 of the Project Manual are a part of this Section.

1.02 DEFINITIONS:

- A. Purchaser, Owner/Agent, City of East Providence means the Owner.
- B. A/E shall mean the Architect who has a Contract with the Owner to prepare construction documents for the project.
- C. Contractor shall mean the person or firm under Contract with the Owner to construct the project.
- D. Furnish and provide means to supply, erect, install and connect up complete in readiness for regular operation, particular work referred to, unless otherwise specified.
- E. Supply means purchase and delivery of material to the site.
- F. Install means to erect in place the supplied item.
- G. The term Owner-Contractor Agreement where used therein, shall refer to the Owner's purchase order.
- H. The term Change Order where used herein, shall refer to the Owner's purchase change order.
- I. Award of Contract and Date of Purchase Order refer to the same.
- J. Day, as used throughout the contract unless otherwise stated, means calendar day.

1.03 THE WORK:

- A. The work comprises the completed construction and documentation required by the Contract Documents and includes all labor needed to produce such construction, and all materials and equipment incorporated or to be incorporated in such construction, and all manuals, reports, tests, releases, punch lists, operating instructions, and the like to provide new work as shown on the Contract Documents.

1.04 DATE OF SUBSTANTIAL COMPLETION:

- A. The Date of Substantial Completion of the Work or designated portion thereof, is the date certified by the Architect when construction is sufficiently complete (95%), in accordance with the Contract Documents, so the Owner can occupy or utilize the Work or designated portion thereof, for the use for which it is intended.

1.05 DATE OF FINAL COMPLETION (FULLY COMPLETED):

- A. The Date of Final Completion of the Work is the date certified by the A/E when he finds all Work is acceptable and has been performed and completed in accordance with the terms and conditions of the Contract Documents.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION 01072

SECTION 01100

SUMMARY OF THE WORK

PART 1 - GENERAL

1.01 SUMMARY

A. Project Identification:

East Providence Community Center
610 Waterman Avenue
East Providence, Rhode Island 02914

B. The work generally includes, but is not limited to the following:

1. Demolition and removal of the existing garage
2. Demolition and removal of the existing irrigation system
3. All required site clearing and site work, including the removal of earth.
4. Excavation for new building concrete spread footings, foundation walls, and floor slabs
5. Installation of temporary site fencing
6. Installation of erosion control system
7. Installation of underground infiltration system
8. Removal of the existing parking lot light poles
9. Installation of pre-engineered metal building structure and building envelope
10. Interior building fit out
11. Asphalt paving, parking lot curbing and concrete sidewalks

C. Permits and Fees:

1. All City permit and fees shall be waived. All State permits and fees shall be enforced and procured by the General Contractor this project.

D. Codes: Comply with applicable codes and regulations of authorities having jurisdiction. Submit copies of inspection reports, notices, and similar communications to Architect.

E. Dimensions: Verify dimensions indicated on drawings with field dimensions, prior to submitting Bid. Do not scale drawings.

F. Existing Conditions: Notify Architect of existing conditions differing from those indicated on the drawings.

1.02 RELATED WORK:

A. The Contract, AIA 201, and applicable portions of Division 1 of the Project Manual are a part of this section which shall consist of all labor, equipment, and materials necessary to complete all work indicated on the drawings, herein specified, or both; and as related to the project or projects defined in the Bidding and Contract requirements.

B. The specification format used herein is in accordance with the master CSI format, and in no way intends to restrict this Contractor from expediting his work as he sees fit, nor is there any intention of segregating the units of work as related to specific trades involving jurisdictional labor problems.

1.03 PROJECT COORDINATION:

A. The Contractor selected to complete work specified herein shall also be responsible for coordinating the work of other trades. All work or portions thereof shall be completed simultaneously.

- B. The Contractor shall provide all work incidental to and necessary for a complete, and proper installation of the specified and intended work of the Project.
- C. Prior to removing existing improvements, consult with Owner to determine which improvements will be turned-in to the Owner. If Owner does not wish to keep existing improvements, Contractor shall dispose of item in a legal and approved manner.
- D. Visit the site and become familiar with the specified and the intended work prior to submitting bid.
- E. Secure and pay for, as necessary for proper execution and completion of the work, and as applicable at time of receipt of bids, the following:
 - 1. All State Permits
 - 2. All State Fees
 - 3. Licenses
 - 4. Utility Company Charges.
- F. Give required notices.
- G. Lay out all work and be responsible for all lines, elevations, and measurements. Verify the figures shown before laying out the work and be responsible for any error resulting from failure to do so.
- H. Notify all trades, subcontractors and suppliers of all designated alternative and be responsible for their coordination.
- I. Coordinate the work of all trades. All mechanical and electrical work shall be completed by qualified Contractors licensed in the State in which the work is being performed.
- J. The Contractor shall be responsible for carefully coordinating all proposed demolition work and new construction work with the Owner. The Owner must maintain use of the sites during the Construction Phase. The Contractor may be required to complete work in several phases. Plan accordingly and include all related costs in the Base Bid. Consult Owner prior to submitting bid.

1.04 GENERAL RESPONSIBILITIES OF THE CONTRACTOR:

- A. The Contractor shall be responsible for all personnel involved in the work, including those of his direct employ, his subcontractors and suppliers of materials and equipment and/or labor. The Technical Specifications have been divided for convenience only, to cover the Scope of Work, and where reference to a particular Contractor is noted, it is for convenience only. **The Owner and A/E recognize only one Contractor as a party to this Contract.**
- B. Except as specifically noted, provide and pay for:
 - 1. Labor, materials and equipment
 - 2. Tools, construction equipment and machinery
 - 3. Water, heat and utilities required for construction - unless otherwise directed herein.
 - 4. Other facilities and services necessary for proper execution and completion of work
- C. Owner is exempt from sales tax on products permanently incorporated in the work.
- D. The Contractor and his subcontractors who are selected to complete the proposed new work shall have a minimum of five (5) consecutive years' experience providing similar work to that specified.

- E. This Contractor shall complete all work within the specified amount of days described in other sections herein.
- F. The Contractor, upon Substantial Completion of this project, shall provide the Owner and Architect with a certified statement stating that all work has been provided in conformance with the Contract Documents, applicable manufacturer(s) written specifications and recommendations.
- G. This Scope of Work may be completed during the winter months or may lapse into the winter months. The Contractor shall prepare his bid as if the work will be completed during winter conditions.
- H. Provide all temporary fencing, hay bales and other related barriers and protection/prevention materials and equipment required to protect the property of the Owner and others and if applicable, to conform to Wetlands rules and regulations.
- I. The Contractor shall provide adequate dust control at each site throughout the duration of the Construction Phase.
- J. The Contractor shall install all products in strict conformance with these specifications and/or the manufacturers' written instructions and recommended practices, whichever is most stringent. No exceptions will be allowed.
- K. Comply with codes, ordinances, rule, regulations, orders and legal requirements of public authorities which bear on performance of work.
- L. Promptly submit written notice to A/E of observed variance of Contract Documents from legal requirements.
 - 1. Appropriate modifications to Contract Documents will adjust necessary changes.
 - 2. Assume responsibility for work known to be contrary to such requirements, without notice.
- M. Enforce strict discipline and good order among employees. Do not employ persons not skilled in assigned task.
- N. The Contractor shall provide all as-built reproducible drawings, flashdrive compatible with Owner's computer equipment at no additional cost to the Owner. The as-built drawings shall reflect actual systems installation and work completed. No exceptions will be allowed.
- O. The Contractor shall be responsible for patching, repairing and restoring to original new condition, all portions of the site and building damaged and or adversely affected in any way during construction. The Owner and the A/E shall review and approve any and all new work and related restoration work prior to the Contractor considering work to be complete. If any portion of the Owner's property is damaged during the course of construction, Contractor shall assume sole responsibility to complete repairs.

1.05 WORK BY OWNER: Not Applicable.

1.06 RESOLUTION OF CONTRACT DOCUMENT CONFLICTS OR CONFUSION:

- A. Conflicts or Confusion: Prior to submitting bid, the Contractor shall carefully study and compare the Contract Documents and shall request clarification in all cases of apparent conflict or confusion. **In case of conflict or confusion where the Contractor did not request clarification prior to submitting his bid, the Contractor shall interpret the Contract Documents to require the greater quantity, higher quality, most restrictive, and most expensive of the possible interpretations.**

1.07 PLANNING THE WORK:

- A. The Contractor shall plan his schedule to produce the work expeditiously in an orderly manner without interfering with the Owner's operations or the operations of other building tenants (occupants).
- B. The Contractor shall substantially complete one phase of construction prior to beginning another phase of construction related work.
- C. Coordinate and carefully plan work described herein and as shown and described elsewhere and on the drawings.
- D. Owner shall be notified by the contractor at least seventy-two (72) hours prior to all "downtime" of systems involved in construction.
- E. The Contractor shall direct all questions and submittals to the office of the Architect, only. The Contractor shall assume all responsibility for work associated with the project if the Architect is not first advised.
- F. The Contractor shall visit the site and become familiar with the specified and the intended work prior to submitting his bid. No additional costs will be allowed for work obviously intended to be a part of this Contract. The Architect's decision shall be final.
- G. Contractor shall be responsible for coordinating and cross-referencing all drawings and portions of the Project Manual. **DO NOT SEPARATE THE DRAWINGS AND PAGES OF THE PROJECT MANUAL.**

1.08 SAFETY PRECAUTIONS:

- A. OSHA:
 - 1. These construction documents of construction hereby contemplated are to be governed at all times by applicable provisions of the Federal Law (s), including but not limited to the latest amendments of the following:
 - a) Williams; Steiger Occupational Safety & Health Act of 1970, Public Law 91-956;
 - b) Part 1510 - Occupational Safety & Health Standards, Chapter XVII of Title 29, Code of Federal Regulations.
 - 2. This project, the Contractor and his subcontractors shall, at all times, be governed by Chapter XIII of Title 29, Code of Federal Regulations, Part 1518 - Safety and Health Regulations for Construction, (36 FR 75), as amended to date.
- B. Asbestos Abatement: No Asbestos reported.
- C. Emergencies:
 - 1. Should a tornado, hurricane, gale or heavy wind warnings be issued, every practicable precaution shall be taken by the Contractor to minimize the danger to persons, to the work and to the adjacent property. Such damage caused to any part of the work shall be rectified or replaced to complete satisfaction of the A/E and at no expense to the Owner. Injury to personnel or damage to adjacent property because of the work shall be the complete responsibility of the Contractor, and he accepts exclusive liability for same.
- D. Loading:
 - 1. No part of any structure involved in this Contract shall be loaded during construction with a weight greater than it is calculated to carry with safety. Should any accidents or

damage occur through any violation of this requirement, the Contractor shall be held solely responsible under his Contract and bond. When, in the opinion of the A/E, portions of the structure appear to be overloaded, it shall be the Contractor's responsibility to prove otherwise, or the Contractor shall follow the instructions of the A/E in connection with reduction of the loads.

E. Compliance with the Owner's Insurer, hereinafter referred to as OI.

1. If applicable, plans and final installation of Fire Suppression Systems are subject to acceptance by the OI.
2. All proposed uses of plastic construction materials shall be referred to the OI for review and appropriate recommendations.
3. Fire protection equipment shall be installed in conformance with the standards to the National Fire Protection Association (NFPA). Devices listed by Underwriters Laboratories Inc. (UL) or any other recognized testing laboratory shall be used.
4. Electrical installation shall conform to the National Electrical Code (NEC).
5. Combustible stock and processing equipment should not be moved into the buildings until recommended suppression systems are properly installed, tested, and in full service.
6. Fire prevention and protection during the construction period shall include the following:
 - a) Use of public fire department, plant fire brigade, and portable extinguishing equipment.
 - b) Early contract awards and expediting of fire protection equipment.
 - c) Proper supervision of open flames and temporary wiring.
 - d) Suitable access to the site with hydrants and water available on the site in early stages of construction.
 - e) Supervision of welding or cutting operations, including use of flame-proofed tarpaulins.
 - f) Keeping combustible material, including process equipment awaiting installation, to a minimum, and as far away as possible from buildings under construction.
 - g) Keeping the construction site clean and orderly.
 - h) Detaching Contractor's sheds from buildings under construction, if applicable.
 - i) Special precautions such as shoring of masonry walls and temporary tie-bracing of structural steel work to prevent windstorm damage during construction.

1.09 WORK SEQUENCE:

- A. The Contractor shall plan his schedule to produce the work expeditiously in an orderly manner without interfering with the Owner's operations.
- B. Work Hours: all work shall be conducted between the normal working hours of 7:00 A.M. and 3:30 P.M. local time, and during regular weekdays, unless otherwise adjusted by the OPM and Architect. No work shall be performed before or after the normal working hours or during Saturdays, Sundays and Holidays as defined by the Department of Labor. The Owner may waive this requirement in an emergency situation.

PART 2 – PRODUCTS: Not Used.

PART 3 – EXECUTION:

3.01 REQUIREMENTS:

- A. Maintain at job site, a minimum of one (1) copy of:
 - 1. Signed Contract Drawings
 - 2. Project Manual
 - 3. Addenda
 - 4. Reviewed Shop Drawings
 - 5. Change Orders
 - 6. Other Modifications to Contract
 - 7. Field Test Records
 - 8. Approved material samples
 - 9. As-built Drawings
- B. The Owner or Architect will accept only those Contract Documents that are signed or initialed and dated on each page.
- C. Store documents in field construction office(s), apart from documents used for construction.
- D. Provide files and racks for storage of documents.
- E. File documents in accordance with CSI Master Format.
- F. Maintain documents in clean, dry, legible condition.
- G. Do not use record document for construction purposes.
- H. Make documents available at all times for inspection by A/E and Owner.
- I. At Final Completion of the Project, turn over to the Architect, all Project Record Documents. All items such as reviewed shop drawings, Change Orders, test reports, etc. shall be delivered in bound book form and on USB drive compatible with the Owner's and the Architect's computer systems.

3.02 RECORDING:

- A. Label each document "PROJECT RECORD DRAWINGS"
- B. Keep record documents current.
- C. Do not permanently conceal any work until required information has been recorded and inspected.
- D. Contract Drawings: Legibly mark to record actual construction.
 - 1. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 - 2. Field change of dimension and detail.
 - 3. Changes made by Change Order or Field Order.

4. Details not on original contract drawings.
- E. Specification and Addenda: legibly mark up each section to record:
1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 2. Changes made by change order or field order.
 3. Other matters not originally specified.
- F. Shop Drawings: Maintain as record documents; legibly annotate drawings to record changes made after review.

3.03 CUTTING AND PATCHING

- A. Execute cutting, fitting or patching or work, required to:
1. Make several parts fit properly.
 2. Uncover work to provide for installation of ill-timed work.
 3. Remove and replace defective work.
 4. Remove and replace work not conforming to requirements of Contract Documents.
 5. Install specified work in existing construction.
- B. In addition to contract requirements, upon written instruction of the A/E:
1. Uncover work to provide for A/E's observation of covered work, as required by the General Conditions.
 2. Remove samples of installed materials for testing; as required by the General Conditions.
 3. Remove work to provide for alteration of existing work.
- C. Do not endanger any work by cutting or altering work or any of it.
- D. Do not cut or alter work of another contractor without written consent of A/E.
- E. Prior to cutting which affects the structural integrity and safety of project work or that of another contractor, seek prior written notice to the Architect requesting consent to proceed with cutting. All such cutting shall be certified by a *Rhode Island*-licensed structural engineer at no additional cost to the Owner or Architect. All related costs shall be the sole responsibility of the Contractor.
- F. Prior to cutting and patching done on instruction of A/E, submit cost estimate.
- G. Should conditions of work, or schedule indicate change of materials or methods, submit written recommendation to A/E, including:
1. Conditions indicating change.
 2. Recommendations for alternative materials or methods.
 3. Submittals as required for substitutions.
- H. Submit written notice to A/E, designating time work will be covered, to provide for observation.

- I. Payment for costs caused by ill-timed or defective work, or work not conforming to Contract Documents, including costs for additional services of A/E, will be borne solely by the Contractor.
- J. Preparation (prior to cutting):
 - 1. Provide shoring, bracing and support as required to maintain structural integrity.
 - 2. Provide protection for other portions of project.
 - 3. Provide protection from elements.
- K. Performance: Perform all work of fitting, adjustment, cutting, patching, finishing and restoration to perfectly match the quality as specified throughout these specifications

3.04 CONTRACTOR INSPECTION:

- A. Inspect existing conditions of work, including elements subject to movement or damage during cutting and patching.
- B. Repair/replacement of defective work will not constitute sufficient cause to extend the contract deadline.

END OF SECTION 01100

SECTION 01121
PHASING OF THE WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for phasing of Work include logistics, phasing, and completion of designated phases prior to commencement of subsequent phases.

1.02 RELATED REQUIREMENTS

- A. Section 01110: Summary of Work.
- B. Section 01330: Submittals.
- C. Section 01016: Coordination and Project Procedures.
- D. Section 01500: Temporary Facilities.
- E. Section 01780: Contract Closeout.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.01 SUBMITTALS

- A. CONTRACTOR shall submit a Project site logistics plans in accordance with and as required by this Section.

3.02 LOGISTICS

- A. Prior to commencement of Work, CONTRACTOR shall prepare and submit to OPM and Architect, a detailed Project site logistic plan, in same size and scale of Drawings, setting forth CONTRACTOR plan of Work relative to following, but not limited to, items:
 - 1 Hauling route shall be in accordance with local ordinances a truck access route to and from Project site.
 - 2. The identification of any overhead wire restrictions for power, street lighting, signal or cable.
 - 3. Local sidewalk access and street closure requirements.
 - 4. Protection of sidewalk pedestrians and vehicular traffic.
 - 5. Project site fencing and access gate locations.
 - 6. Construction parking.

7. Material staging or delivery areas.
 8. Material storage areas.
 9. Temporary trailer locations.
 10. Temporary service location and proposed routing of all temporary utilities.
 11. Location of temporary or accessible fire protection.
 12. Trash removal and location of dumpsters.
 13. Concrete pumping locations.
 14. Crane locations.
 15. Location of portable sanitary facilities.
 16. Mixer truck wash out locations.
 17. Traffic control signage.
 18. Perimeter and site lighting.
 19. Storm Water Pollution Prevention Plan – SWPPP.
 20. Stockpile or lay down areas.
 21. Security lighting
- B. Revised Project site logistic plan may be required by OPM and Architect for separately identified phases of Work as set forth in this Section.
- C. CONTRACTOR is responsible for securing and/or obtaining all approvals and permits from authorities having jurisdiction relative to any activities set forth in Article 3.02.A.

3.03 SEQUENCING/PHASING OF THE WORK

- A. The project is proposed as being completed in a single phase. Sequencing of the Work may be required and any sequencing would fall under the responsibility of the Contractor as means and methods.
- B. Project will be constructed in separate Milestone increments, as identified or as described in this Section or Contract Documents. Unless otherwise approved or directed by OWNER, the Work shall be completed according to approved Baseline schedule.
- C. CONTRACTOR shall install all necessary Work for, but not limited to, power, lighting, signal, HVAC, drainage, and plumbing systems in sequence Work before completion of designated phase. All valves, pull boxes, stub outs, temporary capping, and other Work necessary for completion and operation of all necessary systems shall be provided whether or not such Work is specifically identified in Contract Documents.

3.04 PHASING OF THE WORK – GENERAL

- A. CONTRACTOR shall prepare Construction Schedule in order to complete Work and related activities. CONTRACTOR shall include all costs to complete all Work within Milestones or Contract Time.
- B. OWNER will be seriously damaged by not having all Work completed within Milestones or Contract Time. It is mandatory Work be complete within Milestones or Contract Time.

3.05 PHASING OF THE WORK – SPECIFIC

- A. CONTRACTOR shall prepare Construction Schedule, and shall complete following, but not limited to Milestones and within designated phases in accordance with following:
 - 1. Phase 1 Mobilization – (**# of days**) calendar days: Milestones 1 & 3.
 - 2. Phase 2 Construction – (**#days**) calendar days: Milestone 2, 4-28.
 - 3. Phase 3 Administrative Closeout – (**# of days**) calendar days: Milestone 29.

END OF SECTION 01121

SECTION 01250

ALTERNATES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Work Included: Provide alternative bid proposals as described in this section.
- B. Related Work:
 - 1. Documents affecting work of this section include, but are not necessarily limited to, the Contract, AIA 201, and Sections in Division 1 of these Specifications.
 - 2. Some of the items mentioned in this section are described further in pertinent other sections of these Specifications.
- C. Procedures:
 - 1. Provide alternative bids to be added to or deducted from the amount of the Base Bid if the corresponding change in scope is accepted by the Owner.
 - 2. Include within the alternative bid prices all costs, including materials, installations, and fees.
 - 3. Show the proposed alternative amounts for the proper description on the Bid Form.
 - 4. Alternates are described briefly in this section. The contract documents define the requirements for alternates.
 - 5. Coordinate alternates with related work to ensure that work affected by each selected alternate is properly accomplished.
- D. One, several or all of the Bid Alternates below may be implemented. If deemed necessary, the Owner shall select the appropriate Bid Alternates in the prioritized order shown; Alternates will be taken in order.

1.02 DESCRIPTION OF ALTERNATES:

Note: Additive (Add) Alternates shall not be included as part of the Base Bid amount.

A. BID ALTERNATE NO. 1:

Add to the Base Bid Price, the cost to provide the specified work involving the landscaping and plantings at the Senior Center Building.

B. BID ALTERNATE NO. 2:

Add to the Base Bid Price, the cost to provide the specified work involving the landscape and plantings throughout the designated project area as indicated in the landscape drawings.

C. BID ALTERNATE NO. 3:

Add to the Base Bid Price, the cost to provide the specified work involving the installation of new soffit mounted perimeter building LED accent lighting. **New soffit mounted perimeter building LED accent lighting at the cupolas included as part of the base bid.**

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01251

PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This Section includes administrative and procedural requirements for handling requests for substitutions submitted 60 days after the date established in the Notice of Award.

1.02 RELATED REQUIREMENTS

- A. Section 01 330: Submittals.
- B. Section 01600: Product Requirements.
- C. Section 01780: Closeout.

PART 2 - PRODUCTS (Not used)

PART 3 – EXECUTION

3.01 APPLICATION

- A. CONTRACTOR proposed changes in products or materials required by the Contract Documents 60 days or more after the Notice of Award are considered to be requests for substitutions. OPM and Architect will consider requests for substitution if a product is no longer manufactured or the OPM and ARCHITECT, after a diligent search have verified that product or material is not available to CONTRACTOR. The following are not considered to be valid requests for substitutions:
 - 1. Revisions to the Contract Documents requested by OPM or ARCHITECT.
 - 2. Specified options of products included in the Contract Documents.
 - 3. Substitutions requested on a “or equal” basis.

3.02 SUBMITTALS

- A. Transmit submittals as described in related Sections for each request for substitution.
 - 1. Identify the product to be replaced in each request. Include related Specification Section and Drawing number.
 - 2. Provide complete documentation denoting compliance with the requirements for substitutions, and the following information, as appropriate.
 - a. A detailed comparison of significant qualities of the proposed substitution with those specified in the Contract Documents. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.

- b. Product Data, including Drawings, descriptions of products, fabrication, and installation procedures.
 - c. Samples, where applicable or requested.
 - d. CONTRACTOR certification the proposed substitution conforms to requirements of the Contract Documents in every respect and is appropriate for the applications indicated.
 - e. CONTRACTOR waiver of rights to an increase in the Contract Amount, Milestones and/or Contract Time that may subsequently become necessary because of the failure of the substitution to adequately perform.
- 3. If required, ARCHITECT will request additional information or documentation for evaluation. OPM will notify CONTRACTOR of acceptance or rejection of the substitution.
 - 4. ARCHITECT will review and consider request for substitution and provide a recommendation to OPM.
 - 5. Where a proposed substitution involves and/or affects more than one Subcontractor, CONTRACTOR shall ensure each Subcontractor cooperates with the other Subcontractor involved to coordinate the Work, provide uniformity and consistency, and assure compatibility of all products.
 - 6. CONTRACTOR submittal and ARCHITECT review of Shop Drawings, Product Data, material lists or Samples do not constitute an acceptable or valid request for substitution.

END OF SECTION 01251

SECTION 01261
REQUEST FOR CLARIFICATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Procedure for requesting clarification of the intent of the Contract Documents.

1.02 RELATED REQUIREMENTS

- A. Section 01110: Summary of Work.
- B. Section 01016: Coordination and Project Procedures
- C. Section 01770: Contract Closeout.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.01 PROCEDURE

- A. CONTRACTOR shall prepare a Request in accordance with the bid advertisement. CONTRACTOR shall transmit the Request for Clarification to ARCHITECT with a concurrent copy to the OPM.
- B. ARCHITECT response is a clarification of the intent of the Contract Documents and does not authorize changes in the Contract Amount, Milestones and/or Contract Time.
- C. A Request for Clarification may be returned with a stamp or notation "Not Reviewed," if:
 - 1. The requested clarification is ambiguous or unclear.
 - 2. The requested clarification is equally available to the requesting party by researching and/or examining the Contract Documents.
 - 3. CONTRACTOR has not reviewed the Request for Clarification prior to submittal.
- D. Allow a minimum of nine days for review and response time, after receipt by ARCHITECT and OPM. CONTRACTOR shall verify and is responsible in verifying ARCHITECT and OPM receipt of a Request for Clarification.
- E. Changes or alterations to the approved drawings or specifications shall be made by means of addenda or change orders.

END OF SECTION 01261

SECTION 01300

SCHEDULING

PART 1 - GENERAL

1.01 SUMMARY

- A. Working hours shall be between 7:00 a.m. and 3:30 p.m., Monday through Friday. The contractor will not be allowed to work on holidays observed by *East Providence City Hall* without written approval from the East Providence City Planner and OPM. A list of these holidays can be obtained from the Owner.
- B. Prior to beginning any work, the Contractor shall submit a schedule and site safety plan as described herein for all work to be completed, for the Owner's review and acceptance.

1.02 DESCRIPTION:

- A. Work Included: To assure adequate planning and execution of the work so that the work is completed within the number of calendar days allowed in the Contract, and to assist the Architect in appraising the reasonableness of the proposed schedule and in evaluating progress of the work, prepare and maintain the schedules and reports described in this section.
- B. Related Work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, the Contract, AIA 201, and Sections in Division 1 of these Specifications.
 - 2. Requirements for Progress Schedule: General Conditions.
 - 3. Construction Period: Form of Agreement.

1.03 QUALITY ASSURANCE:

- A. Employ a scheduler who is thoroughly trained and experienced in compiling construction schedule date, and in preparing and issuing periodic reports as required below.
- B. Perform data preparation, analysis, charting, and updating in accordance with standards approved by the Architect.
- C. Reliance upon the approved schedule:
 - 1. The construction schedule as approved by the Architect will be an integral part of the Contract and will establish interim completion dates for the various activities under the Contract.
 - 2. Should any activity not be completed within five (5) days after the scheduled completion date, the Owner shall have the right to require the Contractor to expedite completion of the activity by whatever means the Owner deems appropriate and necessary, without additional compensation to the Contractor.

3. Should any activity be thirty (30) days or more behind schedule, the Owner shall have the right to perform the activity or have the activity performed by whatever method the Owner deems appropriate.
4. Costs incurred by the Owner and by the Architect in connection with expediting construction activity under this Article shall be reimbursed by the Contractor.
5. It is expressly understood and agreed that failure by the Owner to exercise the option either to order the Contractor to expedite an activity or to expedite the activity by other means shall not be considered to set a precedent for any other activities or waive the Owner's right to do so.

1.04 SUBMITTALS:

- A. Submit initial schedules within seven (7) calendar days after date of Award of Contract.
 1. A/E will review schedules and, if changes are required by A/E, return reviewed copy within five (10) workdays after receipt.
 2. If required, Contractor shall resubmit within five (5) workdays after return of reviewed copy.
- B. The General Contractor shall submit updated full schedules accurately depicting progress to first day of each month with each application for payment.
- C. The General Contractor to provide cloud-based construction management platform, similar or equal, to Procore Construction Software.
- D. Comply with pertinent provisions of Section 01300.

1.05 FORM OF SCHEDULE:

- A. Prepare in form of horizontal bar chart:
 1. Provide separate horizontal bar column for each trade or operation.
 2. Order: Chronological order of beginning of each item of work.
 3. Identify each column:
 - a) By major specification number.
 - b) By distinct graphic delineation.
 4. Horizontal Time Scale: Identify first workday of each week.
 5. Scale and Spacing: To allow space for updating.
- B. Minimum sheet size: 11" × 17".
- C. Full updated schedules to be submitted monthly with each application for payment.

1.06 CONTENT OF SCHEDULE:

- A. Provide complete sequence of construction by activity.
 1. Decision dates for:
 - a) Selection of finishes.
 2. Dates for beginning and completion of each element of construction.

- B. Identify work of separate floors, or separate phases, or other logically grouped activities.
- C. Show projected percentage of completion for each item of work as of the first day of every other week.

1.07 UPDATING:

- A. At least every other week, show all changes occurring since previous submission of updated schedule.
- B. Indicate progress of each activity, show completion dates.
- C. Include:
 - 1. Major changes in scope.
 - 2. Activities modified since previous updating.
 - 3. Revised projections due to changes.
 - 4. Other identifiable changes.

1.08 DISTRIBUTION:

- A. Distribute copies of reviewed schedules to:
 - 1. Job site file.
 - 2. Subcontractor.
 - 3. Other concerned parties.
- B. Instruct recipients to report any inability to comply, and provide detailed explanation with suggested remedies.

PART 2 – PRODUCTS:

Not Used.

PART 3 – EXECUTION:

Not Used.

END OF SECTION 01300

SECTION 01330

SUBMITTALS - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Work Included: Make submittals required by the Contract Documents, and revise and resubmit as necessary to establish compliance with the specified requirements.
- B. Related Work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, the Contract, AIA 201, and Sections in Division 1 of these Specifications.
 - 2. Individual requirements for submittals also may be described in pertinent sections of these Specifications.
- C. Work Not Included:
 - 1. Un-required submittals will not be reviewed by the Architect.
 - 2. The Contractor may require his subcontractors to provide drawings, setting diagrams, and similar information to help coordinate the work, but such data shall remain between the Contractor and his subcontractors and will not be reviewed by the Architect.

1.02. GENERAL PROCEDURES FOR SUBMITTALS

- A. Timeliness - The Contractor shall transmit each submittal to the Architect sufficiently in advance of performing related Work or other applicable activities, so that the installation not be delayed by processing times, including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery, and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals to the Architect in advance of the Work.
- B. Contractor's Review and Approval - Only submittals received from and bearing the stamp of approval of the Contractor will be considered for review by the Architect. Submittals shall be accompanied by a transmittal notice stating name of Project, date of submittal, "To", "From", (Contractor, Subcontractor, Installer, Manufacturer, Supplier), Specification Section, or Drawing No. to which the submittal refers, purpose(first submittal, resubmittal), description, remarks, distribution record, and signature of transmitter.
- C. Or-Equals - On the transmittal or on a separate sheet attached to the transmittal, the Contractor shall direct attention to any deviations including minor limitations and variations, from the Contract Documents.
 - 1. The Contractor and all Subcontractors shall submit to the Architect for consideration of any Or-Equal substitution, a written point by point comparison containing the name and full particulars of the proposed product to the product named or described in the Contract Documents.
 - 2. Upon receipt of a written request for approval of an Or-Equal substitution, the Architect shall investigate whether the proposed item shall be considered equal to the item named or described in the Contract Documents. Upon conclusion of

the investigation, the Architect shall promptly advise that the item is, or is not, considered acceptable as on Or-Equal substitution. Such written notice must have the concurrence of the Administrator.

4. In no case may an item be furnished on the Work other than the item named or described, unless the Architect considers the item equal to the item so named or described, as provided by R.I. Gen. Laws § 6-34.1-1.
 5. The equality of items offered as "equal" to items named or described shall be proved to the satisfaction of the Architect at the expense of the Contractor or Subcontractor submitting the substitution.
 6. The Architect may require that full size samples of both the specified and proposed products be submitted for review and evaluation. The Contractor or Subcontractor, as the case may be, shall bear full cost for providing, delivering, and disposal of all such samples.
 7. The Contractor or Subcontractor, as the case may be, shall assume full responsibility for the performance of any item submitted as an "Or-Equal" and assume the costs of any changes in any Work which may be due to such substitution.
- D. Processing - All costs for printing, preparing, packaging, submitting, resubmitting, and mailing, or delivering submittals required by this contract shall be included in the Contract Sum.

1.02 QUALITY ASSURANCE:

A. Coordination of submittals:

1. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted.
2. Verify that each item and the submittal for it conform in all respects with the specified requirements.
3. By affixing the Contractor's signature to each submittal, certify that this coordination has been performed.

B. "Or Equal":

1. Where the phrase "or equal", or "or equal as approved by the Architect", occurs in the Contract Documents, do not assume that the materials, equipment, or methods will be approved as equal unless the item has been specifically so approved for this work by the Architect.
2. The decision of the Architect shall be final.

1.03 SUBMITTALS:

- A. Make submittals of shop drawings, samples, substitution requests, and other items in accordance with the provisions of this section.

1.04 CONTRACTOR'S RESPONSIBILITIES:

- A. It is the responsibility of the Contractor to check all dimensions and details on shop drawings, before submission to the A/E and reject same if necessary, and only forward to the A/E, shop drawings which he is reasonably certain fulfill the requirements of the Contract Documents and the work. **Resulting costs for failure to do so shall be borne solely by the Contractor.**
- B. The review of shop drawings by the A/E shall be general only, in character and not mean dimensions on the drawings have been checked, and will in no way, relieve the Contractor of the responsibility for proper fitting and construction of the work, nor from the necessity of furnishing materials or doing the work required by the drawings and/or specifications, which may not be indicated on the shop drawings when reviewed.
- C. **ALL SHOP DRAWINGS SHALL BE CHECKED BY THE CONTRACTOR, AND MUST BEAR HIS STAMP OF REVIEW AND APPROVAL AND SIGNATURE, DRAWINGS SUBMITTED WITHOUT THIS SIGNED STAMP OF REVIEW AND APPROVAL WILL NOT BE CONSIDERED AND/OR ACCEPTED.**
- D. Submit prints of each drawing, including fabrication, erection, layout and setting drawings, and such other drawings as required under various sections of the specifications until final review is obtained. Submit copies of manufacturer's descriptive data including catalog sheets for materials, equipment and fixtures, showing dimensions, performance characteristics and capacities, wiring diagrams and controls, schedules and other pertinent information as required.
- E. Contractor is fully responsible for obtaining and distributing prints of shop drawings as necessary after, as well as before final approval.
- F. Designated person in Contractor's office shall be responsible for coordinating submission and distribution of submittals and notify A/E in writing within fifteen (15) calendar days after Award of Contract. Notify A/E in writing if designated person is changed.
- G. Meet with A/E within fifteen (15) calendar days after Award of Contract or date of Purchase Order to review procedure for submission and distribution of submittals and format of Submittal Schedule.
- H. Verify:
 - 1. Field measurements.
 - 2. Field construction criteria
 - 3. Catalog numbers and similar data
- I. Contractor's responsibility for errors and omissions in submittals is not relieved by A/E's review of submittals.
- J. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by A/E's review of submittals unless A/E gives written acceptance of specific deviations.
- K. Notify A/E in writing at time of submission of deviations in submittals from requirements of Contract Documents.
- L. Begin no work which requires submittals until return of submittals with A/E's stamp and initials or signature indicating review.
- M. Maintain a complete file of all shop drawings at the job site until completion of the project.

- N. Submit to the A/E samples of all material (whether or not requested) for review and color selection. The Contractor shall not assume that the A/E has certain color samples on file. The A/E shall prepare a color schedule upon receipt of ALL samples and materials. No materials or products submitted for color selections shall be reviewed individually.

1.05 ARCHITECT/ENGINEER'S DUTIES:

- A. Review submittals with reasonable promptness; allow fourteen (14) calendar days for Architect's review and sixteen (16) calendar days for Architect's Design Consultant's review of shop drawings.
- B. Review for:
1. Design concept (general conformance) of project.
 2. Information given in Contract Documents.
- C. Review of separate item does not constitute review of an assembly in which item functions.
- D. Affix stamp and initials or signature certifying general conformance only, of submittal. Review of shop drawings by Architect will be provided only when 1.04, Contractor's Responsibilities are fulfilled.
- E. Return submittals to Contractor for distribution.

1.06 ARCHITECT'S ACTION

- A. The Architect will review the Contractor's submittals and return them with one of the following actions recorded thereon by appropriate markings:
1. **Reviewed:** the Work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents.
 2. **Make Correction Noted:** the Work may proceed provided it complies with the Architect's notations or corrections on the submittal and complies with the requirements of the Contract Documents. Acceptance of the Work will depend upon these compliances.
 3. **Revise and Resubmit or Rejected:** the Work covered by the submittal (purchasing, fabrication, delivery, or other activity) should not proceed. The submittal should be revised or a new submittal resubmitted without delay, in accordance with the Architect's notations stating the reasons for returning the submittal.
 4. **Rejected** - the work covered by the submittal is not in accordance with the Contract Documents and shall not proceed. The contractor shall resubmit without delay.

PART 2 – PRODUCTS

2.01 SCHEDULE OF MATERIALS:

- A. Within seven (7) calendar days after the Award of Contract, the Contractor shall submit to the A/E a schedule of all materials specified for the work which are likely to cause delay due to unavailability, extended delivery dates, or any other reason.

- B. The schedule shall contain the list of materials, the name of the supplier or suppliers that the Contractor contacted in attempting to purchase the material, the projected delivery dates and the reason for the anticipated delay.
- C. The Contractor shall assume full responsibility for additional costs incurred due to delay attributed to unavailability, insufficient time for delivery and/or installation of material or performance of the work, unless he has conformed with Paragraphs A and B above, except as noted in Paragraph D below. No extension of construction schedule time will be allowed.
- D. Delays in delivery of material caused by factors beyond the Contractor's control and occurring after the time stipulated in Paragraph A above, shall not be deemed to be the responsibility of the Contractor.

2.02 SHOP DRAWINGS, PROJECT DATA AND SAMPLES:

A. General:

- 1. Within ten (10) calendar days after Award of Contract, submit to the A/E, shop drawings, project data and samples required by specification sections.
- 2. The Contractor shall immediately submit to Architect for review, all shop drawings for long lead items.
- 3. Prepare and submit with Construction Schedule, a separate schedule listing dates for submission and dates reviewed shop drawings, project data and samples shall be provided for each product.
- 4. Number of Submittals:
 - a) Unless otherwise provided in this Section only, or as otherwise requested, submit five (5) copies of all submittals required. Such submittals included are those herein specified, as well as those indicated in their respective technical specification section. The Owner and A/E shall each retain one (1) copy of each such submittal. Three (3) copies shall be returned to the Contractor. The contractor shall be responsible for preparing and distributing additional copies to his suppliers and subcontractors.

B. Shop Drawings:

- 1. Original drawings, prepared by Contractor, subcontractors, supplier or distributor, which illustrate some portion of the work; showing fabrication, layout setting or erection details.
 - a) Prepared by a qualified detailer.
 - b) Identify details by reference to sheet and detail numbers shown on Contract Drawings.
 - c) Minimum sheet size 11" × 17".
- 2. Submittals shall include:
 - a) Date and revision dates.
 - b) Project title and number.
 - c) The name of: A/E, Contractor, subcontractors, supplier, manufacturer, separate detailer when pertinent.
 - d) Identification of product of material.
 - e) Relation to adjacent structure or materials.
 - f) Field dimensions, clearly identified as such.
 - g) Specification section number.
 - h) Applicable standards, such as ASTM number, or Federal Specification.

- i) A blank space, 4" × 5" for the A/E's grading stamp.
- j) Identification of deviations from Contract Documents.
- k) Contractor's stamp signed, certifying to review and approval of submittal, verification of field measurements and compliance with Contract Drawings.

C. Project Data:

1. Manufacturer's standard schematic drawings:
 - a) Modify drawings to delete information which is not applicable to project.
 - b) Supplement standard information to provide additional information applicable to project.
2. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data.
 - a) Clearly mark each copy to identify pertinent material products or models.
 - b) Show dimensions and clearances required.
 - c) Show performance characteristics and capacities.
 - d) Show wiring diagrams and controls.

D. Samples:

1. Physical examples to illustrate materials, equipment or workmanship, and to establish standards by which complete work is judged.
 - a) Office samples: Of sufficient size and quantity to clearly illustrate:
 - 1) Functional characteristics of product or material, with integrally related parts and attachment devices.
 - 2) Full range of color samples.

E. Upon completion of the project, the Contractor shall provide the Owner with a complete package containing two (2) sets of all project-related shop drawing submittals.

- F. Time lapse videography is required for this project. Videography equipment is to be positioned in such a manner that the end product video fully documents the deconstruction and reconstruction of the tower and roofing work.

2.03 SCHEDULE OF VALUES

- A. Within thirty (30) days of the Award of the Contract or fifteen (15) days prior to the first Application for Payment (whichever is first), submit a detailed Schedule of Values for the project by technical specification section, and coordinated with the Progress Schedule.
- B. Include all cash allowances as line items.
- C. Prepare Schedule of Values in the C.S.I. format as is herein.
- D. Each item in the Schedule of Values shall include its proper share of overhead and profit. This schedule, when approved by the A/E, shall be used only as a basis for the Contractor's Applications for Payment.

2.04 PROJECT PHASING PLAN

- A. Within thirty (30) calendar days of the Award of Contract, prepare and issue for A/E review a Project Phasing Plan, utilizing the Construction Phasing Plan drawing as the basis for development of the Contractor prepared plan.
 - 1. Contractor to provide for a period for of not less than sixty (60) days for the commissioning of all systems and for the installation of Owner provided fixtures/furniture/furnishings prior to the demolition of the existing occupied building – Refer to Section 01015 and Section 01100 for additional information.

2.05 SITE UTILIZATION/STAGE PLAN

- A. Within thirty (30) calendar days of the Award of Contract, prepare and issue for A/E review a Site Utilization/Staging Plan showing at a minimum, the following area(s):
 - 1. Existing conditions including, but not limited to the existing buildings, parking areas, temporary parking areas, hardscape, landscape and lawns.
 - 2. Areas to remain public and be occupied by the public and during construction.
 - 3. Areas to be restricted to the Contractor and Construction Crews.
 - 4. Contractor provided six-foot (6') high construction fencing that is properly secured and maintained around project site in approximate locations shown on the site plan allowing access to all egress doors designated by the Owner. Provide visual screening on fence using fabric approved by the Owner.
 - 5. Site entrance and paths of egress, which must be clearly marked with signage and language approved in advance by the Owner.
 - 6. Staging areas for material, equipment and dumpsters must be situated within the project fenced-in areas.
 - 7. Construction offices and other temporary facilities (refer to section 01500 "temporary facilities) locations.
- B. Large deliveries of materials or equipment that may block parking or access to the roadways or parking lot areas shall occur prior to 7:30am. Use of areas outside of the project area will be permitted during off-hours is permissible provided such use is coordinated with the Owner at least 72 hours in advance.
- C. For activities requiring closure of the parking lot, roadways and/or walkways, the Contractor is responsible for all temporary barriers and Police details to route pedestrians and vehicular traffic.

PART 3 – EXECUTION:

3.01 IDENTIFICATION OF SUBMITTALS:

- A. Consecutively number all submittals.
 - 1. When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new transmittal number.
 - 2. On re-submittals, cite the original submittal number for reference.
- B. Accompany each submittal with a letter of transmittal showing all information required for identification and checking.
- C. On at least the first page of each submittal, and elsewhere as required for positive identification, show the submittal number in which the item was included.

- D. Maintain an accurate submittal log for the duration of the work, showing current status of all submittals at all times. Make the submittal log available to the Architect for his review upon request.

3.02 GROUPING OF SUBMITTALS:

- A. Unless otherwise specified, make submittals in groups containing all associated items to assure that information is available for checking each item when it is received.
 - 1. Partial submittals may be rejected as not complying with the provisions of the Contract.
 - 2. The Contractor may be held liable for delays so occasioned.

3.03 ARCHITECT'S REVIEW:

- A. Review by the Architect does not relieve the Contractor from responsibility for errors or omissions which may exist in the submitted data.
- B. Revisions:
 - 1. Make revisions required by the Architect.
 - 2. If the Contractor considers any required revision to be a change, he shall so notify the Architect as provided for in the General Conditions.
 - 3. Make only those revisions directed or approved by the Architect.

END OF SECTION 01330

**SECTION 01350
SUBMITTAL PROCEDURES**

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide types of submittals listed in individual sections and number of copies required below.
1. Shop drawings, reviewed and annotated by the Contractor - transparency and two black line prints. Note: at project closeout, provide two (2) complete printed packages and two (2) complete digital packages (USB flash drives) consisting of all project submittals for Owner's use.
 2. Product data – Four (4) hard copies and four (4) digital copies (USB flash drives).
 3. Samples - 2, plus extra samples as required to indicate range of color, finish, and texture to be expected.
 4. Inspection and test reports – Four (4) hard copies and four (4) digital copies (USB flash drives).
 5. Warranties – Four (4) hard copies and four (4) digital copies (USB flash drives).
 6. Survey data – Four (4) hard copies and four (4) digital copies (USB flash drives).
 7. Closeout submittals – Four (4) hard copies and four (4) digital copies (USB flash drives).
 8. Daily Log of activities indicating areas of work, crews on site, manpower utilized, testing, site deliveries, etc.
 9. Project photographs – (32) 8x10 color prints for each month of construction and at beginning and end of construction.
 - a. Project Photographs taken by either the Contractor or by a Professional photographer.
 - b. Photographs are to be provided as specified with the following modifications:
 - 1) 8X10 prints on to be on glossy photograph paper.
 - 2) Each photograph is to be accompanied by and inserted in clear protective sleeve (1 sleeve per photograph).
 - 3) Monthly photographs are to be assembled and submitted to the Architect for record in a standard duty white 1 inch thick three ring view binder.
 - 4) Each photograph is to be labeled with project name, name of contractor, date of photos and view description in the bottom right-hand corner of the photograph with a permanent white label affixed to the photograph.
 - a) Labels are to be Standard White Matte 2.625" x 0.875" labels.
 - b) Labels are to be set no more than 1/4inch from the right hand and bottom edge of the paper and no less than 1/8inch from the right hand and bottom edge of the paper
 - c) Text on labels is to be as follows:
 1. Color = black
 2. Font = arial
 3. Size = 10pt
 - c. Digital Photographs –Provide four (4) digital copies (USB flash drives) containing all photographic documentation taken throughout construction.
 10. Time lapse videography: Provide four (4) digital copies (USB flash drives) containing time lapse videography taken from the beginning through the end of construction.
- B. Comply with project format for submittals.
- C. Comply with submittal procedures established by Architect including Architect's submittal and shop drawing stamp. Provide required resubmittals if original submittals are not approved. Provide distribution of approved copies including modifications after submittals have been approved.

- D. Samples and shop drawings shall be prepared specifically for this project. Shop drawings shall include dimensions and details, including adjacent construction and related work. Note special coordination required. Note any deviations from requirements of the Contract Documents.
- E. Provide warranties as specified; warranties shall not limit length of time for remedy of damages Owner may have by legal statute. Warranties shall be signed by contractor, supplier or installer responsible for performance of warranty.

PART 2 - PRODUCTS - Not Applicable To This Section

PART 3 - EXECUTION - Not Applicable To This Section

END OF SECTION 01350

SECTION 01400
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

1.02 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate. Comply with manufacturers' tolerances.

1.03 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, complies with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

1.04 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from the Architect before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by licensed persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with secure anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.05 VERIFICATION OF CREDENTIALS AND LICENSES

- A. Persons employed on the project site shall have appropriate and current credentials and licenses in their possession, at the project site, for the work they are performing.
- B. Owner's Representative will be reviewing Contractor's Certified Payroll Records for conformance with Prevailing Wage Requirements.
- C. A Background Criminal Investigation (B.C.I.) may be required of the Contractor and his subcontractors prior to award. The Contractor shall complete this task and shall do so within a ten (10) workday allotment of time, prior to award of contract.

- D. Those persons without the appropriate credentials and licenses, including B.C.I.'s, will be subject to dismissal from the project site.

1.06 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to perform the following as applicable and to initiate instructions when necessary.
 - a. Observe site conditions.
 - b. Conditions of surfaces and installation.
 - c. Quality of workmanship.

1.07 CONTRACTOR'S QUALITY CONTROL

- A. Perform quality control during installation.

1.08 MOCK-UP REQUIREMENTS

- A. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals and finishes. Accepted mock-ups shall be a comparison standard for the remaining Work.
- B. Where mock-up has been accepted by Architect and no longer needed, remove mock-up and clear area when directed to do so.

1.09 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Contractor will employ and Owner shall pay for services of an independent testing agency to perform specified testing and inspection.
- B. As indicated in individual specification sections, Contractor shall employ and Owner shall pay for services of an independent testing agency to perform other specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Construction Documents.
- D. Contractor Employed Agency:
 - a. Testing Agency : Comply with requirements of ASTM E329, ASTM E543, ASTM E699, ASTM C1021, ASTM 1077, ASTM C1093, and ASTM D3740.
 - b. Inspection Agency: Comply with requirements of ASTM D3740 and ASTM E329.
 - c. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
 - d. Laboratory Staff: Maintain a full-time registered Engineer on staff to review services.
 - e. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 - PRODUCTS - Not Applicable To This Section

PART 3 – EXECUTION - Not Applicable To This Section

END OF SECTION 01400

SECTION 01500
TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 SUMMARY

- A. The General Contractor shall be responsible for providing and maintaining all temporary facilities until Substantial Completion. Removal of such prior to Substantial Completion must be with the concurrence of the Architect. The General Contractor bears full responsibility for providing any facility removed prior to Substantial Completion if required for the Work.

1.02 SECTION INCLUDES

- A. Temporary Utilities:
 - Temporary electricity.
 - Temporary lighting for construction purposes.
 - Temporary heating.
 - Temporary cooling.
 - Temporary ventilation.
 - Telephone service.
 - Temporary water service.
 - Temporary sanitary facilities.
- B. Construction Facilities:
 - Field offices and sheds.
 - Hoisting.
 - Parking/Traffic.
 - Progress cleaning and waste removal.
 - Project identification.
 - Traffic regulation.
- C. Temporary Controls:
 - Barriers.
 - Enclosures and fencing.
 - Security.
 - Fire detection.
 - Water control.
 - Dust control.
 - Erosion and sediment control.
 - Noise control.
 - Pest control.
 - Pollution control.

Rodent control.

- D. Removal of utilities, facilities, and controls with reseeding and repair of grounds.

1.03 FIELD OFFICES

- A. The General Contractor shall provide a suitable office at the site for use by General Contractor personnel.
- B. The offices shall be set in a location approved by the Owner, and shall be maintained by the General Contractor in a clean and orderly condition.
- C. Do not use existing facilities for storage.
- D. Job meetings will be held on site at a location in a General Contractor provided office space. General Contractor to provide space adequate to house a 10-12 person conference table and chairs.
- E. Storage Areas and Sheds: Size to the storage requirements for the products of the individual Sections, allowing for access and orderly provision for the maintenance and for the inspection of Products to the requirements of Section 01 60 00. Containers will be permitted within the project limit line.
- F. Preparation: Fill and grade the sites for the temporary structures to provide drainage away from the buildings.
- G. Removal: At the completion of the Work remove the buildings, foundations, utility services, and debris. Restore the areas.

1.04 TEMPORARY TELEPHONES

- A. The General Contractor shall provide, maintain, and pay for cellular phone service for the use of the General Contractor's authorized personnel and Subcontractors, and communications with Architect at the time of project mobilization.
- B. The General Contractor shall pay for all calls and charges in connection therewith.
- C. The building telephone shall not be used by the General Contractor.

1.05 SECURITY

- A. Security Program:
 - a. Protect the Work, the existing premises, or the Owner's operations from theft, vandalism, and unauthorized entry.
 - b. Initiate the program in coordination with the Owner/Architect at mobilization.
 - c. Maintain the program throughout the construction period until Owner occupancy of each designated area.
- B. Entry Control: Coordinate the access of the Owner's personnel to the site in coordination.

1.06 BARRIERS

- A. Provide barriers to allow for the Owner's use of the site and to protect existing facilities

and adjacent properties from damage from the construction operations, or demolition.

- B. Provide barricades and covered walkways required by the Owner for public and personnel access to the existing occupied building and for public rights- of-way.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 ENCLOSURES AND FENCING

- A. Construction: Provide 6-ft. high commercial grade chain link fence, with privacy scrim around on-site equipment or areas of site disturbance for the period required to protect work and the public. Equip with vehicular and pedestrian gates with locks. Provide one set of keys to all gates and door locks to the Owner.
- B. Perform adjustment to the proposed layout as may be directed by the Owner.

1.08 TEMPORARY STAGING, STAIRS, CHUTES

- A. Except as otherwise specified, the General Contractor shall furnish, install, maintain in safe condition, and remove all scaffolds, staging, and planking, as required for the use of all trades for proper execution of the Work.
- B. The General Contractor shall furnish, install, maintain, and remove all temporary ramps, sidewalk bridging, stairs, ladders, and similar items as required for the use of all trades for the proper execution of the Work.

1.09 HOISTING FACILITIES

- A. General Contractor is responsible for all hoisting required to facilitate, serve, stock, clean, and complete the Work. Include all costs for Operating Engineers, fuel, delivery and removal, mobilization, staging, protection of grades and surfaces, and equipment.

1.10 FIRE DETECTION

- A. Comply with the Owner's insurance underwriting standards and insurer recommendations for Hot Work, sprinkler impairment, and site maintenance.

1.11 TRAFFIC REGULATION

- A. Signs, Signals, And Devices:
 - a. Post Mounted and Wall Mounted Traffic Control and Informational Signs: As approved by local jurisdictions.
 - b. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.
 - c. Flag person Equipment: As required by local jurisdictions.
 - d. Police/Fire Details: Provide all police details as required by local jurisdictions, including payment directly to applicable jurisdiction. Coordinate with city and state as required.
- B. Flag Persons: Provide trained and equipped flag persons to regulate the traffic when construction operations or traffic encroach on the public traffic lanes.
- C. Flares and Lights: Use flares and lights during the hours of low visibility to delineate the

traffic lanes and to guide traffic.

- D. Haul Routes:
 - a. Consult with the authority having jurisdiction, establish the public thoroughfares to be used for haul routes and site access.
- E. Traffic Signs and Signals:
 - a. At approaches to the site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct the construction and affected public traffic.
 - b. Install and operate automatic traffic control signals to direct and maintain the orderly flow of traffic in areas under the General Contractor's control, and areas affected by the General Contractor's operations.
 - c. Relocate as the Work progresses, to maintain effective traffic control.
- F. Removal:
 - a. Remove equipment and devices when no longer required.
 - b. Repair damage caused by installation.
 - c. Remove post settings to a depth of 2 feet.

1.12 PARKING AND ACCESS TO THE BUILDING

- A. Full access to the buildings must be maintained at all times, for use by Owner.
- B. Workers must park in area provided by the General Contractor. See Site Utilization Plan.
- C. Street parking may be permitted, General Contractor to review with Owner's Project Manager and Architect prior. Tracked vehicles are not allowed on paved areas.
- D. Provide and maintain access to fire hydrants and control valves free of obstructions.
- E. Remove mud from construction vehicle wheels before entering streets. Cleanup dirt, rocks, and debris left on street from construction vehicles.
- F. Maintenance:
 - a. Maintain the traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
 - b. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain the paving and drainage in original, or specified, condition.
- G. Removal, Repair:
 - a. Remove temporary materials at Substantial Completion.
 - b. Remove underground work and compacted materials to a depth of 2 feet; fill and grade the site as specified.
 - c. Repair existing and permanent facilities damaged by use, to the original or specified condition.

1.13 WEATHER PROTECTION

- A. "Weather Protection" means the temporary protection of that Work adversely affected by moisture and wind. The General Contractor shall furnish and install "Weather Protection" material and be responsible for all costs associated with the same.
- B. The General Contractor shall assume the entire responsibility for weather protection

during construction (until Substantial Completion), and shall be liable for any damage to any Work caused by failure to supply proper weather protection and proper ventilation.

- C. It is to be specifically understood that the General Contractor shall do no work under any conditions deemed unsuitable by the Architect to the satisfactory execution of the Work. This provision shall not constitute any waiver, release, or lessening of the General Contractor's obligation to bring the Work to Substantial Completion within the period of time set forth in the Contract Documents.

1.14 TEMPORARY SANITARY FACILITIES

- A. The General Contractor shall provide and service an adequate number of toilet booths with chemical type toilets for use by all construction personnel. Trades people will not be permitted to use existing facilities within the building.
- B. The toilets shall be staged in a location approved by the Owner and shall be maintained by the General Contractor in a clean and orderly condition in compliance with all local and state health requirements.
- C. The General Contractor may not use portions of the Owner's sanitary system.

1.15 TEMPORARY WATER

- A. The General Contractor shall provide an adequate supply of cool drinking water with individual drinking cups for personnel on the job.
- B. The General Contractor to carry the cost of temporary water to the project site. The General Contractor will not utilize the Owner's existing water system.

1.16 TEMPORARY ELECTRICITY

- A. The General Contractor is to pay the energy-related costs during construction. The General Contractor shall make arrangements for, and furnish and install all necessary equipment to provide temporary power for his use during construction.
- B. Temporary electrical Work shall be performed under the direct supervision of at least one master electrician, who will be present on the project at all times when such work is being performed.
- C. Temporary Work of a special nature, not otherwise specified hereunder, shall be provided, maintained, and paid for the trade requiring same.
- D. All temporary Work shall be provided in conformity with the National Electric Code, State laws, and requirements of the power company.
- E. The General Contractor shall dismantle and completely remove from the project site, temporary electrical facilities upon Substantial Completion.
- F. Provide power outlets, with branch wiring and distribution boxes located at each floor or as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment. All flexible power cords shall be suspended with hangers to eliminate trip hazards.
- G. Provide main service disconnect and over-current protection at a convenient location or a

feeder switch at the source distribution equipment or meter.

- H. Permanent convenience receptacles may not be utilized during construction.
- I. Provide distribution equipment, wiring, and outlets to provide single-phase branch circuits for power. Provide 20-ampere duplex outlets, single-phase circuits for power tools.

1.17 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain incandescent lighting for construction (interior & exterior) operations to achieve a minimum lighting level of 2 watt/sq. ft. (21 watt/sq m).
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- C. Maintain lighting and provide routine repairs. The General Contractor shall furnish, install, and maintain lamps in operating condition.
- D. Permanent building lighting may be utilized during construction where not removed.

1.18 TEMPORARY HEATING

- A. Supplement with temporary heat devices if needed to maintain the specified conditions for construction operations even in existing buildings.
- B. Maintain a minimum ambient temperature of 55 degrees F in the areas where construction is in progress, unless indicated otherwise in the product Sections.
- C. In areas of work with mechanical hot-air heating, clean units and replace filters after Substantial Completion.
- D. Do not use new equipment for heating during construction.

1.19 TEMPORARY COOLING

- A. The General Contractor to pay for all costs associated with climate control of the newly constructed areas until Substantial Completion. The General Contractor may not use new equipment for temporary climate control.
- B. Maintain a maximum ambient temperature of 75 degrees F in the areas where construction is in progress, unless indicated otherwise in the specifications.
- C. Do not use new equipment for cooling during construction.

1.20 TEMPORARY VENTILATION

- A. Ventilate the enclosed areas to achieve a curing of materials, to dissipate humidity, and to prevent the accumulation of dust, fumes, vapors, or gases.
- B. If newly installed ventilation fans are used during construction, clean fans in areas of work after Substantial Completion.

1.21 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain the site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean the interior areas prior to the start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from the site daily, as necessary to prevent an on-site accumulation of waste material, debris, and rubbish, and dispose off-site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.22 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by the construction operations.

1.23 PEST CONTROL

- A. Provide methods, means, and facilities to prevent pests and insects from damaging the Work, or entering the facility.

1.24 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent the contamination of soil, water, and the atmosphere from discharge of noxious, toxic substances, and pollutants produced by the construction operations.

1.25 RODENT CONTROL

- A. Provide methods, means, and facilities to prevent rodents from accessing or invading the premises.

1.26 WATER CONTROL

- A. The General Contractor for grading the site to drain. Maintain excavations free of water. Provide, operate, and maintain the pumping equipment.
- B. Protect the site from puddling or running water. Provide water barriers as required to protect the site from soil erosion.
- C. Refer to civil drawings and specifications for additional information regarding site preparation and erosion control.

1.27 DUST CONTROL

- A. Execute the Work by methods to minimize raising dust from construction operations.
- B. Provide positive means to prevent air-borne dust from dispersing into the atmosphere.

1.28 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- B. Minimize the amount of bare soil exposed at one time.
- C. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
- E. Periodically inspect the earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.29 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion.
- B. Remove the temporary underground installations to a minimum depth of 2 feet. Grade the site as indicated.
- C. Clean and repair the damage caused by installation or use of temporary work.
- D. Restore the existing and new facilities used during construction to their original condition.
- E. Restore any temporary exterior laydown or storage areas to the original condition. After each use, regrade and reseed as required to meet this requirement.

PART 2 - PRODUCTS

2.01 GENERAL

- A. At the General Contractor's option, portable or mobile buildings or trailers may be used if tied down adequately and modified properly for office use subject to the Owner's approval.
- B. Materials used for the field office may be new or used, but shall be serviceable, adequate for the required purpose, and shall not violate applicable codes or regulations.
- C. Ownership of the equipment furnished, unless other wise specified by the Owner, will be that of the General Contractor.

PART 3 - EXECUTION - NOT USED.

END OF SECTION 01500

SECTION 01550
PROJECT MEETINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Contractor shall schedule and administer pre-construction meetings, periodic progress meetings, and schedule meetings throughout the progress of the work.
 - 1. Prepare agenda for meetings unless otherwise directed in writing by the Architect.
 - 2. Distribute written notice of each meeting unless otherwise directed in writing by the Architect.
 - 3. Make physical arrangements for meetings.
 - 4. Preside at meetings unless otherwise directed in writing by the Architect.
 - 5. Prepare minutes of meetings unless otherwise directed in writing by the Architect.
- B. Representatives of contractors, subcontractors and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. A/E will attend meetings to ascertain that work is expedited consistent with Contract Documents and the Construction Schedules.
- D. Related Work:
 - 1. Documents affecting the work of this Section include, but are not necessarily limited to the Contract, AIA 201, and Sections in Division 1 of these Specifications.
 - 2. The Contractor's relations with his subcontractors and materials suppliers, and discussions relative thereto, are the Contractor's responsibility and normally are not part of project meetings content.

1.02 QUALITY ASSURANCE:

- A. For those persons designated by the Contractor to attend and participate in project meetings, provide required authority and commit the Contractor to solutions agreed upon in the project meetings.

1.03 SUBMITTALS:

- A. Make submittals of shop drawings, samples, substitution requests, and other items in accordance with the provisions of this section.

PART 2 – PRODUCTS:

Not Used.

PART 3 – EXECUTION:

3.01 PRE-CONSTRUCTION MEETING

- A. Schedule within ten (10) calendar days after date of Purchase Order.

1. Minutes:
 - a.) The Contractor shall compile minutes of each project meeting (unless otherwise directed in writing by the Architect) and will furnish three copies to the Architect and required copies to the Owner.
 - b.) Recipients of copies may make and distribute such other copies as they wish.

B. Locations: On Site. (Location to be determined)

C. Attendance:

1. Owner's Representative
2. Clerk of the Works (If applicable)
3. A/E and his/her professional consultants
4. Contractor's Project Manager
5. Contractor's Superintendent
6. Major Subcontractors

D. Suggested Agenda:

1. Distribution and discussion of:
 - a) List of major subcontractors and suppliers.
 - b) Projected Construction Schedules
2. Critical work sequencing.
3. Major equipment deliveries and priorities.
4. Project Coordination
 - a) Designation of responsible personnel.
5. Procedures and processing of:
 - a) Field decisions
 - b) Proposal requests
 - c) Submittals
 - d) Change Orders
 - e) Applications for Payment
6. Adequacy of distribution of Contract Documents.
7. Procedures for maintaining Record Documents.
8. Use of premises:
 - a) Office, work and storage areas.
 - b) Owner's requirements.
9. Construction facilities, controls and construction aids.
10. Temporary utilities.
11. Safety and first-aid procedures.
12. Security procedures.
13. Housekeeping procedures.

3.02 PROGRESS MEETINGS:

- A. Schedule regular (bi-weekly) periodic meetings, as required.
- B. Hold called meetings as required by progress of work.
- C. Location of Meetings: The project field office of the Contractor or other location as determined necessary.

D. Attendance:

1. Owner, Contractor, A/E and his professional consultants as needed or when requested by the Owner.
2. Subcontractors as appropriate to the agenda.
3. Suppliers as appropriate to the agenda.
4. Others.

E. Suggested Agenda:

1. Review and approval of minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Field observations, problems, conflicts.
4. Problems which impede Construction Schedule.
5. Review of off-site fabrication and delivery schedules.
6. Corrective measures and procedures to regain projected schedule.
7. Revisions to Construction Schedule.
8. Plan progress, schedule, during succeeding work period.
9. Coordination of schedules.
10. Review submittal schedules; expedite as required.
11. Maintenance of quality standards.
12. Life/safety issues.

F. Meeting Minutes Format:

1. Refer to Section 01550.1 for sample meeting format.
Note: The format of the Meeting Minutes can be modified with the written approval of the Architect.

G. Contract Documents:

1. **The General Contractor shall bring to every meeting:**
 - a) **Twelve (12) Copies of the following:**
 - i. **Meeting Minutes**
 - ii. **Two week look ahead schedule**
 - iii. **RFI Log**
 - iv. **Priority Submittals**
 - v. **Contract Modification Log**
 - b) **One (1) complete set of drawings and project manual, in addition to the one (1) on-site as-built set of drawings and project manual.**

END OF SECTION 01550

SECTION 01551

FORMAT FOR MEETING MINUTES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The following is a sample format that can be used for all Meeting Minutes

CONSTRUCTION MEETING #8 Meeting Minutes

DATE: Month/Day/Year
TIME: Start Time – End Time
LOCATION: Meeting Location
PROJECT: **Project Name**

PRESENT: Name Company (Acronym)
 Name Company (Acronym)
 Name Company (Acronym)

These notes were prepared to represent instruction, authorizations and discussions during the meeting as dated above. If you find errors or omissions, please advise immediately. All parties should proceed with any directions or action, using these minutes as the written authorization.

Old Business:

A review of the Minutes from Construction Meeting #XX was performed, and the following items were deemed closed:

Items 1.05, 1.27, and 7.02.

The following are outstanding items (italicized) along with updates discussed during this meeting.

5.01 *Initial Item #1 notes from Construction Meeting #5
(11/12/15) Update on this item during the next Construction Meeting #6.
(11/19/15) Update on this item during the next Construction Meeting #7.*

Most recent Update on this item.

New Business:

8.01 Discussion on Item #1 during Construction Meeting #8
8.02 Discussion on Item #2 during Construction Meeting #8

Project Log Updates and Look Aheads:

RFI Log: Include a summary of outstanding RFI's.

RFPCO Log: Include a summary of outstanding RFPCO's (Request for Proposals for Potential Change Orders)

PCO Log: Include a summary of PCO's (Potential Change Orders) awaiting Owner/Architect approval.

Project Look Ahead - summary of activity for the time until the next meeting.

Prepared by: Name of Individual who prepared the minutes
 Company

Copies to: Those in attendance and:
 The names of those individuals to receive copies but were not in attendance.

PART 2 – PRODUCTS:

Not Used.

PART 3 – EXECUTION:

Not Used.

END OF SECTION 01551

SECTION 01600
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide products from one manufacturer of each type or kind as applicable. Provide secondary materials as acceptable to manufacturers of primary materials.
- B. Provide products selected or equal approved by Architect. Products submitted for substitution shall be submitted with complete documentation and include construction costs of substitution including related work.
- C. Request for substitution must be in writing. Conditions for substitution include:
 - 1. An 'or equal' phrase in the specifications.
 - 2. Specified material cannot be coordinated with other work.
 - 3. Specified material is not acceptable to authorities having jurisdiction.
 - 4. Substantial advantage is offered to the Owner in terms of cost, time, or other valuable consideration.
- D. Substitutions shall be submitted subsequently to the opening of bids but prior to award of contract, unless otherwise acceptable. Approval of shop drawings, product data, or samples containing substitutions is not an approval of a substitution unless items are clearly presented as a substitution at the time of submittal.
- E. In making request for substitution, Bidder/Contractor represents:
 - 1. He has personally investigated the proposed product or method and determined that it is equal or superior in all respects to that specified.
 - 2. He will provide the same guarantee for substitution as for product or method specified.
 - 3. He will coordinate installation of accepted substitution into work, making such changes as may be required for work to be complete in all respects.
 - 4. He waives all claims for additional costs related to substitution which consequently becomes apparent.
 - 5. Cost data is complete and includes all related costs under his/her Contract, but excludes:
 - a) Costs under separate contracts.
 - b) Architect/Engineer's redesign.

PART 2 - PRODUCTS - Not Applicable to This Section

PART 3 - EXECUTION - Not Applicable to This Section

END OF SECTION 01600

SECTION 01630

WARRANTY

PART 1 - GENERAL

1.01 SUMMARY

- A. The Contractor shall submit a written labor-and-material warranty covering his work for a period of **one (1)** year. All warranties shall go into effect on the date of Substantial Completion.
- B. Refer to the General Conditions of the Contract for Construction for additional information.

PART 2 - PRODUCTS - Not Applicable to This Section

PART 3 - EXECUTION - Not Applicable to This Section

END OF SECTION 01630

SECTION 01660

CLEANING UP

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Work Included: Throughout the construction period, maintain the site in a standard of cleanliness as described in this Section.
- B. Related Work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, the Contract, AIA 201, and Sections in Division 1 of these Specifications.
 - 2. In addition to standards described in this Section, comply with requirements for cleaning as described in pertinent other sections of these specifications.

1.02 QUALITY ASSURANCE:

- A. Conduct daily inspection, and more often if necessary, to verify that requirements for cleanliness are being met.
- B. In addition to the standards described in this section, comply with pertinent requirements of governmental agencies having jurisdiction.

1.03 RESPONSIBILITIES OF THE CONTRACTOR:

- A. The General Contractor shall be responsible for the work of this Section, however, each subcontractor engaged upon the work shall bear his/her full responsibility in cleaning up immediately each day upon completion of his work in accordance with the provisions of this Section or other applicable Sections of the Specifications and shall cooperate with the Contractor to that effect.
- B. The above shall in no way be construed to relieve the Contractor of his responsibility for leaving all work in a clean and proper condition, satisfactory to the Owner and the A/E.

1.04 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Safety Standards: Maintain project in accordance with the following safety and insurance standards: Federal Occupational Safety and Health Act - Latest Edition.
- B. Fire Protection: Store volatile waste in approved metal containers and remove it from premises daily.
- C. Pollution Control: Conduct clean-up and disposal operations to comply with local ordinances and anti-pollution laws.
 - 1. Burning or burying rubbish and waste materials on the project site is not permitted.
 - 2. Disposal of volatile fluid wastes (such as mineral spirits, oil or paint thinner) in storm sanitary sewer systems or into streams or waterways is not permitted.

PART 2 - PRODUCTS:

2.01 CLEANING MATERIALS:

- A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- B. Use cleaning materials only on surfaces recommended by cleaning materials manufacturer.

PART 3 - EXECUTION

3.01 DURING CONSTRUCTION:

- A. Oversee cleaning and ensure the grounds are maintained free from accumulations of waste material and rubbish.
- B. Sprinkle dusty debris with water and calcium chloride as needed. Calcium chloride shall be utilized only as directed by the Architect.
- C. At reasonable intervals daily, during the progress of work, clean-up site and access and dispose of waste materials, rubbish, and debris.
- D. Do not allow waste material, rubbish, and debris to accumulate and become an unsightly or hazardous condition.
- E. Remove waste materials, rubbish and debris from the site and legally dispose of it at public or private dumping areas off the Owner's property.
- F. Vacuum clean applicable interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for acceptance or occupancy.
- G. Lower waste materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.
- H. Schedule cleaning operations so that dust and other contaminants resulting from the cleaning process will not fall on wet newly painted surfaces.

3.02 FINAL CLEANING:

- A. Use experienced workmen, or professional cleaners for final cleaning.
- B. At completion of construction and just prior to acceptance or occupancy, conduct a final inspection of exposed exterior and interior surfaces.
- C. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from interior and exterior surfaces.
- D. Repair, patch and touch-up marred surfaces to match adjacent surfaces.
- E. Broom clean paved surfaces; rake clean other surfaces of grounds, daily.
- F. Replace air conditioning filters if units were operated during construction.
- G. Clean ducts, blowers and coils if air conditioning units were operated without filters during construction.
- H. Maintain cleaning until the work area is utilized by the Owner.

END OF SECTION 01660

SECTION 01670

PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Any damage to buildings, roads, public roads, bituminous concrete areas, fences, lawn areas, trees, shrubbery, poles, underground utilities, etc. shall be made good by and at the Contractor's own expense, all to the satisfaction of the Owner. The Contractor shall patch, repair and/or replace all adjacent materials and surfaces damaged after the installation of new work at no expense to the Owner. All repair and replacement work shall match the existing in kind and appearance.

PART 2 - PRODUCTS - Not Applicable to This Section

PART 3 - EXECUTION - Not Applicable to This Section

END OF SECTION 01670

SECTION 01700
EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. The following are prerequisites to Substantial Completion. Provide the following:
 - 1. Punch list prepared by General Contractor and subcontractors as applicable.
 - 2. Supporting documentation.
 - 3. Warranties.
 - 4. Certifications.
- B. Provide the following prerequisites to final acceptance:
 - 1. Final payment request with supporting affidavits.
 - 2. Completed punch list.
- C. Provide a marked-up set of drawings including changes which occurred during construction.
- D. Provide the following during project closeout:
 - 1. Submission of record documents.
 - 2. Submission of maintenance manuals.
 - 3. Removal of temporary facilities.

PART 2 - PRODUCTS - Not Applicable to This Section

PART 3 - EXECUTION - Not Applicable to This Section

END OF SECTION 01700

SECTION 01711
DEMOLITION AND REPAIR

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work included: Carefully demolish and remove from the building and site those items specified to be demolished and removed. Provide patching and repairs to all surfaces as indicated and as required for a complete and proper job.
- B. Demolition shall not begin within the construction area or any other portions of the job site until all materials needed to complete the affected areas have been delivered to the job site.
- C. Scope: The demolition and repair work generally consists of, but is not necessarily limited to that work described and shown on the drawings:
 - 1. The work of this section also consists of but is not necessarily limited to that work described in Section 01100, Summary of the Work and elsewhere herein.
- D. Related Work:
 - 1. Documents affecting the work of this section include, but are not necessarily limited to, the Contract, AIA 201, and Sections in Division 1 of these specifications.
 - 2. Section 01740: Cutting and Patching.

1.02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Match existing materials unless otherwise specified.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS:

- A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 DEMOLITION

- A. By careful study of the Contract Documents, determine the location and extent of selective demolition and repairs to be performed.
- B. Prepare and follow an organized plan for demolition and removal of items:

1. Shut off, cap, and otherwise protect existing utility lines.
 2. Completely remove items scheduled to be demolished and removed, leaving surfaces clean, solid, and ready to receive new materials specified elsewhere.
 3. Completely remove all footings, foundations, and above ground and under-ground construction of all kinds.
 4. Remove rocks larger than 6" diameter, roots, and debris.
 5. In all activities, comply with pertinent regulations of governmental agencies having jurisdiction.
- C. The Contractor shall be responsible for the removal and disposal of all materials and equipment from the site and building during the project. Unless directed otherwise by the Owner, all demolition materials to be removed from the site shall be disposed of in accordance with applicable laws and regulations.
- D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- E. Demolished material shall be the property of the Contractor unless Owner otherwise directs Contractor and shall be completely removed from the job site. The Contractor shall, prior to any removal of rubbish from the site, furnish written evidence satisfactory to the Architect and/or Owner, that he has disposed of all debris from his demolition in an approved dumping location. **Owner shall have first right of refusal of any and all materials and equipment scheduled for removal.**
- F. All demolition work shall be carried out in such a manner that the existing building and site and their component parts will not be damaged. Any damage to the site or buildings located on the site shall be corrected by the Contractor, to the satisfaction of the Owner and Architect, at no additional cost to the Owner.
- G. Demolition of any of the material to be removed shall be carefully scheduled so that no portion of the buildings shall remain unprotected from the weather when work is not in progress. The Contractor and/or Subcontractor shall always have on hand temporary covers and other materials to make weather tight areas that may be without protection in the event of a sudden shower, snowfall, freezing weather, etc.

3.02 REPLACEMENTS

- A. In the event of demolition of items not so scheduled to be demolished, promptly replace such items to the approval of the Architect and at no additional cost to the Owner.

3.03 CUTTING, PATCHING, REPAIR

- A. Patch and repair all surfaces damaged as a result of the work of this Contract. When completed, patches or repairs shall not be visible to the naked eye from a distance of 5 feet.

END OF SECTION 01711

SECTION 01740
CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide cutting and patching work to properly complete the work of the project, complying with the applicable project requirements for:
 - 1. Structural work.
 - 2. Mechanical/Electrical/Plumbing/Telecommunications Systems.
 - 3. Civil work
 - 4. Visual requirements, including detailing and tolerances.
 - 5. Operational and safety limitations.
 - 6. Fire resistance ratings.
 - 7. Inspection, preparation, and performance.
 - 8. Cleaning.
- B. Do not cut and patch in a manner that would result in a failure of the work to perform as intended, decrease energy performance, increase maintenance, decrease operational life, or decrease safety performance.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Match existing materials for cutting and patching work with new materials conforming to project requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Inspect conditions prior to work to identify scope and type of work required. Protect adjacent work. Notify Owner of work requiring interruption to building services or Owner's operations.
- B. Perform work with workmen skilled in the trades involved. Prepare sample area of each type of work for approval.
- C. Cutting: Use cutting tools, not chopping tools. Make neat holes. Minimize damage to adjacent work. Inspect for concealed utilities and structure before cutting.
- D. Patching: Make patches, seams, and joints durable and inconspicuous. Comply with tolerances for new work.
- E. Clean work area and areas affected by cutting and patching operations.

END OF SECTION 01740

SECTION 01760

SURVEYS AND RECORD DRAWINGS

PART 1 - GENERAL

1.02 RECORD DRAWINGS

- A. Record Drawings shall consist of all the Contract Drawings.
- B. From the sets of drawings furnished by the Owner, the Contractor shall reserve one set for record purposes. From this set, the Contractor shall detach and furnish, at no charge, to the Mechanical and Electrical Subcontractors the drawings of their portion of the Work for the same purpose.
- C. The Contractor and the above Subcontractors shall always keep their record set on the site and note on it in colored ink or pencil, neatly and accurately, at the end of each working day, the exact location of their work as actually installed. This shall include the location and dimensions of underground and concealed Work and any architectural, mechanical, or electrical variations from the Contract Drawings. All changes, including those issued by Addendum, Change Order, or instructions by the Architect shall be recorded. Record Drawings shall be prepared for the entire project and include all Work.
- D. The Architect may periodically inspect the Record Drawings at the site. The proper and current maintenance of the information required on these drawings shall be a condition precedent to approval of the monthly requisitions for periodic payment.
- E. At Substantial Completion the Contractor shall submit the complete set of Record Drawings to the Architect. The Architect will review these drawings and return them to the Contractor with necessary comments.
- F. Upon receipt of a set of electronic media files of the original contract drawings from the Architect, the Contractor and Subcontractors shall transfer the As-Built information shown on the Record Drawings. This drafting shall be done by an experienced draftsman and match the original drawings.
- G. The Contractor shall, at its own expense, prepare two sets of prints and then submit copies of the prints to the Architect. Each sheet shall be clearly marked "Record Drawing" and bear the date of printing. Submission of accurate Record Drawings and their approval by the Architect shall be a condition precedent to final payment.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION 01760

SECTION 01780

PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 SUMMARY

- A. This section supplements the Contract, AIA 201 and all Division 1 specifications.
- B. Consult the individual sections of the specifications for specific items required under those sections.

1.02 DESCRIPTION:

- A. Work Included: Provide an orderly and efficient transfer of the completed work to the Owner.
- B. Related Work:
 - 1. Documents affecting the work of this Section include, but are not necessarily limited to, the Contract, AIA 201, and Sections in Division 1 of these Specifications.
 - 2. Activities relative to contract closeout are described in, but not necessarily limited to, the General Conditions.
 - 3. "Substantial Completion" is defined in the General Conditions, and herein.

1.03 QUALITY ASSURANCE:

- A. Prior to requesting inspection by the Architect, use adequate means to assure that the work is completed in accordance with the specified requirements and is ready for the requested inspection.

1.04 OCCUPANCY PERMIT (as applicable)

- A. The Contractor shall coordinate the efforts of all Subcontractors and obtain the Completion Certificate from the local Building Department, as required by the Building Official. The Contractor shall pay any Building Department fee associated with the Occupancy Permit.

1.05 RECORD DRAWINGS

- A. Consult the individual sections of the Specifications for the specific requirements of those sections. In cases of inconsistency the more stringent requirement, as directed by the Architect, shall be required.
- B. Prior to final payment and completion, the Contractor shall provide all Record Drawings and media (CDs, flash drives, etc.) as required under other sections of the Specifications.

1.06 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Prior to final payment and completion, the Contractor shall provide all Maintenance Instructions as required by the Contract Documents.
- B. Consult the individual sections of the specifications for the specific requirements for those sections and for further details and descriptions of the requirements.

C. OPERATING INSTRUCTIONS AND MANUALS

1. Subcontractors, installers, and suppliers shall furnish to the Contractor two sets of operating and maintenance instructions of all mechanical, electrical and manually operated equipment furnished and installed by them. Mechanical and electrical Subcontractors shall furnish instructions as specified in their respective sections.
2. The Contractor shall collect all the above instructions, bind them into two complete sets and submit them to the Architect who will deliver them to the Owner.
3. Submission of operating and maintenance instructions shall be a condition precedent to final payment.

D. INSTRUCTION OF OWNER'S PERSONNEL.

1. Where specified in the individual sections of the specifications, the Contractor and Subcontractor shall instruct the Owner's personnel at the site, in the use and maintenance of equipment installed under the Contract.
2. Submission to the Architect of a certificate of compliance with this requirement, signed by the Contractor and the Owner's Representative, shall be a condition precedent to final payment.

1.07 SUBSTANTIAL COMPLETION:

- A. When Contractor considers the work is substantially complete, he shall submit to A/E:
 1. A written notice that the work, or designated portion thereof is substantially complete.
 2. A list of items to be completed or corrected.
- B. Within a reasonable time after receipt of such notice, A/E will make an inspection to determine the status of completion.
- C. Should A/E determine that the work is not substantially complete:
 1. A/E will promptly notify the Contractor in writing, giving reasons thereof.
 2. The Contractor shall remedy the deficiencies in the work and send a second written notice of substantial completion to the A/E.
 3. A/E will re-inspect the work.
- D. When A/E concurs that the work is substantially complete he will:
 1. Prepare a Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected, as verified, and amended by the A/E.

1.08 FINAL INSPECTION:

- A. When Contractor considers the work is complete, he shall submit written certification that:
 1. Contract Documents have been reviewed.
 2. Work has been inspected for compliance with Contract Documents.
 3. Work has been completed in accordance with Contract Documents.

4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 5. Work is completed and ready for final inspection.
- B. A/E will inspect to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should A/E consider that the work is incomplete or defective:
1. A/E will promptly notify the Contractor in writing, listing the incomplete or defective work.
 2. The Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to A/E that the work is complete.
 3. A/E will re-inspect the Work.
- D. When the A/E finds that the work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.09 RE-INSPECTION FEES:

- A. Should A/E perform re-inspections due to failure of the work to comply with the claims of status of completion made by the Contractor, and site visits are required in addition to those noted previously under Substantial Completion and Final Inspection:
1. The Contractor shall compensate A/E for such additional services. A/E fees shall be charged to the General Contractor at the A/E standard hourly rate of \$175.00/hr.
 2. Processing of Final Payment to the Contractor will not be completed until full payment for additional A/E Services is made by the Contractor to the Architect.

1.10 CONTRACTOR'S CLOSEOUT SUBMITTALS AND PROCEDURES:

- A. Provide submittals to Architect that are required by governing or other authorities, including the following closeout documents. Six (6) originally executed copies of all documentation shall be submitted. **Note: these items must be submitted prior to issuance of the Final Application for Payment.**
1. AIA Document G706 - Contractor's Affidavit of Payment of Debts and Claims, latest Edition.
 2. AIA Document G706A - Contractor's Affidavit of Release of Liens, latest Edition.
 3. AIA Document G707 - Consent of Surety Company to Final Payment, latest Edition.
 4. Contractor's Certificate and Release (Architect to provide Contractor with form for Contractor to complete and return to Architect)
 5. Certificate of Completion-Consolidated (completed by Architect)
 6. Four (4) copies of the Contractor's 2-year Warrantee statement
 7. Four (4) sets As-Built Drawings, per Section 01760 herein.
 8. Four (4) sets of submittals, per Section 01330 herein
- B. Submit Final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- C. Convey fully corrected and updated set of Project Record Documents to Architect with Final Application for Payment.
- D. Evidence of compliance with requirements of governing authorities:
1. Certificate of Occupancy.

- E. Final Completion will be considered only when Architect has approved and accepted possession of required closeout documents and has determined closeout procedures are completed.
- F. Operating and Maintenance Data, Instructions to Owner's Personnel.
- G. Warranties and Bonds.
- H. Keys and Keying Schedule.
- I. Spare Parts and Maintenance Materials.

1.11 FINAL ADJUSTMENT OF ACCOUNTS:

- A. Submit a final statement of accounting to the Architect.
- B. Statement shall reflect all adjustments to the Contract Sum:
 - 1. The original Contract Sum.
 - 2. Additions and deductions resulting from:
 - a) Previous Change Orders.
 - b) Deductions for uncorrected work.
 - c) Penalties and Bonuses.
 - d) Deduction for liquidated damages.
 - e) Deductions for re-inspection payments.
 - f) Other adjustments.
 - 3. Total Contract Sum, as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.
- C. The Architect will prepare a final Change Order reflecting approved adjustments to the Contract Sum which were not previously made by Change Orders.

1.12 FINAL APPLICATION FOR PAYMENT:

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Provisions of the Contract.
- B. See 1.09 regarding inspection fees, preceding.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION 01780

SECTION 02411

DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Furnishing labor, materials and equipment necessary for demolition, dismantling, cutting and alterations as indicated, specified, or required for completion of the Work. Includes items such as the following:

1. Protection of existing improvements to remain.
2. Cleaning existing improvements to remain.
3. Disconnecting and capping utilities.
4. Removing debris, waste materials, and equipment.
5. Removal of items for performance of the Work.
6. Salvageable items to be retained by the Owner.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01110 - Summary of Work.
3. Section 01500 - Temporary Facilities.
4. Section 01740 - Cutting and Patching.
5. Division 22 — Plumbing.
6. Division 23 — HVAC.
7. Division 26 — Electrical.
8. Division 31- Earthwork

1.02 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating the extent of items and systems to be removed. Indicate items to be salvaged or items to be protected during demolition. Indicate locations of utility terminations and the extent of abandoned lines to be removed. Include details indicating methods and location of utility terminations.

1.03 QUALITY ASSURANCE

- A. Perform the Work of this section by workers skilled in the demolition of buildings and structures. Perform the Work of this section under direct superintendence at all times.
- B. Prior to commencement of Work, schedule a walkthrough with the OPM AND ARCHITECT, to confirm Owner property items have been removed from scheduled Work areas. Identify and mark remaining property items and schedule their removal.
- C. Coordinate demolition for the correct sequence, limits, and methods. Schedule demolition Work to create least possible inconvenience to the public and facility operations.
- D. Related Standard: ANSI/ASSE A10.6.

1.04 PROJECT CONDITIONS

- A. Drawings may not indicate in detail all demolition Work to be performed. Examine existing conditions to determine the full extent of required demolition.
- B. Repair damage to existing improvements or damage due to excessive demolition.
- C. Provide all measures to avoid excessive damage from inadequate or improper means and methods, improper shoring, bracing or support.
- D. If conditions are encountered that varies from those indicated, promptly notify the Architect for clarification before proceeding.

PART 2 - PRODUCTS

2.01 HANDLING OF MATERIALS

- A. Items scheduled for salvage by the Owner shall be delivered to a location designated by the OPM and Architect. Items shall be cleaned, packaged and labeled for storage.
- B. Items scheduled for reuse shall be stored on the Project site and protected from damage, theft and other deleterious conditions.

PART 3 - EXECUTION

3.01 GENERAL

- A. Protection:
 - 1. Do not commence demolition until safety partitions, barricades, warning signs and other forms of protection are installed. Refer to Section 01500 "Temporary Facilities".
 - 2. Provide safeguards, including warning signs, lights and barricades, for protection of workers, occupants, and the public.
- B. If safety of existing construction appears to be endangered, take immediate measures to correct such conditions; cease operations and immediately notify the OPM and Architect.

3.02 DEMOLITION

- A. Do not throw or drop materials. Furnish ramps or chutes as required by the Work.
- B. Remove existing construction only to extent necessary for proper installation of Work and interfacing with existing construction. Cut back finished surfaces to straight, plumb or level lines as required for a smooth transition.
- C. Where openings are cut oversize or in improper locations, replace or repair to required condition.

3.03 CUTTING EXISTING CONCRETE

- A. Cutting of existing concrete shall be performed by skilled workers familiar with the requirements and space necessary for placing concrete. Perform concrete cutting with concrete cutting wheels and hand chisels. Do not damage concrete intended to remain.
- B. Extent of cutting of structural concrete shall be as indicated on Drawings. Cutting of non-structural concrete shall be as indicated on Drawings or as reviewed by the Architect or structural engineer. Replace concrete demolished in excess of amounts indicated.
- C. Prior to cutting or coring concrete, determine locations of hidden utilities or other existing improvements and provide necessary measures to protect them from damage.

3.04 REMOVAL OF EXISTING PLUMBING AND ELECTRICAL EQUIPMENT AND SERVICES

- A. Remove existing plumbing and electrical equipment fixtures and services not indicated for reuse and not necessary for completion of the Work. Remove abandoned lines and cap unused portions of existing lines.

3.05 REMOVAL OF OTHER MATERIALS

- A. Masonry: Cut back to joint lines and remove mortar without damaging units to remain. Allow space for repairs to backing where applicable.
- B. Woodwork: Cut or remove to a joint or panel line.
- C. Roofing: Remove as required, including accessory components such as insulation and flashings. At penetrations through existing roofing, trim cut edges back to sound roofing with openings restricted to the minimum size necessary to receive Work.
- D. Sheet Metal: Remove back to joint, lap, or connection. Secure loose and unfastened ends or edges and provide a watertight condition. Re-seal as required.
- E. Glass: Remove broken or damaged glass and clean rebates and stops of glazing channels.
- F. Modular materials such as acoustical ceiling panels, resilient tile, or ceramic tile: Remove to a natural joint without leaving damaged or defective Work where joining new Work. After flooring removal, clean substrates to remove setting materials and adhesives.
- G. Gypsum Board: Remove to a panel joint line on a stud or support line.

- H. Remove existing improvements not specifically indicated or required but necessary to perform Work. Cut to clean lines, allowing for installation of Work.

3.06 PATCHING

- A. Patch or repair materials to remain when damaged by the performance of the Work of this section. Finish material and appearance of patch and/or repair Work shall match existing.

3.07 CLEANING

- A. Clean existing materials to remain with appropriate tools and equipment.
- B. Protect existing improvements during cleaning operations.
- C. Debris shall be dampened by fog water spray prior to transporting by truck.
- D. Debris pick-up area shall be kept broom-clean and shall be washed daily with clean water.
- E. Remove waste and debris, other than items to be salvaged. Turn over salvaged items to Owner, or store and protect for reuse where required. Continuously clean up and remove items as demolition Work progresses.
- F. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 02411

SECTION 02900 PLANTING

PART 1 - GENERAL

1.01 The General Conditions, Supplementary Conditions of the Contract and Division 1 of these specifications are hereby included as part of this section.

1.02 SECTION INCLUDES

- A. Furnish labor, materials, equipment, and services for, and reasonably incidental to the proper and complete provision of Landscaping.
- B. Items include, but are not necessarily limited to the following:
 - 1. Spread stockpiled loam and/or furnishing and spreading off-site loam
 - 2. Finish grading
 - 3. Seeding new lawn
 - 4. Sodding new lawn
 - 5. Furnish and install trees, shrubs and groundcovers
 - 6. Water, mulch and fertilizer provisions for trees, shrubs and groundcovers
 - 7. Prune dead or diseased wood from existing trees

1.03 REFERENCES

- A. ANSI Z260.1 - Nursery Stock, latest edition (American Association of Nurserymen, Inc.)

1.04 QUALITY ASSURANCE

- A. Subcontract landscaping work to a firm specializing in such work.
- B. All plants are to be tagged at the nursery by the Landscape Architect and other standard products sealed and delivered unbroken.
- C. Do not make substitutions without written approval. If specified landscape material is not available, obtain written approval for substitution from the Landscape Architect.
- D. Pruning of existing trees shall be performed by an arborist licensed in the State of Rhode Island.

1.05 SUBMITTALS FOR APPROVALS

- A. Certified analysis and source of off-site topsoil to be provided. Certification shall list soil additives to topsoil, rates, and type.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect all products from weather or other damaging or deteriorating conditions.
- B. Plants which have been damaged or have deteriorated in transit or storage are not acceptable.
- C. Keep plants moist, fresh and protected against exposure to sun, wind and freezing temperatures whether in the receiving yard, in transit, while being handled, or at the job site awaiting planting.
- D. Deliver trees and shrubs after preparations for planting have been completed and plant immediately.
- E. Planting Schedule: Prepare a proposed planting schedule. Schedule dates for each type of landscape work during normal seasons for such work,

Deciduous material	March 1 - May 1
Bare root material	only in dormant condition
Evergreen material	March 1 - June 1 August 15 - October 15
Seeding	April 1 - June 1 August 15 - October 15

1.07 WARRANTY

- A. Provide a warranty for tree, shrub and groundcover plantings for a minimum of one (1) year including one continuous growing season. Commence warranty on date identified in the Certificate of Final Completion.
- B. Warranty: Include coverage of plants from death or unhealthy conditions.
- C. Replacements: Plants of the same size and species as specified, planted in the next growing season, with a new warranty.
- D. Warranty lawns until final acceptance of lawns.

1.08 REGULATORY REQUIREMENTS

- A. Comply with regulatory requirements for fertilizer and herbicide composition.

- B. Plant materials certified to be free of disease of hazardous insects.

PART 2 - PRODUCTS

2.01 LOAM (for planting soil mix and as required for lawn work)

- A. Fertile, friable, medium textured sandy loam with no admixture of refuse or any natural or introduced materials toxic to plant growth and free from subsoil and stumps, roots, brush, stones, clay lumps or other extraneous matter or 1 1/2 inches in diameter. Sandy loam shall possess good filtration and permeability rates and shall possess mechanical analysis where:

85% of sand size is 0.5 to 1.0 mm *and*

95% of sand mix is between 0.5 and 2.0 sand no more than 5% of mix is less than 0.5 mm

- B. Acidity range of approximately pH 5.5 to 7.5 when tested according to methods of testing of A.O.A.C. and organic content not less than 3% nor more than 20% as determined by wet combustion method (Chromic acid reduction). Loam may be amended to meet requirements. Provide analysis prior to delivering topsoil to site, including recommended rates and types of soil additives to achieve desired mix.
- C. On site loam (stockpiled) shall be free of debris, roots and branches. It shall be made to conform to the requirements for sandy loam furnished from the Contractor as specified herein.

2.02 PEAT HUMUS

- A. Natural peat humus, free from excessive amounts of zinc, low in wood content, free from hard lumps and in shredded or granular form; acidity range approximately 5.5 pH to 7.5pH and organic matter not less than 85%, minimum water absorbing ability shall be 200% by weight on a oven-dry basis.

2.03 SEED

- A. General: Pure, live, fresh seed from commercial sources meeting and labeled in accordance with State and Federal laws, rules and regulations. All seed to have minimum germination rate of 85%. Weed seed 0%.

- 1. URI Seed Mix shall conform to the following requirements:

<i>Grass Type</i>	<i>% by weight</i>
Creeping Red Fescue	40
Baron Kentucky Bluegrass	20

Kentucky Bluegrass 98	20
Nobility Perennial Ryegrass	20

2. Seeding rate is 7 pounds per acre.

2.04 SOIL ADDITIVES

- A. Limestone: Containing up to 50% magnesium carbonate in a dry, granular form. Granular treatment to be applied at a rate recommended by test report.
- B. Lawn Starter Fertilizer: Complete fertilizer in granular form from commercial sources bearing manufacturer's analysis; applied at a rate recommended by test report.
- C. Tree and Shrub Fertilizer: Complete water-soluble controlled release fertilizer, slow-release tablets bearing manufacturer's analysis and recommendation.
- D. Post-emergent for weed control for shrub beds in accordance with manufacturer's written instructions.

2.05 MULCH

- A. Clean, well-aged, shredded pine bark free from weeds or other extraneous materials.

2.06 TREE WRAP

- A. Waterproof heavy crepe paper 4 inches wide of first quality burlap at least 8 ounces and not less than 10 inches wide. Remove after six (6) months.

2.07 ANTIDESSICANT

- A. Emulsion which provides a protective film over plant surfaces, delivered in containers of the manufacturer and mixed according to directions,

2.08 STAKING MATERIALS

- A. Guy wire: Shall be No. 12 gauge, galvanized, pliable zinc coated steel.
- B. Hose: For use in covering wire shall be 1/2 inch diameter rubber hose with fiber lining, color black or brown.
- C. Stakes (upright): 2"x 4"x 8' wood free from weakening knots or other imperfections.

2.09 WOUND DRESSING

- A. Black asphalt emulsion, “Treekote” or equal.

2.10 WATER

- A. Clean, fresh potable water.

2.11 PLANT MATERIALS

- A. Plant materials shall be of size and caliper required and comply with the Horticulture Standards of the American Association of Nurserymen (ANSI 2260-1) in all respects.
- B. Plants of other kinds than those named in the Plant Schedule on the Drawings shall not be accepted.
- C. Unless otherwise approved by Landscape Architect, all plants shall be nursery-grown in accordance with good horticultural practices and shall have been grown under climatic conditions similar to those in the locality of the project for at least nine (9) months previous to moving to the site.
- D. Replacement plants larger in size than specified may be used if approved by the Landscape Architect, provided use of larger plants does not increase the Contract price.
- E. Pruning: All plants and all tree trunks shall be measured when branches are in their normal position. Dimensions for height and requirements for spread, where specified, refer to main body of plant and not from branch-tip to branch-tip. Desired clear unbranched height of tree trunks may be created provided necessary pruning of lower branches does not Leave unsightly scars or otherwise damage trunk.

PART 3 - EXECUTION

3.01 LAWN ESTABLISHMENT/NEWLY DISTURBED AREAS

- A. Grading and spreading of topsoil in disturbed areas:
 - 1. Remove all debris and other inorganic materials on any prepared subgrades, and reshape and dress any damaged or eroded slopes, swales and other areas. Scarify and loosen subgrade to a friable condition in any areas where compaction may have occurred. Topsoil shall not be placed until subgrade is in suitable condition and free of excessive moisture or frozen materials.

2. Area shall be progressively fine graded, and machine and hand raked, with stockpiled and off-site topsoil added as required to correct depressions and other irregularities, to produce smooth and unbroken finish grades and the depth of topsoil required as four (4) inches. Where additional topsoil is placed on existing topsoil, disc harrow to mix top 4 inches.

Drawings show grading design intent to achieve a uniform grade not less than 1.25% slope. Finish grades shall conform to lines, grades, sections and shapes of lawn areas as required. Provide positive drainage. Provide smooth, uniform, rounded transitions at all changes and breaks in grade. Topsoil to be consistent depth of 1/2 inch below adjacent pavement surfaces.

3. Starter fertilizers: All required materials shall be spread and distributed into the soil at rate and amounts specified herein.

4. After establishment of finish grade, the entire area shall be rolled.

3.02 PLANTING

A. Layout: Plant pit and bed locations shall be staked on ground by Contractor and approved prior to excavation. Adjustments in locations and outline shall be made as directed in the field. Labor, equipment and new smooth stakes are to be furnished by the Contractor for this purpose.

B. Excavation

1. Excavation for planting beds and pits shall conform to the approved staked locations and outlines. The latter shall be neatly formed by means of spades and/or other approved tools. Remove from the site immediately, sod, weeds, roots and other objectionable excavated material unsuitable for backfill.

2. Pits and Beds: Size of pits shall be indicated on detailed drawings. Any excavation in excess of that required shall be replaced with planting soil.

C. Setting Plants

1. Set plant plumb at such a level that after settlement they bear the same relation to the surrounding ground as they bore to the ground from which they were dug. Settle backfill material for plants, thoroughly and properly, by firming or tamping. Accompany backfilling with thorough watering unless otherwise approved. Form saucer capable of holding water around individual plants, exclusive of plant beds, by placing ridges of planting soil around each or as directed by Owner's Representative.

2. Place balled or burlapped plants carefully in the prepared pits so the required distance from excavation walls is maintained as shown on the drawings. Remove top 1/3 of burlap from around rootball and if plastic burlap is used, remove in its entirety.

3. Backfill with approved topsoil mix and tamp around rootball to eliminate air pockets.

4. For container grown materials, remove plant from container and 'butterfly' rootball or otherwise spread roots on setting mound. Backfill shall be sifted through the roots and solidly firmed.

3.03 PRUNING OF NEW PLANT MATERIAL

- A. After planting, prune only broken or deformed branches and in such manner as to preserve the natural character of the plant
- B. Perform all pruning with sharp tools, with cuts flush and clean. Paint exposed living tissue on pruning cuts over two (2) inches in diameter with tree wound compound.
- C. Trees which have their leaders cut, or so damaged that cutting is necessary, will not be accepted. There shall be no abrasion of the bark, nor fresh cuts of limbs over 1/2 inch.

3.04 SPRAYING

- A. Spray with antidessicant with discretion and as approved by Owner's Representative.

3.05 FERTILIZING

- A. During backfill operations, place plant tablets in upper foot of backfill around perimeters at a rate of one (1) tablet per 1/2 inch of caliper or as recommended by manufacturer.

3.06 GUYING AND STAKING

- A. Immediately after planting, stake trees as indicated on Detail Drawing.
- B. Place stakes exercising care not to damage ball of earth.
- C. Guy trees to each stake near top of stake, with two strands of wire and encase in guy hose where they come in contact with trunk or where necessary to prevent damage to bark of tree. Draw guys taut, through use of turnbuckles installed and securely fastened to guys.

3.07 TRUNK WRAPPING

- A. Wrap trunks with burlap or other approved wrapping securely tied or taped at top and bottom and at two (2) foot intervals along trunk. Cover entire surface to height of first branches with wrapping. Start wrapping at the base of trees.

3.08 TAGS AND LABELS

- A. Leave all tree and label seals unbroken and visible on plant material until final inspection. Remove all seals immediately after final inspection.

3.09 MULCHING PLANTS

- A. Application of mulch should occur only after planting operations have been completed and initial watering has taken place.
- B. Mulch shall be applied a minimum of three (3) inches in depth in all planting beds, as indicated on the Drawings.

3.10 WATERING

- A. The plants shall be watered immediately following planting, preferably when two thirds of the backfill has been placed so that all air pockets are removed and the plant properly set.
- B. Soak the plants thoroughly again within 24 hours after initial planting.
- C. Additional watering shall be done at least once every week unless otherwise directed until final acceptance of the plant material.

3.11 MAINTENANCE

- A. Contractor is responsible for protection and maintenance of all work prior to final acceptance. No plants will be accepted unless they show healthy growth and satisfactory condition.

- 3.12 A. Guarantee that, upon completion and final acceptance, tree, shrub and groundcover plantings conform to requirements of the Contract Documents and that all plants are healthy and will remain so for a period of one (1) year. Such period shall commence on the date of final acceptance.
- B. At any time within a period of guarantee, the Contractor shall replace any plantings which for any reason, other than vandalism, have died or are in a dying condition, or which failed to thrive in such a manner that their usefulness or appearance have been impaired.
- C. The Owner will not maintain plantings until after guarantee period. Contractor shall not have any claim that materials have failed to thrive as a result of Owner's maintenance operations, or lack of maintenance and shall abide by the terms stated herein for guarantee and replacement of plant materials.
- D. The decision of the Owner's Representative as to the necessity to replace any plant material or repair any defects on workmanship, or cause of any

destruction or; loss, impairment of failure to thrive, shall be conclusive and binding upon the Contractor. Replacements shall be of same species and size as specified on the Drawings. All plant material replacements shall be inspected, sealed, furnished, planted and mulched as specified herein at the Contractor's Expense.

- E. 'Vandalism' is intended to mean acts, whether intentional or accidental, by other persons occurring following final acceptance, which clearly result in breakage or other damage to individual plants or plant beds, and which may reasonably be considered to be beyond the Contractor's reasonable control, as determined by the Owner's Representative.

END OF SECTION - 02900

SECTION 05400

COLD-FORMED METAL FRAMING

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, including Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Interior non-load-bearing wall framing, for framing that exceeds the height limitations of standard, nonstructural metal framing.
 - 3. Ceiling joist framing.
 - 4. Soffit framing.
- B. Related Requirements:
 - 1. Section 05500 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Cold-formed steel framing materials.
 - 2. Exterior non-load-bearing wall framing.
 - 3. Interior non-load-bearing wall framing.
 - 4. Vertical deflection clips.
 - 5. Single deflection track.
 - 6. Double deflection track.
 - 7. Drift clips.
 - 8. Ceiling joist framing.
 - 9. Soffit framing.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Environmental Product Declaration (EPD): For each product.
 - 3. Health Product Declaration (HPD): For each product.
 - 4. Construction and Demolition Waste Management Planning: Develop and implement a construction and demolition waste management plan.

- C. Shop Drawings:
 - 1. Provide Shop Drawings prepared by cold-formed steel framing manufacturer.
 - 2. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 3. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- D. Delegated Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.
- D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.
- E. Research Reports:
 - 1. For cold-formed steel framing.
 - 2. Steel framing manufacturer to have a third-party evaluation report for its products that are reviewed to the local building code or its model code (IBC 2018 and AISI S100).
 - 3. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA).
 - 1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.
- B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed steel framing that are similar to those indicated for this Project in material, design, and extent.

- D. Testing Agency Qualifications: Qualified in accordance with ASTM E329 for testing indicated.
- E. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- F. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the SFIA.
- G. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- H. Fire-Test-Response Characteristics: Where indicated, provide cold-formed steel framing identical to that of assemblies tested for fire resistance per ASTM E119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.
- I. Comply with the following AISI specifications and standards:
 - 1. AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members."
 - 2. AISI S200, "North American Standard for Cold-Formed Steel Framing - General Provisions."
 - 3. AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Standard."
 - 4. AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."
 - 5. AISI S240, "North American Standard for Cold-Formed Steel Structural Framing."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide cold-formed steel framing products by ClarkDietrich; as specified in other Part 2 articles or comparable product by one of the following current members of the SFIA:
 - 1. CEMCO; California Expanded Metal Products Co.
 - 2. Telling Industries.
 - 3. Or approved equal

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated on Drawings
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Load-Bearing Wall Framing: Horizontal deflection to be provided by Pre-Engineered Metal Building Manufacturer.
 - b. Exterior Non-Load-Bearing Framing: Horizontal deflection to be provided by Pre-Engineered Metal Building Manufacturer.
 - c. Interior Non-Load-Bearing Framing: Horizontal deflection to be provided by Pre-Engineered Metal Building Manufacturer.
 - d. Ceiling Joist Framing: Vertical deflection to be provided by Pre-Engineered Metal Building Manufacturer.
 - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1 inch.
 - 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100 and AISI S200 and ASTM C955, Section 8.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with AISI S200 and ASTM C955, Section 8 for conditions indicated.
- C. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, grade and coating designation.

- D. Steel Sheet for Vertical Deflection, Drift, Rigid, Foundation Clips: ASTM A1003/A1003M, ASTM A653/A653M, structural steel, zinc coated, grade and coating.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges.
- C. Headers and Jambs - Heavy-Duty Stud: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges.
- D. Vertical Deflection Clips: Manufacturer's standard bypass clips with horizontal standoff, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- E. Head-of-Wall Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- F. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure, as follows:
- G. Single Deflection and Firestop Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure. Install a continuous row of bridging, composed of 1-1/2-inch (38-mm) cold-formed channel secured to each stud with clip angle, or bridging, or spacer bar, at uppermost knockout, not more than 12 inches (305 mm) from top of wall.
- H. Firestop Track: Manufacturer's ceiling runner with an offset shoulder to accommodate up to 2 inches (100 mm) of deflection.
- I. U-Channel Assembly: Manufacturer's standard-length U-channel for lateral bracing for exterior curtain-wall framing.
- J. Bridging and Spacer Bar
- K. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure.
 - 2. Inner Track: Of web depth indicated.
- L. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

- M. Partial Wall Framing Connection: Connector designed to support out-of-plane loading of cantilevered partial wall systems that are unsupported at the top track.

2.5 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges.
- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Deflection Track and Firestop Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thicknesses not less than indicated for studs and in width to accommodate depth of studs.
- E. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure.
- F. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure. Install a continuous row of bridging, composed of 1-1/2-inch (38-mm) cold-formed channel secured to each stud with clip angle, or bridging, or spacer bar, at upper-most knockout, not more than 12 inches (305 mm) from top of wall.
- G. length U-channel for lateral bracing for high interior partitions constructed of structural studs.
- H. Bridging and Spacer Bar
- I. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Inner Track: Of web depth indicated, and as follows

2.6 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with enlarged service holes with stiffened flanges, and as follows:

2.7 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges.

2.8 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, Bridging, and Solid Blocking
 - 3. Web Stiffeners:
 - 4. Anchor Clips:
 - 5. End clips.
 - 6. Foundation Clips:
 - 7. Stud kickers and knee braces.
 - 8. Joist Hangers and End Closures:
 - 9. Hole-reinforcing plates.
 - 10. Backer plates.

2.9 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process in accordance with ASTM A123/A123M.
- B. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- D. Welding Electrodes: Comply with AWS standards.

2.10 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M or SSPC-Paint 20.
- B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

- E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.11 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, in accordance with referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install in accordance with Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, in accordance with Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.
- C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.
- E. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing in accordance with ASTM C1007, AISI S200, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install in accordance with Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

- H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to **[top and]** bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install **[single deep-leg deflection tracks] [proprietary single deep-leg, U-shaped steel, slotted-deflection track]** and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to **[bypassing] [infill]** studs and anchor to building structure.
 - 4. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-formed steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bar Bridging: Proprietary bridging bars installed in accordance with manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging or proprietary bridging bar within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at **centers indicated on** Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to **[top and]** bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to studs and anchor to building structure.
 - 4. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-formed steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bar Bridging: Proprietary bridging bars installed in accordance with manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

- C. Space joists not more than 2 inches from abutting walls, and as follows:
 - 1. Joist Spacing: 16 inches
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - 2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work included: Provide metal fabrication work where shown on the drawings, as specified herein, and as needed for a complete and proper installation. Work generally includes:

1. Fasteners
2. Miscellaneous metal materials and accessories

1.02 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Perform shop and/or field welding required in connection with the work of this Section in strict accordance with pertinent recommendations of the American Welding Society.

1.03 SUBMITTALS:

A. Comply with pertinent provisions of Section 01330.

1.04 PRODUCT HANDLING:

A. Comply with pertinent provisions of Section 01600.

1.05 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

2.01 MATERIALS (General)

A. In fabricating items which will be exposed to view, limit materials to those which are free from surface blemishes, pitting, rolled trade names, and roughness.

B. Comply with the following standards, as pertinent:

ASTM A36	- Steel plates, shapes and bars
ASTM A283	- Grade C - Steel plates to be bent or cold-formed
ASTM A501	- Steel tubing (hot formed, welded or seamless)
ASTM A306	- Grade 65 or ASTM A36 - Steel bars and bar size shapes
ASTM A108	- Cold finished steel bars
ASTM A336	- Cold rolled carbon steel sheets
ASTM A526	- Galvanized carbon steel sheets
ASTM A525	- (with G90 zinc)
AISI	- Type 302, A 653, Grade 33, or 304 - 22 ga. with No. 4 finish unless otherwise specified on the drawings or herein.

ASTM A53	- Gray iron castings, Grade A, Sched. 40; black finish unless otherwise noted.
ASTM A47	- Malleable iron castings
ASTM A53	- Steel pipe, Grade A, Sched. 40; black finish unless otherwise noted.
ASTM F1554	-Carbon steel, Grade 36, hot-dip-galvanized

2.02 FASTENERS:

A. General:

1. Unless otherwise indicated, 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.
 - a. Provide stainless steel fasteners for fastening stainless steel
 - b. Use compatible fastening materials. Use only hot-dipped galvanized metal, copper or stainless steel fasteners where used in conjunction with preservative-treated wood.
 - c. For roof sheathing, provide fasteners with hot-dip galvanized coating complying with ASTM A153/A153M

B. Comply with the following standards as pertinent:

1. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, where indicated, flat washers.
2. Screws for Fastening Plywood Sheathing to Metal Framing: refer to structural drawings.
3. 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.
4. Post-Installed Anchors: Chemical anchors.
 - a. Material for Exterior Locations and Where Stainless Steel Is Indicated: Group 2 (A4) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
 - b. 3/8-inch diameter, threaded anchor rod, zinc-plated or as noted on the drawings.
 - c. Modular composite mesh sleeve

2.03 MISCELLANEOUS MATERIALS AND ACCESSORIES:

- A. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Clean surfaces in accordance with Steel Structures Painting Council Sp-3, "Power Tool Cleaning".
- D. After surfaces are properly cleaned, apply the primer to a uniform 1.5 mils. dry thickness.

2.04 OTHER MATERIALS:

- A. All other materials as needed for a complete and proper installation.

2.05 FABRICATION:

- A. Except as otherwise shown on the drawings or the approved shop drawings, use materials or size, thickness and type required to produce reasonable strength and durability in the work of this section.
- B. Fabricate with accurate angles and surfaces which are true to the required lines and levels, grinding exposed welds smooth and flush, forming exposed connections with hairline joints and using concealed fasteners wherever possible.
- C. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish for the proposed use of the item.
- D. On surfaces inaccessible after assembly or erection, apply two coats on the specified primer. Change color of second coat to distinguish it from the first.
- E. Galvanizing where indicated or specified shall be performed after fabrication. Shapes, plates and bars shall be galvanized in accordance with the requirements of "Standard Specifications for the Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips" ASTM Designation A 123-71. Nuts, bolts, and washers shall be galvanized in accordance with the requirements of "Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware" ASTM Designation A 153-71 and A286. All galvanized material shall comply with specifications and marked with stamp indicating ASTM number and weight of zinc coating in ounces per square foot similar to Duncan Stamp. Notarized statement of compliance with list of galvanized items to accompany shipment of galvanized materials and furnished to A/E.
- D. Dissimilar Material: Where aluminum surfaces come in contact with metals other than stainless steel, zinc, white bronze of small area or other metals compatible with aluminum, aluminum surfaces shall be kept from direct contact with such parts by painting the dissimilar metal with a coating of zinc chromate paint, a good quality caulking placed between aluminum and dissimilar metal, or a non-absorptive tape or gasket.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 COORDINATION:

- A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

3.03 INSTALLATION:

- A. General:

1. Set work accurately into position, plumb, level, true and rack-free.

2. Anchor firmly into position.
 3. Where field welding is required, comply with AWS recommended procedures of manual-shielded metal-arc welding for appearance and quality or weld and for methods to be used in correcting welding work.
 4. Grind exposed welds smooth and touch-up shop prime coats.
 5. Do not cut, weld or abrade surfaces which have been hot-dip galvanized after fabrication and which are intended for bolted or secreted field conditions.
- B. Immediately after erection, clean the field welds, bolted connections, and abraded areas of shop priming. Paint the exposed areas with the same materials used for shop priming.
- 3.04 CLEANUP:
- A. Upon completion of this section of work, remove all protective wraps and debris. Repair any damage due to installation of this section of work.
- 2.05 PROTECTION:
- A. During installation, it shall be the responsibility of the installer to protect this work from damage.

END OF SECTION 05500

SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rough carpentry Work.
2. Installation of glued laminated members, plywood web joists or wood chord metal web joists.

B. Related Requirements:

1. Division 01 - General Requirements.
5. Section 06200: Finish Carpentry.
6. Section 09290: Gypsum Board.

1.02 SYSTEM DESCRIPTION

A. Regulatory Requirements:

1. Work of this Section shall comply with IBC Chapter 23.

1.03 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. Redwood structural and framing lumber shall be graded in accordance with Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
2. Douglas fir, larch or hemlock structural and framing lumber shall be graded in accordance with the Standard Grading Rules of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Lumber Grading Rules of the Western Wood Products Association (WWPA).
3. Plywood shall conform to requirements of Product Standard PS 1, and shall be grade marked by a recognized grading agency (APA and PTL).

B. Lumber shall bear official grade mark of the association under whose rules it was graded or official grade mark of another recognized grading agency.

C. Structural and framing members 2-inch thick (nominal) and larger shall be air-dried to moisture content not to exceed 19 percent before installation.

D. Each piece of preservative treated lumber shall be identified by the Quality Mark of an approved inspection agency in accordance with IBC Chapter 23.

E. Lumber showing visible signs of mold growth:

1. Lumber showing visible signs of mold growth shall be removed from the project site or cleaned as outlined below.
2. The contractor is responsible for all costs associated with cleaning, post-cleaning testing, and reporting for lumber with mold.
 - a. Lumber that shows visible signs of mold growth prior to, or after installation, shall be cleaned pursuant to USEPA's guidance publication "Mold Remediation in Schools and Commercial Buildings dated March 2001 (EPA 402-K-01-001).
 - b. A minimum of 10 percent of the total locations cleaned must be sampled (tape lift method) post cleaning to ensure cleaning effort was successful. Cleaning will be considered acceptable when tape lift sample results evaluated by direct microscopic examination determine that the general abundance of mold is non-detect or rare (normal trapping to 1+).
 - c. A report prepared by a Certified Industrial Hygienist (CIH) that details the sampling and cleaning results shall be prepared and submitted to the Owner's Project Manager and Architect for review and approval.
 - d. Cleaned lumber shall not be installed or enclosed by finish materials until approval of test results. Cleaned lumber must meet moisture content requirements as required elsewhere in this specification prior to installation or application of finishes.

1.04 STORAGE, HANDLING AND PROTECTION

- A. The materials supplied as part of the Work of this section shall be protected from exposure to inclement weather before being covered by other Work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Lumber: Structural and framing lumber shall be of following species and grades:

	<u>INSTALLATION</u>	<u>SPECIES</u>	<u>GRADE</u>
1.	Subfloor, wall sheathing, roof sheathing and ceiling furring	Douglas fir and larch	Construction Board, WCLIB; WWPA
2.	Posts, (5-inch by 5-inch and larger, width not more than 2 inches greater than thickness).	Douglas fir and larch	No. 1 or better Structural Posts and Timbers, WCLIB. No. 1 or better Post and Timbers, WWPA.
3.	Beams, girders and truss members (5-inch and thicker, rectangular, width more than 2-inches greater than thickness) where exposed as finish members.	Douglas fir and larch	No. 1 or better Structural Beams and Stringers, WCLIB; WWPA.

4.	Joists, rafters, lintels, posts, mullions and members (2 to 4-inch thick, 2 to 4-inch wide)	Douglas fir and larch	No. 1 or better; Structural Light Framing, WCLIB;
5.	Other lumber (2 to 4-inch thick, 2 to 4-inch wide) not specified in subparagraph 5 above.	Douglas fir and larch	Construction Light Framing WCLIB; WWPA
6.	Framing lumber (2 to 4-inch thick, 5-inch and wider).	Douglas fir and Larch	No. 1 or better Structural Joists and Planks, WCLIB; WWPA.
7.	Mudsills and plates in contact with earth.	Douglas fir and Larch Treated	Same as subparagraphs 5 and 6.
8.	Sills or plates installed on concrete or masonry surfaces 6 inches or less above earth or finish grade.	Douglas fir and Larch Treated	Same as subparagraphs 5 and 6.
9.	Sills, foundation plates and sleepers installed on concrete, masonry foundations, or installed on concrete slab in direct contact with earth.	Douglas fir and Larch treated	Same as subparagraphs 5 and 6.
10.	Miscellaneous nailing strips and blocks embedded in concrete or masonry.	Douglas fir and Larch treated	Same as subparagraphs 5 and 6.
- B. Plywood: Plywood furnished for structural purposes, when exposed outdoors, shall be exterior type plywood. Other plywood furnished for structural purposes shall be exterior type, or Exposure 1.
- C. OSB Board or Panels:
1. Oriented strand board or panels shall not be furnished as part of the Work of this section.
- D. Preservative Treated Wood:
1. Wood and plywood specified; as treated wood shall be pressure treated wood in accordance with IBC requirements.
 2. Seasoning: Treated lumber shall be air seasoned after treatment, for a minimum of two weeks before installation. Moisture content shall be 15 percent maximum.
 3. Creosote or arsenic is not permitted for treating wood.
 4. When treated wood member have been notched, dapped, drilled, or cut, such newly cut surfaces shall be painted with a heavy coat of the same preservative material originally provided for treatment of wood member.

- E. Fire Retardant Protection: Wood and plywood specified as fire retardant protected wood shall be treated by approved methods and materials and shall be dried following treatment to maximum moisture content as follows:
 - 1. Solid sawn lumber 2-inch thick or less: 19 percent.
 - 2. Plywood: 15 percent.
- F. Plywood Subflooring: Underlayment, Group 1, Exposure 1; of thickness indicated.
- G. Mineral Fiber Panels: Asbestos-free, thickness as indicated.
- H. Adhesive: Tec, Inc. Sturdi-Bond TA-175, Top Industrial Inc., Rainbuster 345, Liquid Nails LN-940, or equal elastomeric adhesive conforming to ASTM D 3498 and APA-AFG-01.

PART 3 - EXECUTION

3.01 FASTENINGS

- A. Nails and Spikes:
 - 1. Furnish only common wire nails or spikes whenever indicated, specified or required.
 - 2. Whenever necessary to prevent splitting, holes shall be pre-drilled for nails and spikes.
 - 3. Nails in plywood shall not be overdriven.
 - 4. Machine Applied Nailing: Use of machine nailing is subject to a satisfactory Project site demonstration for each Project and approval by the Architect or structural engineer retained by the Architect as an Architect Consultant and DSA. Installation is subject to continued satisfactory performance. Machine nailing is not permitted for 5/16 inch plywood. Do not permit nail heads to penetrate outer ply. Maintain minimum allowable edge distances when installing nails.
- B. Lag Screws:
 - 1. When installing lag screws in a wood member, pre-drill hole as required by the IBC.
 - 2. Lag screws, which bear on wood, shall be fitted with standard steel plate washers under head. Lag screws shall be screwed and not driven into place.
- C. Bolts:
 - 1. Lumber and timber to be fastened together with bolts shall be clamped together with holes for bolts bored true to line.
 - 2. Bolts shall be fitted with steel plates or standard cut washers under heads and nuts. Bolts shall be tightened when installed and again before completion of the Work of this section.
- D. Wood Screws: When installing wood screws, pre-drill holes as required by the IBC.

- E. Metal Framing Devices: Framing anchors, joist hangers, ties, and other mechanical fastenings shall be galvanized or furnished with a rust inhibitive coating. Nails and fastenings shall be of the type recommended by manufacturer.
- F. Powder Driven Fasteners:
 - 1. Loads shall not exceed 75 pounds unless indicated on the Drawings or when reviewed by the Architect.
 - 2. The operator, tool, and fastener shall perform the following as observed by the Inspector.
 - a. Observe installation of first 10 fasteners.
 - b. Test the first 10 fasteners by performing a pullout test. Load shall be at least twice the design load, or 150 pounds, whichever is greater.
 - c. Random testing:
 - 1) Load less than 75 pounds - approximately 1 in 10 pins.
 - 2) Load 75 pounds or greater - 1/2 of the pins.
 - 3. Failure of any test will result in testing of all installed pins.
 - 4. Nail heads shall not break the outer skin of sheathing.
 - 5. Non-compliant pins shall be replaced.

3.02 INSTALLATION

- A. Stud Walls, Partitions and Furring:
 - 1. Wood stud walls, partitions and vertical furring shall be constructed of members of size and spacing indicated. Provide single treated plate at bottom and double plate at top unless otherwise indicated. Interior, nonbearing non-shear partitions may be framed with a single top plate, installed to provide overlapping at corners and at intersections with other wall and partitions or by metal ties as detailed.
 - 2. Walls and partitions shall be provided with horizontal staggered blocking at least 2 inch nominal thickness and same width as studs, fitted snugly, and nailed into studs. Blocking shall be installed at mid-height of partition or not more than 7 feet on center vertically. Install wood backing on top of top plate wherever necessary for nailing of lath or gypsum board.
 - 3. Walls, partitions and furred spaces shall be provided with 2-inch nominal thickness wood firestops, same width as space to be firestopped, at ceiling line, mid-height of partition and at floor line. Firestops at floor line are not required when floor is concrete. If width of opening is such that more than one piece of lumber is necessary, provide two thicknesses of one inch nominal material installed with staggered joints.
 - 4. Firestops shall be installed in stud walls and partitions, including furred spaces, so the maximum dimension of any concealed space is not over 10 feet.

5. Corners, and where wood stud walls and wood vertical furring meet, shall be constructed of triple studs. Openings in stud walls and partitions shall be provided with headers as indicated and a minimum of 2 studs at jambs, one stud of which may be cut to support header in bearing.
6. Where wood and masonry or concrete walls intersect, end stud shall be fastened at top, bottom and mid-height with one 1/2 inch diameter bolt through stud and embedded in masonry or concrete a minimum of 4 inches. Bolts shall be provided with washers under nuts.
7. Sills under bearing, exterior or shear walls shall be bolted to concrete with 5/8 inch diameter by 12-inch long bolts with nuts and washers, spaced not more than 4 feet on center unless noted otherwise. There shall be a bolt within 9 inches of each end of each piece of sill plate. Sills shall be installed and leveled with shims, washers, with nuts tightened to level bearing. Space between sill and concrete shall be dry packed with cement grout.

B. Roof and Wall Sheathing:

1. Plywood roof sheathing shall be Structural I, Grade C-D, Exposure 1, thickness as indicated.
2. Where exposed roof sheathing is indicated, area shall be sheathed solid with dressed and center matched, V-jointed boards of sizes indicated. Boards shall be installed perpendicular to supports.
3. Soffits of overhanging eaves, where indicated, shall be boxed-in using Group I, Exterior Type, Grade A-C, plywood, thickness as indicated.
4. Plywood for shear walls shall be Structural I, Grade C-D Exterior Type, thickness as indicated. Install with the long dimension parallel or perpendicular to the supports. Blocking shall be provided behind edges not located over supports. Shear wall construction, nailing, and top and bottom anchorage shall be as indicated.
5. Provide and install metal H-clips of required size, midway between rafters at unsupported edge joints of plywood roof sheathing where rafters are spaced at 24 inches on center. Clips shall be Plyclips, by Timber Fasteners Inc., Panel Clips by Simpson Co., USP Structural Connectors, or equal.

C. Furring:

1. Rafters or ceiling joists indicated to be furred for support of materials other than acoustical tile shall be furred with 2 by 4 wood members installed at right angles to supports, spaced as indicated and nailed in place. Furring shall be aligned, and bottoms shall be leveled by installing wood shims as required, and nailed as indicated.
2. Furring for protective wall padding in gymnasium shall be 1 by 3 Douglas fir, Construction Boards, S1S1E; applied horizontally to concrete walls at top and bottom of padding panels; and at uniform intermediate spacing not more than 18 inches on center. Stripping shall be shimmed where required, aligned to a true plane, and secured to concrete walls with concrete nails at not more than 18 inches on center.

- D. Furring: Where metal furring is not indicated or specified, provide wood furring at points indicated and required for concealing conduit, piping, structural framing or other unfinished materials. Wood furring shall be 2-by studs of required width. Vertical members contacting concrete or masonry shall be attached as specified for anchoring interior wood stud partitions.
- E. Grounds:
1. Provide and set wood grounds at points where wood trim occurs and work is to be plastered. Grounds at 3/4 inch metal lath shall be 5/8 inch thick, net, 1 1/2-inch wide Douglas Fir, S1S. Grounds shall be doubled where trim member exceeds 5-inch width, or wherever indicated. Grounds shall be applied after lath has been installed set plumb, level and true to line.
 2. Apply grounds over wood framed surfaces and lath and securely nail to wood backing at each stud or bearing. Grounds applied over steel channel studs and lath shall be securely nailed at each stud or bearing to nail-blocks provided and installed in metal studs.
 3. Grounds applied to concrete surfaces shall be securely nailed to woodblocks provided and built into concrete.
- F. Nailing Strips and Plates:
1. Provide wood nailing strips, plates and blocking indicated or required. Nailing strips in connection with metal work shall be bolted to metal. Wood nailing blocks for securing grounds shall be built into concrete, or masonry.
 2. Nailing schedule shall comply with CBC requirements.
 3. Treated wood nailing strips for lightweight insulated concrete roof decks at eaves, ridges, rakes, base of curbs and wherever else indicated, shall be provided and installed. Strips shall be treated Douglas fir, 4 inches (nominal) width by thickness of insulated concrete.
- G. Wood Backing: Provide wood backing as indicated and as required to receive plumbing, electrical fixtures and equipment, cabinets, door stop plates and other fixed equipment.
- H. Wood Bucks: Furnish and set wood bucks to form openings for doors and other openings in concrete or masonry walls and in steel stud or channel partitions and furring. Bucks shall be Douglas fir, S1S2E, 2 inches (nominal) thickness and of width indicated or required. Bucks in connection with concrete shall be bolted thereto, and bucks in masonry walls shall be attached by means of strap anchors embedded in masonry joints. Bucks in connection with steel studs and metal channels shall be secured with nail
s or screws spaced not to exceed 24 inches on centers.
- I. Bench Tops and Backs: Tops and backs shall be 3/4 inch thick asbestos free board, fabricated to minimize number of joints. Edges shall be neatly cut, smoothly finished and joints accurately fitted and butted. Tops and backs shall be secured with countersunk flathead galvanized wood screws. At bench with steel pan, apply with manufacturer's recommended adhesive. Cut and drill as required for Work to be attached to benches.

3.03 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.
- East Providence Community Center
East Providence, Rhode Island
- Rough Carpentry - 06100
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3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 06100

SECTION 06200
FINISH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Finish carpentry.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 061000: Rough Carpentry.
3. Section 08141: Wood Doors and Frames.
4. Section 08710: Door Hardware.
5. Section 09290: Gypsum Board.

1.02 SUBMITTALS

- A. Shop Drawings:** Submit Shop Drawings of each item of finish carpentry and millwork, indicating materials, dimensions, construction, and anchorage details.

1.03 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. Douglas fir finish lumber shall be manufactured and graded in accordance with WCLIB - Standard Grading and Dressing Rule No. 17.
2. Redwood finish lumber shall be manufactured and graded in accordance with RIS - Standard Specifications for Grades of California Redwood Lumber.
3. Hardwood finish lumber shall be manufactured and graded in accordance with NHLA - Rules for the Measurement and Inspection of Hardwood and Cypress Lumber.
4. Softwood Plywood: Plywood shall comply with APA - Product Standard PS 1. Plywood shall be grade marked by APA.
5. Products and installation shall comply with the North American Architectural Woodwork Standards (NAAWS) for the Grade or Grades specified.

- B. Finish lumber shall be kiln-dried according to recognized methods for the thickness and species. Lumber one inch thick or less shall be dried to an average moisture content of not more than 13 percent. Lumber 1-1/4 inches to 2 inches in thickness shall be dried to an average moisture content of not more than 15 percent.**

1.04 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the Project site in undamaged condition, stored in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.
- B. Interior millwork and finish carpentry shall not be installed unless interior building temperature and humidity levels are within the ranges recommended by the manufacturer and/or recognized standards.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Douglas Fir: Interior trim, solid lumber shelves, partitions, door frames and other concealed members of interior finish; NAAWS Economy Grade.
- B. Hardwood: Birch, maple firsts and seconds.
 - 1. Birch: NAAWS Custom Grade.
 - 2. Maple: NAAWS Custom Grade.
- C. Softwood Plywood: Except where otherwise specified, AWI Custom Grade, Douglas fir unless otherwise indicated.
- D. Hardwood Plywood: NAAWS Premium Grade, species as indicated.
- E. Redwood: Exterior millwork, except framing lumber, shall be clear heartwood redwood. Where installed in direct contact with earth or provided for exterior storage units, install Foundation Grade.
- F. Perforated Hardboard Panels: Panels shall be 1/4 inch thick tempered hardboard, SIS with 1/4 inch diameter holes spaced one inch on center.

2.02 FABRICATION

- A. The means of fastening various parts together shall be concealed in finished Work. Work which is curved shall be fabricated from solid stock, or if veneered, shall be bent to a uniform radius.

PART 3 - EXECUTION

3.01 GENERAL

- A. Interior and exterior wood, millwork, blocking, and lumber shall be installed level, plumb, and true to line. Members shall be neatly and accurately scribed in place, maintaining full widths of end members, wherever possible. Trim shall be installed in full lengths, without piecing, except where use of single lengths is not required. Butt joints, if necessary, shall be beveled. Exterior angles shall be mitered, and interior angles of molding parts coped. Nails shall be set for putty. Grain and color of adjoining interior finish shall match adjacent finishes. Where Work specified in this section adjoins other Work, provide a neat tight joint.
- B. Interior and exterior finish carpentry and other fixed wooden equipment having hammer marks or other visible damage will be deemed defective Work.

- C. Staff or brick moulds of exterior wood doorframes shall be attached to frames after frames have been set and caulked. Moulds shall be mitered at corners and coped to sills, accurately secured in place with finish nails, and nails set.

3.02 INSTALLATION

- A. Install Work of this section as specified in the North American Architectural Woodwork Standards.
- B. Wood shoe base shall be fitted and temporarily tacked in place until floor covering is installed. Provide and install corner fillets, same contour and materials as shoe base, in corners where shoe base is installed.
- C. Platform Front: Plywood at platform front and adjoining steps in Multi-Purpose Building shall be provided with face veneers of unselect birch. Trim and frames shall match face veneer of panels. Joints shall be V-shaped where indicated.
- D. Door Frames: Frames shall be installed plumb and true, solidly blocked, reinforced for butts and hardware, and shall be fastened to structural frame with 16d set finish nails at not more than 24 inches on centers. Nails securing exterior door and window frames shall be cement coated. Doorframes shall be dadoed together at the head.
- E. Sealing of Joints: Joints between exterior frames and adjoining surfaces shall be primed before sealing.

3.03 CLEAN UP

- A. Remove debris, rubbish and waste material and legally dispose of off the Project site.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 06200

SECTION 06650

PLASTIC SIMULATED WOOD TRIM

PART 1 - GENERAL

1.01 SUMMARY

- A. Cellular PVC trim boards for:
 - 1. Corner boards
 - 2. Soffits
 - 3. Fascia
 - 4. Frieze boards
 - 5. Rake boards
 - 6. Cupolas
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 5. Section 06200 – Finish Carpentry
 - 6. C. Section 09900 – Painting and Coating

A.02 REFERENCES

- A. ASTM D792 - Density and Specific Gravity of Plastics by Displacement.
- B. ASTM D570 - Water Absorption of Plastics.
- C. ASTM D638 - Tensile Properties of Plastics.
- D. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- E. ASTM D1761 - Mechanical Fasteners in Wood.
- F. ASTM D5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by means of a Striker Impacted by a Falling Weight.
- G. ASTM D256 - Determining the Pendulum Impact Resistance of Plastics.
- H. ASTM D696 - Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer.
- I. ASTM D635 - Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- J. ASTM E84 - Surface Burning Characteristics of Building Materials.
- K. ASTM D648 - Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

- L. ASTM D3679 - Standard Specification for Rigid Poly Vinyl Chloride (PVC) Siding1.03

1.04 SUBMITTALS

- A. General: Submit under provisions of Section 01300 – Submittals - Shop Drawings, Product Data and Samples.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Installation instructions and methods.
 - d. Code compliance reports.
- C. Samples: For each product specified, two samples, minimum size 6 inches long, representing actual product, color, finish.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with a minimum of 15 years producing PVC trim products.
- B. Installer Qualifications: Installer with a minimum of 3 years experience with the installation of PVC trim products.
- C. Regulatory Requirements: Check with Local Building Code for installation requirements.
- D. Allowable Tolerances:
 - a. Variation in component length: -0.00 / +1.00"
 - b. Variation in component width: $\pm 1/16$ "
 - c. Variation in component thickness: $\pm 1/16$ "
 - d. Variation in component edge cut: $\pm 2^\circ$
 - e. Variation in Density -0% + 10%
- E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - a. Finish areas designed by Architect.
 - b. Do not proceed with remaining work until workmanship, color, and sheen are approved by architect.
 - c. Refinish mock-up area as required to produce acceptable work.
 - d. Accepted mock-ups shall be comparison standard for remaining work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Trim materials should be stored on a flat and level surface on a full shipping pallet. Handle materials to prevent damage to product edges and corners.
- B. Store materials under a protective covering to prevent jobsite dirt and residue from collecting on the boards.

1.07 WARRANTY

- A. Provide manufacturer's Limited Lifetime warranty against defects in manufacturing that cause the products to rot, corrode, delaminate, or excessively swell from moisture.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new plastic simulated wood trim is based upon AZEK[®] Trimboards manufactured by The AZEK[®] Company, which is located at: 888 N Keyser Ave Scranton, PA 18508. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. Plym Gem
 - 2. Or approved equal

2.02 MATERIALS

- A. PVC: Free foam cellular PVC material with a small cell microstructure and density of .55 grams/cm³.
 - a. Material shall have a minimum physical and performance properties specified in the following Section B.
- B. Performance and physical characteristic requirements:

Property	Units	Value	ASTM Method
PHYSICAL			
Density	g/cm3	0.55	D 792
Water Absorption	%	0.15	D 570
MECHANICAL			
Tensile Strength	psi	2256	D 638
Tensile Modulus	psi	144,000	D 638
Flexural Strength	psi	3329	D 790
Flexural Modulus	psi	144,219	D 790
Nail Hold	Lbf/in of penetration	35	D 1761

Property	Units	Value	ASTM Method
Screw Hold	Lbf/in of penetration	680	D 1761
Staple Hold	Lbf/in of penetration	180	D 1761
Gardner Impact	in-lbs	103	D5420
Charpy Impact (@23°C)	ft-lbs	4.5	D256
THERMAL			
Coefficient of Linear Expansion	in/in/°F	3.2 x 10 ⁻⁵	D 696
Burning Rate	in/min	No burn when flame removed	D 635
Flame Spread Index	--	25	E 84
Heat Deflection Temp 264 psi	°F	150	D 648
Oil Canning (@140°F)	°F	Passed	D 648

2.03 SIMULATED WOOD TRIM

- A. PVC Trimboard: AZEK® Trimboard with Sealed Edge, designed with a natural appearance to compliment fiber cement and natural cedar.

1. Size:

- a. Nominal Width:
 - 1) 4 inches
 - 2) 10 inches
 - 3) 12 inches
 - 4) 16 inches
- b. Nominal Thickness:
 - 1) 5/8 inch (5/8 inch actual size)
 - 2) 1 inch (3/4 inch actual size)
- c. Length:
 - 1) 12 feet
 - 2) 18 feet

2. Finish:

- a. Traditional/Smooth finish

- B. Sheet Board: AZEK® Traditional (Smooth)/Frontier (Woodgrain) finish Sheet. For use as sheet materials or to create columns and gingerbread millwork.

1. Size:

- a. Width/Length:
 - 1) 4 foot by 12 foot
 - 2) 4 foot by 18 foot
 - 3) 4 foot by 20 foot
- a. Thickness:
 - 1) 1/2 inch
 - 2) 5/8 inch

2.04 ACCESSORY PRODUCTS

- A. Fasteners:

- a. AZEK® Cortex for Trim

- b. Use fasteners design for wood trim and wood siding (thinner shank, blunt point, full round head) with AZEK®.
 - c. Use a highly durable fastener such as stainless steel or hot-dipped galvanized.
 - d. Staples, small brads and wire nails must not be used as fastening members.
 - e. The fasteners should be long enough to penetrate the solid wood substrate a minimum of 1½”.
 - f. Fasteners must be installed no more than 2” from the end of each board.
 - g. AZEK® should be fastened into a flat, solid substrate. Fastening AZEK® into hollow or uneven areas must be avoided.
- B. Sealants:
- a. Use urethane, polyurethane or acrylic based sealants without silicone.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Manufacturer instructions:
- 1. Comply with manufacturer's product catalog installation instructions and product technical bulletin instructions.
- B. Cutting:
- 1. AZEK® products can be cut using the same tools used to cut lumber.
 - 2. Carbide tipped blades designed to cut wood work well. Avoid fine tooth metal cutting blades.
 - 3. Rough edges from cutting may be caused by excessive friction, poor board support, or worn or improper tooling. Nails in plywood shall not be overdriven.
- C. Drilling:
- 1. AZEK® products can be drilled using the same tools used to drill lumber.
 - 2. Drilling AZEK® products is similar to drilling a hardwood. Care should be taken to avoid frictional heat build-up.
 - 3. Use standard woodworking drills. Do not use drills made for normal rigid pvc.
 - 4. Periodic removal of AZEK® shavings from the drill hole may be necessary.2. Lag screws, which bear on wood, shall be fitted with standard steel plate washers under head. Lag screws shall be screwed and not driven into place.
- D. Milling:
- 1. AZEK® products can be milled using standard milling machines used to mill lumber.
 - 2 Relief Angle 20° to 30°

- 3 Cutting speed to be optimized with the number of knives and feed rate.

E. Routing:

1. AZEK® products can be routed using standard router bits and the same tools used to rout lumber.
2. Carbide tipped router bits are recommended.

F. Edge Finishing:

1. Edges can be finished by sanding, grinding or filing with traditional woodworking tools.

G. Fastener Location:

1. Use 2 fasteners per every framing member for trimboard applications.
2. Trimboards over 12" or wider, as well as sheets, will require additional fasteners.
3. Fasteners must be installed no more than 2" from the end of each board.

H. Thermal Expansion and Contraction:

1. AZEK® products expand and contract with changes in temperature.
2. Properly fastening AZEK® material along its entire length will minimize expansion and contraction.
3. When properly fastened, allow 1/8" per 18 foot of AZEK® product for expansion and contraction.
4. Joints between pieces of AZEK® should be glued to eliminate joint separation. When gaps are glued on a long run of AZEK®, allow expansion and contraction at ends of the run.

3.03 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 06650

SECTION 07210
THERMAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Thermal batt insulation for exterior walls and under roof decks.
2. Extruded polystyrene board at horizontal waterproofing.
3. Continuous insulation at exterior walls.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 07140 – Cold Fluid-Applied Waterproofing Membrane.
3. Section 09810 – Acoustical Insulation

1.02 SUBMITTALS

A. Product Data:

1. Material List: Provide a list of materials for installation under this section.
2. Provide manufacturer's printed Product Data for each type insulation and accessory.

B. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.

1.03 QUALITY ASSURANCE

A. Surface Burning Characteristics: Flame spread rating shall not exceed 25 and smoke density shall not exceed 50 when tested in accordance with ASTM E84.

B. Combustion Characteristics: Rated as non-combustible when tested in accordance with ASTM E136.

C. Comply with following as a minimum requirement:

1. ASTM C553: Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
2. ASTM C578: Specification for Rigid, Cellular Polystyrene Thermal Insulation.
3. ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
4. ASTM D1622 – Standard Test Method for Apparent Density of Rigid Cellular Plastics.

5. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site and store in a safe, dry place, with labels intact and legible at time of installation.
- B. Protect building insulation materials from damage.

1.05 PROJECT CONDITIONS

- A. Avoid exposure to humidity and moisture. Protect from exposure to sunlight.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Rockwool
- B. Owens Corning.
- C. Johns Manville.
- D. CertainTeed Corporation.
- E. The DOW Chemical Company.
- F. Or Approved Equal.

2.02 MATERIALS

- A. General:
 1. Provide Unfaced, friction-fit batt insulation where both sides of installation are enclosed.
 2. Provide batt insulation with integral vapor barrier when one side of installation will be unenclosed.
 3. Provide batt insulation with integral vapor barrier where at least one side of installation will be exposed to high humidity, such as showers.
 4. Recycled content shall be a minimum of 30 percent.
- B. Extruded-Polystyrene (XPS) Board Insulation: ASTM C578, Type IV, thickness as indicated on drawings.
 1. Manufacturers:
 - a. DiversiFoam Products, Certifoam.
 - b. Dow Chemical Company, Thermax.

- c. Owens Corning, Foamular.
 - d. Or Approved Equal.
- 2. Physical Properties:
 - a. Compressive Strength, ASTM D1621
 - b. Surface Burning Characteristics, ASTM E84: Flame spread less than 25, smoke developed no greater than 50.
 - c. Compressive Strength, ASTM D1621: 25 psi minimum.
 - d. Thermal Resistance, ASTM C518: R 5 minimum per inch of thickness.
 - e. Water Vapor Transmission, ASTM E96: Less than 0.03 perms.
 - f. Water Absorption by Volume, ASTM C209: Maximum 0.10 percent.
- C. Mineral Rock Wool Insulation:
 - 1. Semi-rigid stone wool batt insulation. Insulation shall consist of mineral fiber complying with ASTM C665, Type 1, Density ASTM C167, ≥ 2 lbs/ft³, and Thermal Resistance ASTM C518.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Work to verify suitability to receive insulation. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Fit batt insulation, of R-value indicated on Drawings, snugly between framing members.
 - 2. Maintain total insulation integrity over entire area to be insulated, including areas between closely spaced members.
 - 3. Extend full thickness insulation over entire area to be insulated. Furnish manufacturer's recommended clips to tightly fit batts at joints.
 - 4. Cut and fit batt insulation tightly around pipes, conduits and penetrations.
 - 5. Do not compress batt insulation in excess of 10 percent (R-20 may be installed in 2 by 6 stud walls).
 - 6. Prevent batt insulation from sagging during and after installation by installing adequate wire.
 - 7. Metal door and window frames in acoustically insulated walls shall be filled with insulation, unless otherwise indicated.

8. Where vapor barrier is provided, install with vapor barrier facing room.
 - a. Mineral Rock Wool Insulation in Stud Framing: Provide friction-fit batts tightly fitted to stud webs and to stud furring.
9. Extruded-Polystyrene (XPS) Board Insulation Continuous Insulation:
 - a. Install extruded polystyrene (XPS) insulation boards over the concrete foundation wall and layer in accordance with manufacturers' written recommendations.
 - b. Install XPS insulation with long edges horizontal in maximum sizes to minimize joints.
 - c. Align horizontal rows and stagger vertical joints.
 - d. Insulation board edges shall be butted together tightly and fit around openings and penetrations. Install square edges to fit square and tight.
 - e. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation.
 - f. Fasten XPS insulation to exterior face of CMU or concrete wall using mechanical fasteners per manufacturer's written instructions

3.03 PROTECTION

- A. Protect Work of this section until Substantial Completion.

3.04 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION 07210

SECTION 07260

VAPOR BARRIERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Testing of concrete slabs for moisture and acidity / alkalinity (pH).
2. Under Slab Vapor Barrier
3. Sheet Retarder

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 033000: Cast in Place Concrete.
3. Division 09: Finishes.

1.02 REFERENCES

A. American Concrete Institute (ACI) Publication:

1. ACI 302.2R - Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

B. ASTM International (ASTM):

1. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
2. ASTM D1709 - Standard Test Methods of Impact Resistance of Plastic Film by the Free-Falling Dart Method.
3. ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.
4. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
5. ASTM E1643 - Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
6. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for vapor barrier and accessories.
- B. Samples:
 - 1. 12 inch by 12 inch vapor barrier samples.
 - 2. Pressure-Sensitive Tape: 12 inch long sample.
- C. Test Reports: Conducted by nationally recognized independent testing agency indicating conformance with specified performance requirements.

1.04 QUALITY ASSURANCE

- A. ASTM tests referenced in this Section shall be performed on a single production roll per ASTM E1745 Section 8.1. Submit third party documentation certifying this requirement.
- B. Pre-Installation Conference: CONTRACTOR shall coordinate and conduct pre-installation conference in accordance to Section 01 3119, Project Meetings, to review the progress of construction activities and preparations for the installation of vapor barrier.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging with labels intact.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Under Slab Vapor Barrier: Multi-layer plastic extrusion manufactured with high grade prime, virgin, polyolefin resins. Thickness as specified in the drawings.
 - 1. Stego Wrap by Stego Industries LLC.
 - 2. Perminator by W.R. Meadows.
 - 3. Ecoshield-E by Epro.
 - 4. Equal.
- B. Physical Properties:

1. Maintain permeance of less than 0.01 Perms [grains/(ft² · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
 2. Class Rating per ASTM E1745: Class A.
 3. Thickness: 15 mil.
 4. Puncture resistance per ASTM D 1709: 2200 g or higher.
 5. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1
- C. Accessories: Provide manufacturer recommended accessories for seams, penetrations and perimeter edges, including tapes, mastics, termination for a complete vapor barrier installation per ASTM E1643.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine subsoil and notify OAR of deficiencies detrimental to proper vapor barrier installation; do not proceed until corrected.

3.02 INSTALLATION

- A. Install vapor barrier in accordance ASTM E1643 and manufacturer's instructions.
1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise, where obstructed by impediments, such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself using manufacturer ASTM E1643 compliant accessory designed to adhere to concrete. Seam tape shall not be used for sealing the vapor barrier to the foundation wall, grade beam or slab.
 3. Overlap joints 6 inches and seal with manufacturer's seam tape.
 4. Seal vapor barrier penetrations per manufacturer's instructions.
 5. Avoid the use of non-permanent stakes driven through the vapor barrier.
- B. Prior to concrete placement inspect vapor barrier for damage. Clean damaged areas and with vapor barrier material cut a minimum 6 inches larger than damaged area on all sides. Seal to main vapor barrier with continuous seam tape.

3.03 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 07260

SECTION 07270
INTERIOR AIR AND VAPOR CONTROL LAYER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior air and vapor control layer, including surface preparation.

1.2 RELATED SECTIONS

- A. Section 07210 – Thermal Insulation.

1.3 REFERENCES

- A. ISO 9972:2006 / EN 13829 — Determination of air permeability of buildings, Fan pressurization method
- B. ASTM E779 – Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
- C. ASTM E84 - Standard test method for surface burning characteristics of building materials.
- D. ASTM E2178 - Standard Test method for. Air Permeance of Building Materials
- E. AATCC 127 – Hydrostatic pressure test
- F. ISO 12572 - Hygrothermal performance of building materials and products
- G. EN 1849-2 - Flexible sheets for waterproofing - Determination of thickness and mass per unit area
- H. EN 12114 - Thermal performance of buildings - Air permeability of building components and building elements
- I. EN 12310-1 - Flexible sheets for waterproofing. Determination of resistance to tearing (nail shank)
- J. EN 12311-2 - Flexible sheets for waterproofing. Determination of tensile properties.
- I. EN 13859-1 - Flexible sheets for waterproofing - Underlays for discontinuous roofing/(sheathing)
- J. EN 1296 - Flexible sheets for waterproofing - Method for artificial ageing by long term exposure to elevated temperature
- K. EN 1931: Determination of water vapor transmission properties

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Installation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
- C. Verification Samples: For each product specified, two samples.
 - 1. Membranes: minimum size 6"x8"
 - 2. Tapes: minimum length 5"
 - 3. Gaskets, adhesives, accessories: one each

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Comply with one of the following requirements:
 - 1. The (sub-)contractor installing the interior airtight layer shall have as minimum experience with at least two buildings.
 - 2. The (sub-)contractor has completed all required manufacturer required training.
- B. Mock-Up: Provide a mock-up for evaluation of installation techniques and application workmanship.
 - 1. Prior to installation of airtight layer, mock up airtight layer as follows to verify details and to demonstrate connections to adjoining construction elements, and other termination conditions.
 - 2. Install mockup of airtight layer in location designated by Architect.
 - 3. Do not proceed with remaining work until workmanship and application technique are approved by Architect.
 - 4. Construct typical interior wall, 8 feet wide by 8 feet long, illustrating materials interface and connections (tape, adhesives, gaskets), incorporating specified options including but not limited to the following:
 - a. junctions of walls, foundations, ceilings, floors and roof,
 - b. corner conditions
 - c. window and doorframe connections, and
 - d. blow-in insulation seals/battens.
- C. Cooperate and coordinate with the owner's inspection and (blowerdoor) testing agency. Do not cover (with sheetrock, blocking, mechanical equipment or other elements that would restrict access to the airtight membrane) any components of the mock up (installed airtight layer membrane or other airtight elements) until it has been inspected, blowerdoor tested and approved.

1.6 PRECONSTRUCTION MEETING

- A. Preconstruction Meeting: Convene a meeting with all subcontractors affected by the Work of this Section a minimum of one week prior to commencing work of this section. Agenda shall include materials, details of construction, compatibility of materials, sequencing of construction/installation of membranes, the airtightness goal and emphasize that the success during the blowerdoor test is dependent on the collaboration of all subcontractors.
- B. Coordinate Work with other subcontractors (plumbers, electricians, carpenters, HVAC), operations and installation of finish materials to install correct-sized gaskets on pipes, ducts and cable when these elements pass through the interior airtight layer, and to avoid damage to installed materials. Before they commence work on site, provide each effected trade with sufficient gaskets.
- C. After meeting, post the following warning in a prominent location at all building entrances and top of each stair – 1/2" letter height minimum for header, 1/4" for all other text

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials on pallets, in clean and dry areas, not exposed to direct sunlight and in accordance with manufacturer's instructions. Store adhesives and primers at temperatures at or above 40 degrees Fahrenheit (4 degrees Celsius) to facilitate handling.
- C. Protect materials during handling and application to prevent damage, puncturing or contamination.

1.8 ENVIRONMENTAL CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) as per manufacturers recommendations. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Minimize exposure of airtight membranes to direct sunlight. Use blinds or covers over window openings to block direct sunlight to prevent UV damage to membranes, if membranes will not be covered by sheetrock within 2 weeks or use exterior grade products.
- C. Minimize exposure to water.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new vapor retarder is based upon Pro Clima/Moll bauökologische Produkte GmbH, 68723 Schwetzingen Germany. Imported by 475 High Performance Building Supply, 334 Douglass street, Brooklyn NY, Tel: 718-622-1600; Email; info@foursevenfive.com; Web: www.foursevenfive.com / www.foursevenfive.ca. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. Revolution Company
 - 2. Or Approved Equal

2.2 AIRTIGHT LAYER SYSTEMS

- A. INTELLO X:
 - 1. Description: High performance vapor variable (Hydrosafe) membrane and temporary WRB for commercial buildings. Made from Polyethylene-Copolymer protected with two robust PP fleex
 - 2. 3 layer material – includes two robust PP protection fleeces that protect smart vapor retarder. Suitable to use as temporary roof or WRB during construction.
 - 3. Class A rated material per ASTM E84 (Flame spread: 0, SDI:105)
 - 4. Airtight material per ASTM E2178: 0.00005cfm/sf
 - 5. Appearance: Translucent white

6. Weight 0.6 oz/sf ± 0.5 g/m² (150g/m²) EN1849-2
 7. Thickness: 18 mils (0.45 mm ± 0.05 mm) EN1849-2
 8. Perm rating: 13.20 to 0.13 (Sd value from 0.25m to >25m) ISO 12572
 9. Temperature exposure limits: -40 to 176 degrees F (-40 to 80C)
 10. Tensile Strength (EN13859-1)
 - a. 250 N/50 mm MC
 - b. 170 N/50 mm DC
 11. Elongation (EN13859-1)
 - a. 60% (MC)
 - b. 60% (DC)
 12. Nail Tear Resistance: 27/27 lbf 120N/120N (MC/DC) EN 13859-1
 13. Permeability consistent after artificial age testing: Pass – DIN EN 1296/1931
 12. Water column 8.2ft (2.5m) AATCC 127 – DIN EN 20811
 12. UV and weather exposure: 2 months
- B. Airtight interior tape: TESCON VANA:
1. Solid Acrylic tape with PP carrying fleece
 2. Perm rate: 8 (sd-value 0.4m) DIN EN1931
 3. Adhesion (ASTM D3330): 4.45lbs/lin.inch INTELLO, 3.34lbs/lin/inch OSB
 4. Artificial age test: 100 years (per DIN 4108-7)
 5. Living Building Challenge Declare label – red list free
 6. Free of VOCs
- C. Airtight interior corner tape: TESCON Profil or TESCON Profect, Solid Acrylic tape with PP carrying fleece and split release paper: Living Building Challenge Declare label – red list free, free of VOCs
- D. Airtight window tape: CONTEGA SOLIDO SL(-D): vapor retarding window tape with multiple release papers for specific or blind taped window airsealing.
- E. Airtight adhesive: CONTEGA HF (contains VOC's/bio-ethanol) or CONTEGA Classic (VOC free), CONTEGA MULTIBOND (pre-cure adhesive on roll): non-embrittling adhesives for membrane connections to concrete, plywood floors and very rough/split wood.

2.3 ACCESSORIES

- A. PRESSFIX tape pressurization tool.
- B. Lessco Utility Box
- C. Pipe, duct, cable sealing: ROFLEX and KAFLEX gaskets
1. EPDM gaskets per specific pipe sizes
 2. Tape with TESCON VANA to airtight layer
- D. Outlet sealing (recessed): INSTAABOX / LESSCO boxes
1. Self sealing airtight outlet box
 2. Tape with TESCON VANA to airtight layer
- D. Metal studs: Fastweb strips or cap screws

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates/surfaces have been properly prepared and cleaned from dust, silicones, oils and grease. Before installation, verify substrate is free of splinters, nails or other objects that could puncture membranes.
- B. If window or door opening preparation is the responsibility of another installer, notify architect of unsatisfactory preparation before proceeding.
- C. If there are unexpected pipes, ducts or wires in the installation area/airtight layer or these penetrations do not have ROFLEX/KAFLEX gaskets around them, notify architect of unsatisfactory preparation before proceeding.
- D. If floor, walls or ledger boards have been built that interfere with the airtight layer and a drawn/planned pre-installed airtight membrane was not installed as per sequencing plan, notify architect of unsatisfactory preparation before proceeding.
- E. If long term exposure to UV or liquid water is likely or can be expected – USE INTELLO X or SOLITEX membranes only.
- F. Acceptance of Conditions: Beginning of installation constitutes acceptance of existing conditions.

3.2 PREPARATION

- A. Clean and prepare surfaces to receive air/vapor barrier in accordance with manufacturer's installation guidelines.
- B. All surfaces must be clean, smooth and dry and must be clean of oil, dust, and silicone.
- C. Batt installation: install membrane immediately after batt insulation is installed in winter.
- D. Properly ventilate space or use dehumidifier to prevent high humidity conditions after concrete pours, sheetrock compounding and tile work . Monitor humidity if needed to ensure it stays below 60% relative humidity.

3.3 APPLICATION

- A. Apply airtight layer/vapor retarder in accordance with manufacturer's instructions.

- B. Install membranes taut and without creases along the substrate.
- B. Overlap subsequent courses of membrane. Use the printed lines on the membrane as a guide.
- C. Mechanically fasten as per 475 installation manuals
- D. Battens for service cavities for densepacking should be spaced less than 20" o.c. and be perpendicular to the direction of the structure behind. Or other means should be employed to mechanically fix the membrane sufficiently to the substructure to long term support the weight/force exerted by the insulation – please contact 475 for additional means and methods.
- E. Tape all overlaps. Use a PRESSFIX tape pressurization tool to ensure there is sufficient back-pressure when applying the pressure sensitive Pro Klima tapes. Make sure that tape joints are not permanently under stress, ie are supported by a batten or by cross taping the taped joint with 12" long pieces of tape every 12"
- F. Overlap the membrane a minimum of 2" over dissimilar airtight materials (concrete, plaster).
- G. Use CONTEGA HF (for below 0F application) or CONTEGA classic (VOC free) or MULTIBOND to adhere membranes to concrete, brick, plaster or rough OSB. Leave some slack in the membrane to allow for expansion and contraction between these dissimilar materials. Prime substrates with TESCON Primer RP if necessary.
- H. If taping to membrane to porous or unknown substrates, they should be free of oil, silicone and dust. Do an adhesion test when in doubt. Primer recommended for application to brick, concrete, wood fiber insulation board and certain OSB brands.
- I. Cut membrane with a utility knife in detail around penetrations.
- J. Seal membranes to windows, joist and beams with TESCON Profil or CONTEGA line of airtight window tapes. Follow application guides of specific tapes.
- K. Seal all penetrations with gaskets (ROFLEX or KAFLEX) taped with TESCON VANA airtight tape to airtight layer. Air seal around pre-existing penetrations (pipes, ducts or cables) with TESCON VANA tape in step like fashion, avoiding creases in tape.
- L. Apply blown in insulation directly after installing interior airtight membranes.
- M. Inspect membrane before blowerdoor test and/or dense-packing insulation. Ensure:
 - 1. each overlap is taped and has been pressurized
 - 2. staples applied at appropriate intervals
 - 3. counter battens at recommended distances
 - 4. tears and punctures repaired with Pro Klima tape
 - 5. adhesives (CONTEGA HF or classic) have had 48 hours to set up before test.

3.4 TESTING

- A. Do a blowerdoor test as soon as the airtight layer is completely installed. During the test search for any detectible leaks with hands, IR or smoke pencils.
- B. Document any leaks, and repair with Pro Clima tapes, adhesives and accessories.
- C. Repeat test until building complies with project airtightness (ACH50 or CFM/SF75) goal, but at a minimum better than 1.0ACH50 or 0.15CFM/SF75
- D. Re-do blowerdoor test if more than 3 holes/penetrations are made following completion of blowerdoor test above, or at the request of the Architect.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Repair tears, punctures or burns (e.g. from sweating copper pipe) and/or replace damaged products before covering materials. Re-do blowerdoor test if more than 3 holes are made or by request of Architect.
- C. To protect interior airtight layer/membranes, apply service cavity insulation and sheetrock as soon as possible, and not later than specified exposure limit of used materials. Use tarps or other means of blocking UV if exposure times will be exceeded to protect membranes.

3.6 FINAL TEST

- A. Blowerdoor test the installed membrane/interior airtight layer when:
 - 1. All penetrations have been made and sealed.
 - 2. Sheetrock and other finishes on exterior walls have been installed.
- B. Find and repair leaks.
- C. Repeat testing and repairs until the project complies with the project airtightness goal.

END OF SECTION 07270

SECTION 07440

CONCRETE FACED PANELS

PART 1 GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 - 1. Convene at Project site 2 weeks prior to beginning work of this Section.
 - 2. Attendance: Architect, Owner, Contractor, Construction Manager, installer, and related trades.
 - 3. Review: Project conditions, manufacturer requirements, delivery and storage, staging and sequencing, and protection of completed work.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Manufacturer's data sheets on each product to be used, including:
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Installation methods.
 - 2. Samples:
 - a. Color chips representing manufacturer's full range of available colors and patterns.
 - b. After color selection submit 4 x 4 inch samples of each color and patterns.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 3 years experience in work of this Section.
- B. Manufacturer: Provides design, engineering, fabrication, and testing of required components and assemblies for complete system.
- C. Mockup: Provide mockup for evaluation of surface preparation techniques and application workmanship.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- B. Store panels flat.
- C. Do not drop panels.

1.5 SITE CONDITIONS

- A. Substrate and ambient air temperature in accordance with manufacturer's requirements.

1.6 WARRANTY

- A. Manufacturer's standard year warranty against defects in materials and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Contract Documents are based on products by T. Clear Corporation, 800-544-7398, email sconfer@tclear.com, www.tclear.com.
- B. Acceptable Manufacturers:
 - 1. CertainTeed
 - 2. Or Approved Equal

2.2 MATERIALS

- A. Concrete Faced Insulated Perimeter Wall Panels: To establish a level of quality and performance characteristics the desired specified for the new concrete facer panels is based upon T.Clear Coporation, WallGUARD Concrete Faced Insulated Perimeter Wall Panels. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - a. Dupont
 - b. Tech-crete
 - c. Or approved equal
- 2. Construction:
 - a. Extruded polystyrene board, ASTM C578, Type IV, rigid, closed cell, with integral high density skin, with integral 5/16 inch thick latex-modified concrete facing.
 - b. Board Size: 2 x 4 feet x 2-5/16 inches thick.
 - c. Edges: Tongue-and-groove sides, square ends.
 - d. thermal resistance: Long term aged R-value of 5 per inch, tested to ASTM C518.
 - e. Foam compressive strength: Minimum 35 PSI, tested to ASTM D1621.
 - f. Compressive strength: Minimum 40 PSI, tested to ASTM D 1621.
 - g. Water absorption: Maximum 0.7 percent by volume, tested ASTM D2842.
 - h. Water vapor permeance: 0.8, tested to ASTM E96/E96M.
 - i. Coefficient of lineal thermal Expansion: 3.5×10^{-5} inches per inch x degree F, tested to ASTM D696.
- 3. Accessories:
 - a. Metal cap flashing: 24 gage galvanized steel J-channel; 2-1/4 inches wide, 4 inch long leg and 2-1/4 inch short leg; prefinished, color to be selected.
 - b. Clips and fasteners: Corrosion-resistant, sized to suit application; as supplied by insulation manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's instructions.

3.2 INSTALLATION - CONCRETE FACED INSULATED PERIMETER WALL PANELS

- A. Surfaces to Receive Panels: Flat, sound, clean, and free from irregularities and or jagged surfaces.
- B. Lay out panels to maximize board sizes. Do not use boards less than 6 inches wide.

C. Install panels in orientation to maximize full sheets.

D. Install fastening clips and cap flashings.

3.3 PROTECTION

A. Protect installed products from damage during construction.

END OF SECTION 07440

SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Work included: Provide flashing and sheet metal work where shown and described on the drawings and elsewhere not specifically described in other Sections of these Specifications but required to prevent penetration of water through the exterior shell of the building.
- B. Related Work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, the Contract, AIA 201, and Sections in Division 1 of these Specifications.

1.02 RELATED SECTIONS

- A. Section 06100 –Rough Carpentry
- B. Section 07210 – Thermal Insulation
- C. Refer to other applicable Sections herein

1.04 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. In addition to complying with pertinent codes and regulations, comply with pertinent recommendations contained in current edition of "Architectural Sheet Metal Manual" published by the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- C. Standard commercial items may be used for flashing, trim, reglets, and similar purposes provided such items meet or exceed the quality standards specified.

1.05 SUBMITTALS

- A. Comply with pertinent provisions of Section 01300.

1.06 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01600.

PART 2 - PRODUCTS

2.01 MATERIALS AND GAUGES

- A. Where sheet metal is required and no material or gauge is indicated on the Drawings, provide the highest quality and gauge commensurate with the referenced standards.

2.02 ALUMINUM

- A. Aluminum Sheet ASTM B209, 5005 alloy, H34 temper; 040 inch thick; mill finish shop pre-coated with thermal setting polyester enamel of color selected by the Architect or clear anodized, as directed on the drawings, herein or by the Architect. Assume the more costly of the two will be provided.
 - 1. Where aluminum coil stock is specified to be fastened with exposed nails, aluminum shall be pre-drilled and vinyl-coated nails used, color to match aluminum finish.

2.03 ZINC-COATED COPPER

- A. Zinc-Tin Alloy-Coated Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper; coated on both sides with a zinc-tin alloy (50 percent zinc, 50 percent tin). Weight of all zinc-coated copper shall be 20 oz. (0.027") per sq. ft. unless otherwise noted elsewhere herein and/or on the drawings.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Revere Copper Products, Inc.
 - b. Riverside Sheet Metal
 - c. K&M Sheet Metal

2.04 STAINLESS STEEL

- A. Provide in accordance with Section 05500, Metal Fabrications, if applicable.

2.05 CONCEALED SHEET METAL:

- 1. Stainless-Steel Sheet: AISI Type 302/304 stainless steel or strip, complying with ASTM A 167; dead soft; 28 gauge (0.015 inches thick); No. 2D conventional dull finish; or,
 - 2. Copper Sheet: Cold-rolled sheet copper, complying with ASTM B 370, except soft temper; 28 gauge (16 oz./sq. ft.), CDA 2B (bright) finish.

2.06 NAILS, RIVETS, AND FASTENERS

- A. Use compatible fastening materials. Use only hot-dipped galvanized metal, copper or stainless steel fasteners where used in conjunction with preservative treated wood.
- B. Nails used for fastening copper shall be copper or hardware bronze of stronghold type, or equal, with large flat head. The shall be not smaller than No. 12 stubs gauge (0.109 inch) and of sufficient length to penetrate mounting surfaces not less than 7/8".
- C. Screws and bolts used for fastening copper shall be copper, bronze, or brass.
- D. Use only soft iron rivets having rust-resistive coating, galvanized nails, and cadmium plated screws and washers in connection with galvanized iron and steel.
- E. Use compatible fastening materials. Use only hot-dipped galvanized metal, copper or stainless steel fasteners where used in conjunction with preservative treated wood.

2.07 SOLDER

- A. Solder shall conform to ASTM Specifications B32 or Federal Specifications QQ-S-571.

2.08 SEALANTS

- A. Conform to Section 07920, Sealants and Caulking.

2.09 VENT STACK/PIPE COLLAR SLEEVE

- A. Two-piece, 20-ounce per sq. ft. zinc-coated copper sleeves:
 - 1. Sleeve collar, full height of vent stack, with minimum 8 inch base flange.
 - 2. "Doughnut" shaped cap, with minimum 1 inch outside sleeve overlap, and 1 inch, interior downward return.
- B. Fabricate in conformance with SMACNA Manual Plate 66, Figure B, and with the above.

2.10 GALVANIZED IRON

- A. Provide sheet metal or sheet iron of a standard brand of open-hearth copper-bearing steel, copper molybdenum iron, or pure iron sheets.
- B. Zinc coating:
 - 1. Where galvanizing is required, provide zinc coating by hot-dip galvanize to all surfaces.
 - 2. Weight:
 - a) Provide not less than 1-1/4 oz per sq. ft., nor more than 1-1/2 oz per sq. ft., to surfaces required to be galvanized.
 - 3. Comply with ASTM A93.

2.11 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. To establish a level of quality and performance characteristics the desired specified new gutter assembly is based upon Metal Era, Inc., 1600 Airport Road, Waukesha, WI 53188, Phone: 262-549-6900, Fax: 2662-549-6009, www.metalera.com, Seal-Tite LT. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. RDCA
 - 2. Pac-Clad
 - 3. Or approved equal.
- B. Hanging Gutters:
 - 1. Furnish to cross section required, complete with end pieces, outlet tubes, and other accessories as required.

2. Fabricate in minimum 96-inch-long sections.
 3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
 4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
 5. Gutter Profile: Half round in accordance with cited sheet metal standard.
 6. Expansion Joints: Butt type with cover plate.
 7. Accessories: Wire-ball downspout strainer.
 8. Gutter Width: 7-inch minimum
 9. Gutter Hanging: Strap fabricated of 1/16 x 3/4" (min.) flat stock of same material as gutter and secured with non-corrosive watertight, neoprene washers
 10. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:
 - a. Aluminum: 0.040 inch thick.
- C. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
1. To establish a level of quality and performance characteristics the desired specified new downspout is based upon Metal Era, Inc., 1600 Airport Road, Waukesha, WI 53188, Phone: 262-549-6900, Fax: 2662-549-6009, www.metalera.com, Seal-Tite LT. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - a. RDCA
 - b. Pac-Clad
 - c. Or approved equal
- D. Hanger Style: Fig. 1-35J in accordance with SMACNA's "Architectural Sheet Metal Manual."
- E. Fabricate from the following materials:
1. Aluminum: 0.040 inch thick.
- F. Cast Iron Downspout Boot: 5"x4"x24" cast iron downspout boot, dura-coated with straps and cleanout access with plug, pipe size 4 inches.

2.12 OTHER MATERIALS

- G. Provide other materials not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the A/E.
- H. For metal work, provide the type solder and fasteners recommended by the producer of the metal sheets.
- I. For non-metallic work, provide the types of substrate primers, adhesives, tapes and fasteners recommended by the producer of the non-metallic items.
- J. Roofing Cement: ASTM D 2822.

- K. Bituminous Coating: FS TT-C-494, or Mil-C-18480, or SSPC-Paint 12, cold-applied bituminous mastic, compounded for 15-mil dry film thickness coating.
- L. Glass-Fiber Mesh Fabric: 20-by-20 or 20-by-30 mesh of PVC-coated, glass-fiberglass threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration; in the following color. Comply with ASTM D 3656. Color as selected by Architect.
- M. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- N. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- O. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- B. Verify vents through roof are solidly set, and nailing strips located to details included in the SMACNA Manual.
- C. Verify that roofing termination and base flashings are in place, sealed and secured.

3.02 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 2. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 3. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of welds and sealant.
 - 4. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 5. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 - 6. Install continuous cleats with fasteners spaced not more than 12 inches o.c.

7. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 8. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 9. Do not field cut sheet metal flashing and trim by torch.
 10. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 ft. with no joints within 24 inches of corner or intersection.
 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
- G. Prepare joints and apply sealants to comply with requirements in Section 079200 "Sealant and Caulking."

3.03 INSTALLATION OF METAL TRIM AND VENT COUNTER FLASHINGS.

- A. Conform to drawing details included in SMACNA Manual.
- B. Secure metal trim in place using concealed fasteners. Use exposed fasteners only where permitted by Architect.

- C. Match existing flashings and counter-flashings - Remove and dispose existing where directed or where existing at masonry areas to be restored.
- D. Fit metal trim tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight.
- F. Cap flashing, lap base flashing minimum of 4" with bottom edge folded to provide spring action to hold bottom tightly against base.
- G. Lock Strips: Continuous.
- H. Turn exposed edges back 1/2".

3.04 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
 - 1. Join sections with riveted joints with sealant.
 - 2. Provide for thermal expansion.
 - 3. Attach gutters at eave or fascia to firmly anchor them in position.
 - 4. Provide end closures and seal watertight with sealant.
 - 5. Slope to downspouts.
 - 6. Fasten gutter spacers to front and back of gutter.
 - 7. Anchor and loosely lock back edge of gutter to continuous cleats.
 - 8. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
 - 9. Anchor gutter with gutter brackets spaced not more than 24 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
 - 10. Install gutter with expansion joints at 33-feet apart. Install expansion-joint caps.

3.05 WORKMANSHIP

- A. General:
 - 11. Form sheet metal accurately and to the dimensions and shapes required, finishing molded and broken surfaces with true, sharp and strait lines and angles and, where intercepting other members, coping to an accurate fit and soldering securely.
- B. Form, fabricate and install sheet metal so as to adequately provide for expansion and contraction in the finished work.
- C. Weatherproofing:
 - 1. Finish watertight and weathertight where so required.
 - 2. Make lock seam work flat and true to line, sweating full of solder.
 - 3. Make lock seams and lap seams, when soldered, at least 1/2" wide.

4. Where lap seams are not soldered, lap according to pitch, but in no case less than 3".
5. Make flat and lap seams in the direction of flow.

D. Joints:

1. Join parts with rivets or sheet metal screws where necessary for strength and stiffness.
2. Provide suitable watertight expansion joints for runs more than 40' - 0", except where closer spacing is indicated on the Drawings or required for a complete and proper installation.

E. Nailing:

1. Whenever possible, secure metal by means of clips or cleats, without nailing through the exterior metal.
2. In general, space nails, rivets, and screws not more than 8" apart and, where exposed to the weather, use lead washers.
3. For nailing into wood, use barbed roofing nails 1-1/2" long by 11 gauge.
4. For nailing into concrete, use drilled plug holes and plugs.

3.06 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.

3.07 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

3.06 TESTS

- A. Upon request of the A/E, demonstrate by hose or standing water that the flashing and sheet metal are completely watertight. Do so at no additional cost to the Owner.

END OF SECTION 07620

SECTION 07725

SNOW GUARDS

GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Snow guards for roofs.
 - 2. Face-fastened attachment system.

1.2 RELATED SECTIONS

- A. Division 01: Administrative, procedural and temporary work requirements apply to this section.
- B. Section 07 62 00 – Sheet Metal Flashing and Trim

1.3 REFERENCES

- A. Aluminum Association (AA) - Aluminum Standards and Data, Current Edition.
- B. ASTM International (ASTM):
 - 1. A484/A484M-16 – Standard Specifications for General Requirements for Stainless Steel Bars, Billets and Forgings.
 - 2. A554-16 – Standard Specification for Welded Stainless Steel Mechanical Tubing.
 - 3. A555/A555M-16 – Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods.
 - 4. B85-03 – Standard Specification for Aluminum-Alloy Die Castings.
 - 5. B221-04a – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
 - 6. F836M-02 (Current) – Standard Specification for Style 1 Stainless Steel Metric Nuts (Metric).
 - 7. F880-12 – Standard Specification for Stainless Steel Socket, Square Head, Torx and Slotted Headless-Setscrews.
- C. ICC Evaluation Service (www.icc-es.org):
 - 1. Division: 05 00 00 – METALS; Section: 05 05 23 – METAL FASTENERS Evaluation Report ESR-3869.
- D. IAPMO Uniform Evaluation Services
 - 1. IAPMO UES EC 029-2018; Division: 05 00 00 – METALS; 05 05 23 METAL FASTENINGS; UES Evaluation Report Number: 805

1.4 SUBMITTALS

- A. Action Submittal:
 - 1. Shop Drawings: Include roof plans showing locations of snow guards on roof and attachment details and spacing.
 - 2. Product Data:
 - a. Product description.
 - b. Construction details.
 - c. Material descriptions.
 - d. Individual component dimensions.
 - e. Finishes.
 - f. Installation instructions.
 - 3. Samples:

- a. Bracket samples.
 - b. 12-inch long cross member samples including all associated hardware.
- B. Informational Submittals:
 - 1. Proof of Job Specific Engineering: Include registered professional engineer wet-stamped calculation for number and frequency of snow guard attachments based on designed roof snow load, roof slope, roof dimensions, specific roof profile name, material type, gauge thickness and brand of manufacture; brand and model of snow retention device.
 - 2. Proof of Product Testing: Results of appropriate product tensile load testing, issued by a recognized ISO 17025 accredited independent testing laboratory, showing the mean (of a minimum three test pulls) ultimate load-to-failure value of attachment bracket proposed on the specimen material.
 - 3. Proof of Certified Production: Copy of manufacturer current ISO 9001 certificate (latest edition).
 - 4. Proof of Best Practice Compliance: Manufacturer duly executed letter stating full compliance with all provisions of the Metal Construction Association technical bulletin, "Qualifying Snow Retention Systems for Metal Roofing" (latest edition).
- C. Closeout Submittals:
 - 1. Certification: Installer's certification or duly executed letter stating snow guard system was installed in accordance with manufacturer's instructions and approved shop drawings.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer to specialize in production of snow guard products of the type specified with a minimum of 10 years documented experience.
- B. Manufactured in an ISO 9001 (current) certified facility; ICC audited facility.
- C. Installer Qualifications: Installer to specialize in metal roof installation and installation of snow guard products with a minimum of 5 years documented experience.
- D. Mockup:
 - 1. Size: Minimum: 8 feet long.
 - 2. Show: Snow guard attachment, cross members, and accessories.
 - 3. Location: To be determined in the field.
 - 4. Approved mockup may remain as part of the Work.
- E. Warranty:
 - 1. Lifetime material/workmanship warranty on all products.
 - 2. System performance warranty.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver components to jobsite properly packaged to provide protection during transport, delivery and handling.
- B. Store products in manufacturer's original labeled and unopened packaging in a clean and dry location, protected from potential damage, until ready for application.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Attachment system to provide attachment to standing seam metal roofs:
 - 1. With dimpling deformation of panel seams only at setscrew locations.

2. Without penetrations through roof seams or panels.
3. Without use of sealants or adhesives.
4. Without violation of roof warranty.
- A. Attachment system to provide attachment to trapezoidal exposed-fastened metal roofs:
 1. Factory-applied butyl sealant.
 2. Without use of sealants or adhesives.
- B. Performance Requirements: Provide snow guards to withstand exposure to the weather and environmental elements and resist design forces without failure due to defective material or manufacture.
 1. Loading: Design snow guard system to resist minimum design roof snow load(s). See structural drawings for roof design snow loads.
 2. Factor of Safety: Utilize a factor of safety ≥ 2 to determine allowable loads from ultimate tested bracket tensile mean load values.
 3. Source Limitation: Provide snow guard system as designed and tested by the manufacturer as a complete system. Install all system components by the same manufacturer.

2.2 MANUFACTURER

- A. Basis-of-Design Product: To establish a level S-5!® div. of Metal Roof Innovations, Ltd., 500 W. Highway St., Iowa Park, TX 76367; Tel: 888-825-3432; Fax: 719-495-0045; Email: support@s-5.com; Web: www.s-5.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 1. LMCurbs. <https://www.lmcurbs.com/>
 2. Rocky Mountain Snow Guards Inc. <https://www.rockymountainsnowguards.com/>
 3. Or Approved Equal
- B. Substitutions: [Under provisions in Division 1.] Not permitted.

2.3 Continuous, Color-Matching – Type snow retention systems for trapezoidal-ribbed insulated metal panel

- A. Basis of Design: ColorGard®, manufactured by S-5! Div. of Metal Roof Innovations, Ltd.
- B. Components:
 1. Clamps:
 - a. Manufactured from 6000-series aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85 and to AA Aluminum Standards and Data.
 - 1) Clamp model to be as recommended by the manufacturer for the specific seam profile used on the project.
 - b. Setscrews: 300-series stainless steel, 18-8 alloy, 3/8 inch diameter, with round nose point.
 - c. Attachment bolts: 300-series stainless steel, 18-8 alloy, 8 mm diameter, hex flange bolt.
 2. Brackets:
 - a. Manufactured from 6000-series alloy and temper-aluminum extrusions conforming to ASTM B221 and AA Aluminum Standards and Data.
 - 1) Model: VersaBracket
 - b. Screws for attachment of brackets to roof: as specifically tested to the substrate used on the project, and furnished by snow guard manufacturer. All fastener portions exposed to the weather shall be stainless steel or Zinc/Aluminum cap.
 3. Cross Members:

- a. Manufactured from 6000-series alloy and temper-aluminum extrusions conforming to ASTM B221 and AA Aluminum Standards and Data.
 - b. Receptacle in face to receive color-matched metal strips.
 - c. Provide splice connectors ensuring alignment and structural continuity at end joints.
4. Color Strips: Same material and finish as roof panels; obtained from roof panel manufacturer.
5. Snow and Ice Clips:
 - a. Aluminum, with rubber foot extending to and resting at surface of metal panels; minimum 3 inches wide.
 - 1) Model: SnoClip II or SnapClip II for standing seam heights 1 inch to 1.5 inches .
 - 2) Model: SnoClip III or SnapClip III for standing seam heights 1.75 inches to 3.25 inches.

PART 3- EXECUTION

3.1 EXAMINATION

Prior to beginning installation, verify:

1. Panel seaming is complete.
2. Panel attachment is sufficient to withstand loads applied by snow guard system.
3. Installation will not impeded roof drainage.

Prior to beginning installation, verify:

1. Roof attachment is sufficient to withstand loads applied by snow guard system.
2. Installation will not impede roof drainage.

3.2 PREPARATION

- A. Clean areas to receive attachments; remove loose and foreign matter that could interfere with installation or performance.
- B. Wipe away excess oil and debris at bracket locations.

3.3 INSTALLATION

- A. Install system in accordance with manufacturer's instructions and approved shop drawings.
- B. ColorGard snow retention system:
 1. Place clamps at maximum 32 inches on center or as required by certified calculation.
 2. Place clamps in straight, aligned rows using a string line.
 3. Place both setscrews on same side of clamp.
 4. Tighten setscrews to manufacturer's recommended torque. Calibrate tool to setscrew torque using calibrated dial-indicating torque wrench.
 5. Insert color-matched metal strips into cross members, staggering strips to cover cross-member joints.
 6. Attach cross members to clamps; tighten bolts to manufacturer's recommended torque.
 7. Install splice connectors at cross-member end joints.

8. Do not cantilever cross members more than 8 inches beyond last clamp at assembly ends.
9. Install SnoClips or SnapClips at spacings indicated on shop drawings.
 - a. SnoClips: slide onto cross member before securing cross member to clamps.
 - b. SnapClips: Secure clips to back side of the cross member using stainless steel #10 x ½ inch screw provided.
1. Place brackets at maximum 32 inches on center or as required by certified calculation.
2. Clean roof area to receive bracket. Remove protective seal on butyl tape.
3. Place brackets in straight rows along underlying substrate using a string line.
4. Insert color-matched metal strips into cross members.
5. Place brackets at spot of attachment. Fasten with screws best suited for type of attachment, and install according to the manufacturer's instructions.
6. Attach cross members to brackets using self drilling screws.
7. Install splice connectors at cross-member end joints.
8. Do not cantilever cross members more than 8 inches beyond last bracket at assembly ends.
9. Install SnoClips or SnapClips at spacings indicated on shop drawings.
 - a. SnoClips: slide onto cross member before securing cross member to clamps
 - b. SnapClips: Secure SnapClip II or SnapClip III to back side of cross member using stainless steel #10 x ½ inch screw (provided).
1. Place brackets at maximum 32 inches (812.6 mm) on center or as required by certified calculation.
2. Clean roof area to receive bracket. Remove protective seal on butyl tape.
3. Place brackets in straight rows along underlying substrate using a string line. Orient the bolt hole downslope.
4. Secure the bracket directly to the rib of the panel, straddling the profile.
5. Secure the SnoBrackets by driving the provided fasteners into the pre-punched holes. All eight pre-punched holes must be used to achieve published tested strength. Drive fasteners in until they are tight and the washer is firmly seated. Do not overdrive fasteners.
6. Install the ColorGard system using Versaclips with provided M8 bolts.
7. Be sure not to cantilever more than 8 inches beyond the last bracket. Any trimmed piece of ColorGard must be attached with at least two clamps.
8. Insert color-matched metal strips into cross members.
9. Install splice connectors at cross-member end joints.
10. Install SnoClips or Snapclips at designated spacings indicated on shop drawings.
 - a. SnoClips: slide onto cross member before securing cross member to clamps.
 - b. SnapClips: Secure clips to back side of the cross member using stainless steel #10 x ½ inch (12.7 mm) screw provided.

END OF SECTION 07725

SECTION 07841

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
2. Mineral fiber insulation, fire safing, and safing edge of floor slabs and curtain walls.
3. Damming material, clips, and closures.
4. Gaps between the top of walls and ceilings or roof assemblies.
5. Expansion joints in walls and floors.
6. Openings around structural members which penetrate floors or walls.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03300 - Cast-in-Place Concrete.
3. Section 07210 - Thermal Insulation.
4. Section 07920 - Joint Sealants.
5. Section 09290 - Gypsum Board.
6. Division 22 - Plumbing.
7. Division 23 - HVAC.
8. Division 26 - Electrical.

1.02 REFERENCES

A. ASTM Standards:

1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.

3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 4. ASTM E1399 – Standard Test Method for Cyclic Movement and Measuring Minimum and Maximum Joint Widths on Architectural Joint Systems.
 5. ASTM E1966 – Standard Test Methods for Fire-Resistive Joint Systems.
 6. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops
 7. ASTM E2307 – Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus.
 8. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- B. Underwriters Laboratories, Inc.
1. UL Fire Resistance Directory.
 2. UL 263 – Standard for Fire Tests of Building Construction and Materials.
 3. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
 4. UL 1479 – Fire Tests of Through Penetration Firestops.
 5. UL 2079 – Test for Fire Resistance of Building Joint Systems.
- C. Testing Services:
1. Underwriters Laboratories.
- D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
- E. International Building Code, Chapter 7 Fire Tests of Through-Penetration Fire Stops.

1.03 SYSTEM DESCRIPTION

- A. Provide fire stops and smoke seals to prevent the passage of fire, smoke, toxic gasses or water from one floor or area to another. Seal openings in floors, fire rated walls and permanent partitions penetrated by pipes, ducts, conduits and other items as shown, specified, and as required for the type of construction.
- B. Mineral fiber insulation installed as fire safing at non-rated penetrations not containing pipes, ducts, conduits, and other items in floor slabs, wall partitions, construction-joint conditions between slabs and adjacent construction and where indicated or required.
- C. Provide damming material, clips, and closures as required for support and containment of dams, and other insulation materials required for tested and rated fire stop systems.

1.04 QUALITY ASSURANCE

- A. Performance Criteria:

1. Provide materials and Work to conform to source quality control criteria specified herein and IBC requirements in fire resistant wall and floor assemblies to prevent the passage of fire, smoke, and toxic gases.
 2. Installed fire stops shall be of sufficient thickness, width, and density to provide a fire resistance rating at least equal to the floor, wall, or partition construction into which it is installed.
- B. Comply with IBC requirements for fire rated construction.
- C. Qualifications of Manufacturer: Products furnished for fire stopping and smoke seals shall be manufactured by a firm which has been continuously and regularly employed in the manufacture of these materials for a period of at least 5 years; and which can provide evidence of these materials being satisfactorily installed on at least 5 projects of similar size and type within such period.
- D. Qualifications of Installer: The Work of this section shall be installed by a firm which has been in the business of installing similar materials for at least 5 consecutive years; and can provide evidence of satisfactory completion of 5 projects of similar size and scope. Installer shall have applicators trained and certified by manufacturer for performing this Work. Comply with requirements of FICA Manual of Practice.
- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, an engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.
- F. Firestopping tests shall be performed by a qualified testing and inspection agency. A qualified testing and inspection agency shall be UL, Intertek or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction. Firestopping products shall bear the classification marking of a qualified testing and inspection agency.

1.05 SUBMITTALS

- A. Product Data:
1. Submit manufacturer's Product Data for each type of fire stop and smoke seal material proposed for installation. Indicate product characteristics, typical installations, performance, and limitation criteria and test data.
 2. Submit manufacturer's printed installation instructions for each type of product, system, and construction required for the Work. Indicate fire resistance rating of each installation.
 3. Submit fire test reports from independent testing agency indicating the following:
 - a. Fire test report of fire stop material installed to substrate and penetration materials similar to the Work of this section. Test to indicate both Fire Resistance (F) and Temperature (T) Ratings.
 - b. Test reports of products to be installed shall indicate conformance to ASTM E814 or UL 1479 for penetrations, ASTM E1966 or UL 2079 for joints, and ASTM E2307 for perimeter fire barrier (edge-of-slab) systems.

- B. Field Samples: No less than 10 days before commencing the Work of this section, provide field installed Samples of fire stop materials and systems.
 - 1. Apply one Sample of fire stop material for each different penetration and related fire rating required for the Work.
 - 2. Sample areas shall comply with thickness, fire resistance ratings, and finished appearance.
- C. Manufacturer's Qualifications: Submit evidence of conformance with qualification requirements specified above.
- D. Installer's Qualifications: Submit evidence of conformance with qualification requirements specified above.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the Project site in manufacturer's original, unopened containers bearing correct UL labeling.
- B. Fire stop material shall be stored above grade in an area protected from detrimental weather and moisture conditions and in compliance with manufacturer's requirements, including temperature restrictions.
- C. Fire stop and seal materials shall be installed before expiration of shelf life.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Unless otherwise noted, products of this section shall be as manufactured by:
 - 1. 3M Fire Protection Products.
 - 2. Hilti, Inc.
 - 3. Nelson Firestop Products.
 - 4. Specified Technologies, Inc. (STI).
 - 5. Tremco, Inc.
 - 6. Or Approved Equal.
- B. Provide materials and systems of specified manufacturers to suit penetration and substrate as determined by various conditions of installation.
- C. Provide firestopping composed of components that are compatible with the substrates forming openings and the items penetrating the firestop, under conditions of service and application, as demonstrated by the fire stopping manufacturer based on testing and field experience.

- A. Cast-in Firestop Devices: Pre-installed firestop devices penetrating cast-in-place concrete decks and concrete over metal decks, for use with combustible and non-combustible pipe, (closed and open systems) insulated pipe, conduits and cable bundles. Provide metal deck adapters and top seal plugs.
1. 3M: Fire Barrier Cast-in-Place Devices.
 2. Hilti: CP 680 Cast-in-Place FS Device
 3. Specified Technologies, Inc. (STI): Cast-In Firestop Devices.
 4. Or Approved Equal.
- B. Firestop Collar: Made of galvanized steel housing and Intumescent inserts for firestopping combustible pipes through walls and floors. For use with concrete, masonry, wood floor and gypsum wall assemblies. Provide two collars on walls, one on each side, and one collar on underside of floors.
1. 3M: Plastic Pipe Device PPD.
 2. Hilti: CP 643N and CP 644.
 3. Tremco: TREMstop D.
 4. Specified Technologies, Inc. (STI): Intumescent Firestop Collars, type LCC, SSC or RTC.
 5. Or Approved Equal.
- C. Fire Pillows and Blocks: Intumescent flexible pillows consisting of a mineral fiber core sealed with a water-resistant intumescent membrane, heat-sealed in a durable fire-retardant poly bag; or intumescent block based on a two component foam, for use in walls and floors and concrete, masonry and gypsum wall assemblies. For large openings containing multiple penetrations: wall openings up to 48 inches by 48 inches and floors up to 36 inches by 36 inches.
1. 3M: Fire Barrier Self-Locking Pillow.
 2. Hilti: CFS-BL Firestop Block
 3. Tremco: TREMstop PS
 4. Nelson Firestop Products: Fire Brick, Pillows.
 5. Specified Technologies, Inc. (STI): SSB Firestop Pillows.
 6. Or Approved Equal.
- D. Firestop Putty Stick: Intumescent, non-hardening, firestop putty for single or bundled cables and non-combustible pipe penetrations. For use in horizontal or vertical, concrete, masonry or gypsum wall assemblies.
1. 3M: Fire Barrier Moldable Putty Stix MP+.
 2. Hilti: CP 619T.

3. Tremco: TREMstop MP Putty Stick.
 4. Nelson Firestop Products: PN AA445.
 5. Specified Technologies, Inc. (STI): SpecSeal SSP Putty and Putty Pad.
 6. Or Approved Equal.
- E. Firestop Putty Pad: Moldable firestop putty for protection of electrical outlet boxes.
1. 3M: MPP+.
 2. Hilti: CP 617.
 3. Tremco: TREMstop MP Putty Pad.
 4. Nelson Firestop Products: FSP AA452.
 5. Specified Technologies, Inc. (STI): SSP Putty Pads or Electrical Box Insert.
 6. Or Approved Equal.
- F. Firestop Sealant: Smoke, gas and water resistant. For use in horizontal or vertical, concrete, masonry or gypsum wall assemblies.
1. Single component intumescent sealant for protection of combustible and non-combustible pipe, conduit and cable penetrations.
 - a) 3M: CP-25WB+, IC-15WB+, 3000WT.
 - b) Hilti: FS ONE MAX.
 - c) Tremco: TREMstop IA+ or Fyre-Sil.
 - d) Nelson Firestop Products: ES1399.
 - e) Specified Technologies, Inc. (STI): LCI or SSS Intumescent Firestop Sealant.
 - f) Or Approved Equal.
 2. Silicone based system that provides maximum movement in fire-rated joint applications and pipe penetrations.
 - a) 3M: 2000+, 2000 NS.
 - b) Hilti: CP 601S.
 - c) Tremco: TREMstop Fyre-sil.
 - d) Nelson Firestop Products: CLK AA529, AA542, PN AA492.
 - e) Specified Technologies, Inc. (STI): SIL Silicone Firestop Sealant SIL300 or SIL300SL (self-leveling).
 - f) Or Approved Equal.

3. Self-leveling silicone-based firestop sealant for use with through penetrations and construction joints in horizontal floor/ceiling assemblies.
 - a) 3M: 1000 SL.
 - b) Hilti: CP 604.
 - c) Tremco: TREMstop Fyre-sil S.L.
 - d) Nelson Firestop Products: CLK AA539, AA552.
 - e) Specified Technologies, Inc. (STI): SIL Silicone Firestop, type SIL300SL.
 - f) Or Approved Equal.
- G. Firestop Wrap Strip: Wrap strip of intumescent, flexible firestop for use with plastic and insulated pipe penetrations. For use in horizontal or vertical, concrete, masonry or gypsum wall assemblies.
 1. 3M: Ultra GS, FS-195+.
 2. Hilti: CP 648-S, CP 648-E.
 3. Tremco: TREMstop SuperStrip or TREMstop WS.
 4. Nelson Firestop Products: MCT, MPS.
 5. Specified Technologies, Inc. (STI): SSW Intumescent Wrap Strips, type BLU, BLU2, RED or RED2.
 6. Or Approved Equal.
- H. Spray: Sprayable or brush applied fire-rated mastic for construction joints where maximum movement is required. For use in horizontal or vertical, concrete, masonry or gypsum wall assemblies, at top of wall joints, curtain wall/slab edge and expansion joints.
 1. 3M: Fire Dam Spray 200.
 2. Hilti: CP 672 FC.
 3. Tremco: TREMstop Acrylic SP spray.
 4. Nelson Firestop Products: FSC3.
 5. Specified Technologies, Inc. (STI): AS200 Elastomeric Spray with or without SpeedFlex® Joint Strip, or Fast Tack® Firestop Spray.
 6. Or Approved Equal.
- I. Fire Rated Grommet or Disc: For single or dual cable penetrations through the same small opening.
 1. Hilti: CFS-D Firestop Cable Disc.
 2. Specified Technologies, Inc. (STI): EZ-Path Firestop Grommets
 3. Equal.

- J. Fire Safing, Mineral Fiber or Ceramic Wool Non-Combustible Insulation:
1. Mineral Fiber: Density 4 pounds per cubic foot, USG Thermafiber, Johns Manville Industrial Insulation Group (IIG), Roxul AFB, or equal.
 2. Ceramic Wool: Density 6 pounds per cubic foot, Johns Manville "Ceramic Fiber Insulation", Unifrax "Fiberfrax" ceramic fiber, or equal. Provide material in tested thickness for required hour rating.
 - a. Flame Spread: Less than or equal to 25.
 - b. Smoke developed: Less than or equal to 50.
 3. For mineral fiber, provide 20 gage minimum size metal retainer clips and plates for fire safing support in vertical applications and in compliance with tested system design.
- K. Supplemental Material: Provide supplementary materials required for complete, fire rated, installation.

2.03 SOURCE QUALITY CONTROL

- A. Fire stop and smoke seal material shall be tested by an independent testing agency for conformance to Flame (F) and Temperature (T) requirements of ASTM E814/UL 1479, ASTM E1966/UL 2079, or ATSM E2307.
- B. Conform to UL Fire Hazard Classification Requirements. Material shall be classified as a fill, void, or cavity material and system for UL through Penetration Firestop System.
- C. Material shall be tested and shall display Flame Spread Index of 25 or less, and Smoke Developed Index of 450 or less when tested in accordance with ASTM E84.

PART 3 - EXECUTION

3.01 APPLICATION REQUIREMENTS

- A. Provide single component fire stop sealant or putty:
 1. Within penetrations subject to movement including conduit, cable bundles, buss duct, and noncombustible pipe.
 2. As a sealant or caulking for smoke barrier construction, fire, and smoke dampers, mechanical/electrical framed elements in masonry and gypsum board partition systems, and other conditions.
- B. Provide mineral fiber insulation for fire safing at joints and openings through floor slabs, walls, and partitions not indicated to be grouted, gaskets, sealed or otherwise made sound or air tight in this or other sections. Fire safing shall be packed and wedged solidly from both sides of walls and partitions, and from both top and bottom sides of slabs with noncombustible mineral fiber insulation.

3.02 PREPARATION

- A. Examine the areas and conditions where fire stops and smoke seals are to be installed for conditions detrimental to the proper completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected for rated fire protection.
- B. Surface to receive fire stops or smoke seals shall be free of dirt, dust, grease, form release agents, or other matter that would impair the bond of the fire stop material to the substrate or penetrating items. Substrate shall be frost free and when required, dry.
- C. Voids and cracks in substrate shall be filled and unnecessary projections removed before installation of fire stops.
- D. Assure that all pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed before installation of fire stops. Schedule and sequence the Work to assure that partitions and other construction, which would conceal penetrations, are not installed before the installation of fire stops and smoke seals.
- E. Comply with manufacturer's recommendations for temperature and humidity conditions before, during, and after installation of fire stops and smoke seals.

3.03 INSTALLATION

- A. General: Provide installation in accordance with manufacturer's installation procedures, as required. Install fire stops in accordance with fire test reports, UL Fire Resistance Directory, Intertek Testing Services Directory or SpecDirect, and reviewed Sample installations.
- B. Dam Construction:
 - 1. Install dams when required to properly contain fire stopping materials within openings and as required to achieve fire resistance rating as tested and rated.
 - 2. Provide in conformance with installation requirements for type of floor, wall, and partition construction, and as recommended by fire stop manufacturer.
 - 3. Combustible damming material shall be removed after appropriate curing. Noncombustible damming material may be left as a permanent component of the fire stop system.
 - 4. Placement of dams shall not interfere with function, or adversely affect the appearance, of adjacent construction.
- C. Installation of Single Component Fire Stop Sealant:
 - 1. Provide noncombustible insulation as required to achieve fire resistance rating.
 - 2. Install with manual or powered sealant gun. For up to four hour rating, install to the thickness required by the Listed System Designs as directed for wall and floor applications.
 - 3. Surface of gun grade fire stop sealant shall be tooled in accordance with manufacturer's recommendations.
 - 4. Remove excess materials from adjacent surfaces within 10 minutes, with either water or other material compatible with sealant and recommended by sealant manufacturer, leaving the Work in a neat, clean condition.

3.04 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Repair damaged areas and restore integrity of assembly.
- C. Keep areas of work accessible until inspection by authorities having jurisdiction.
- D. OWNER will engage a qualified independent inspection agency to inspect through-penetration firestop systems in accordance with ASTM E2174, or joint systems in accordance with ASTM E2393. Manufacturer representatives shall not perform inspections of installed firestopping systems.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

- A. Clean surfaces adjacent to sealed openings and joints and remove excess of firestopping materials.
- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 07841

SECTION 07920
SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Joint sealants.
2. Preparation for application of sealants.

B. Related Requirements:

1. Division 01 - General Requirements.
4. Section 06200 - Finish Carpentry.
5. Section 07620 - Sheet Metal Flashing and Trim
6. Section 07841 - Penetration Firestopping
7. Division 08 - Openings.
8. Division 09 - Finishes.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating sealant joint locations, with full-size sealant joint details.
- B. Product Data: Submit manufacturer's literature for each sealant material.
- C. Material Samples: Submit Samples indicating color range available for each sealant material intended for installation in exposed locations.
- D. Certifications: Submit manufacturer's certification materials comply with requirements specified.
- E. Site Samples: At locations required, provide a Sample of sealant for each typical installation, approximately 24 inches long, including joint preparation, backing, sealant and tooling. Allow backing to extend 6 inches beyond end of sealant for inspection of substrate.
- F. Test Reports: Submit manufacturer's adhesion compatibility test reports according to ASTM C794 for each substrate.

1.03 QUALITY ASSURANCE

- A. Qualifications of Installer: The Work of this section shall be installed by a firm which has been in the business of installing similar materials for at least five consecutive years; and can show

evidence of satisfactory completion of five projects of similar size and scope. Installer shall have applicators trained and approved by manufacturer for performing this Work.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Store in accordance with manufacturer's recommendations. Provide a uniform ambient temperature between 60 and 80 degrees F.

1.05 WARRANTY

- A. Manufacturer: five year material warranty.
- B. Installer: two year installation/application warranty.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Furnish sealants meeting following in-service requirements:
 - 1. Normal curing schedules are permitted.
 - 2. Non-staining, color fastness (resistance to color change), and durability when subjected to intense actinic (ultraviolet) radiation are required.
- B. Furnish the products of only one manufacturer unless otherwise required, sealant colors as selected to match the adjoining surfaces.

2.02 MANUFACTURERS

- A. Sealants must be approved by the Environmental Health and Safety (OEHS). Check OEHS website for approved products. Not all products by a manufacturer are approved by OEHS.

2.03 MATERIALS

- A. Sealants:
 - 1. Sealant 1: Acrylic latex, one-part, non-sag, mildew resistant acrylic emulsion compound complying with ASTM C834, Type S, Grade NS, formulated to be paintable.
 - a. Tremco Inc., Acrylic Latex Caulk.
 - b. Pecora Corporation, AC-20.
 - c. Sika Corporation, Sikaflex 1A
 - d. Or Approved Equal.
 - 2. Sealant 2: Butyl sealant, one-part, non-sag, solvent-release-curing sealant complying with ASTM C1311, gun grade and formulated with a minimum of 75 percent solids.
 - a. Tremco Inc., Tremco Butyl Sealant.
 - b. Pecora Corp., BC-158.

- c. Sika Corporation, SikaLastomer 511
 - d. Or Approved Equal.
3. Sealant 3: Silicone sealant, one-part non-acid-curing silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25.
- a. Dow Corning Corp., Dow Corning 790, 791, 795.
 - b. General Electric Co., Silpruf.
 - c. Tremco, Inc., Spectrem 1.
 - d. Pecora Corp., 864.
 - e. Or Approved Equal.
4. Sealant 4: One-part mildew-resistant silicone sealant, complying with ASTM C920, Type S, Grade NS, Class 25.
- a. Dow Corning Corp., Dow Corning 786.
 - b. General Electric Co., Sanitary 1700.
 - c. Tremco, Inc., Proglaze White.
 - d. Or Approved Equal.
5. Sealant 5: One-part non-sag urethane sealant, complying with ASTM C920, Type S, Grade NS, Class 25.
- a. Sika Corporation, Sikaflex -221e.
 - b. Tremco Inc., Dymonic 100
 - c. Pecora Corp., Dynaflex SC
 - d. Or Approved Equal.
6. Sealant 6: Multi-part pouring urethane sealant, complying with ASTM C920, Type M, Grade P, Class 25.
- a. Sika Corporation, Sikaflex 2C NS/SL.
 - b. Pecora Corp., DynaTrol II
 - c. Tremco Inc., Vulkem 445SSL
 - b. Or Approved Equal.
7. Sealant 7: Acoustical sealant, non-drying, non-hardening permanently flexible conforming to ASTM D217.
- a. Pecora Corp., BA-98 Acoustical Sealant.

- b. Sika Corporation, Sikaflex 11 FC
 - c. Tremco Inc., Acoustical Curtainwall Sealant
 - d. Or Approved Equal.
- B. See 07841 - Penetration Firestopping for rated sealants.
- C. Joint Backing: ASTM D1056; round, closed cell Polyethylene Foam Rod; oversized 30 to 50 percent larger than joint width, reticulated polyolefin foam.
- D. Primer: Non-Staining Type. Provide primer as required and shall be product of manufacturer of installed sealant.
- E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer.
- F. Sealants shall have normal curing schedules, shall be nonstaining, color fast and shall resist deterioration due to ultraviolet radiation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that joint openings are ready to receive Work and field tolerances are within the guidelines recommended by sealant manufacturer.

3.02 SURFACE PREPARATION

- A. Joints and spaces to be sealed shall be completely cleaned of all dirt, dust, mortar, oil, and other foreign materials which might adversely affect sealing Work. Where necessary, degrease with a solvent or commercial degreasing agent. Surfaces shall be thoroughly dry before application of sealants.
- B. If recommended by manufacturer, remove paint and other protective coatings from surfaces to be sealed before priming and installation of sealants.
- C. Preparation of surfaces to receive sealant shall conform to the sealant manufacturer's specifications. Provide air pressure or other methods to achieve required results. Provide masking tape to keep sealants off surfaces that will be exposed in finished Work.
- D. Etch concrete or masonry surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance. Etch with 5 percent solution of muriatic acid; neutralize with dilute ammonia solution, rinse thoroughly with water and allow to dry before sealant installation.
- E. Perform preparation in accordance with ASTM C804 for solvent release sealants, and ASTM C962 for elastomeric sealants.
- F. Protect elements surrounding Work of this section from damage or disfiguration.

3.03 SEALANT APPLICATION SCHEDULE

<u>Location</u>	<u>Type</u>	<u>Color</u>

A.	Exterior and Interior joints in horizontal surfaces of concrete; between metal and concrete masonry and mortar.	Sealant 6	To be selected from manufacturer's standard colors
B.	Exterior door, entrance and window frames. Exterior and interior vertical joints in concrete and masonry metal flashing.	Sealant 3 or 5	To be selected from manufacturer's standard colors
C.	Joints within glazed curtain wall system. Skylight framing system. Aluminum entrance system glass and glazing.	Sealant 3	Translucent or Black
D.	Interior joints in ceramic tile and at plumbing fixtures.	Sealant 4	Translucent or White
E.	Under thresholds.	Sealant 2	Black
F.	All interior joints not otherwise scheduled	Sealant 1	To be selected from manufacturer's standard colors
G.	Heads and sills, perimeters of frames and other openings in insulated partitions	Sealant 7	To be selected from manufacturer's standard colors

3.04 APPLICATION

- A. Provide sealant around all openings in exterior walls, and any other locations indicated or required for structure weatherproofing and/or waterproofing.
- B. Sealants shall be installed by experienced mechanics using specified materials and proper tools. Preparatory Work (cleaning, etc.) and installation of sealant shall be as specified and in accordance with manufacturer's printed instructions and recommendations.
- C. Concrete, masonry, and other porous surfaces, and any other surfaces if recommended by manufacturer, shall be primed before installing sealants. Primer shall be installed with a brush that will reach all parts of joints to be filled with sealant.
- D. Sealants shall be stored and installed at temperatures as recommended by manufacturer. Sealants shall not be installed when they become too jelled to be discharged in a continuous flow from gun. Modification of sealants by addition of liquids, solvents, or powders is not permitted.
- E. Sealants shall be installed with guns furnished with proper size nozzles. Sufficient pressure shall be furnished to fill all voids and joints solid. In sealing around openings, include entire perimeter of each opening, unless indicated or specified otherwise. Where gun installation is impracticable, suitable hand tools shall be provided.

- F. Sealed joints shall be neatly pointed on flush surfaces with beading tool, and internal corners with a special tool. Excess material shall be cleanly removed. Sealant, where exposed, shall be free of wrinkles and uniformly smooth. Sealing shall be complete before final coats of paint are installed.
- G. Comply with sealant manufacturer's printed instructions except where more stringent requirements are indicated on Drawings or specified.
- H. Partially fill joints with joint backing material, furnishing only compatible materials, until joint depth does not exceed 1/2 inch joint width. Minimum joint width for metal to metal joints shall be 1/4 inch. Joint depth, shall be not less than 1/4 inch and not greater than 1/2 inch.
- I. Install sealant under sufficient pressure to completely fill voids. Finish exposed joints smooth, flush with surfaces or recessed as indicated. Install non-tracking sealant to concrete expansion joints subject to foot or vehicular traffic.
- J. Where joint depth prevents installation of standard bond breaker backing rod, furnish non-adhering tape covering to prevent bonding of sealant to back of joint. Under no circumstances shall sealant depth exceed 1/2 inch maximum, unless specifically indicated on Drawings.
- K. Prime porous surfaces after cleaning. Pack joints deeper than 3/4 inch with joint backing to within 3/4 inch of surface. Completely fill joints and spaces with gun applied compound, forming a neat, smooth bead.

3.05 MISCELLANEOUS WORK

- A. Sealing shall be provided wherever required to prevent light leakage as well as moisture leakage. Refer to Drawings for condition and related parts of Work.
- B. Install sealants to depths as indicated or, if not indicated, as recommended by sealant manufacturer but within following general limitations:
 - 1. For joints in concrete walks, slab and paving subject to traffic, fill joints to a depth equal to 75 percent of joint width, but not more than 3/4 inch deep or less than 3/8 inch deep, depending on joint width.
 - 2. For building joints, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2 inch deep or less than 1/4 inch deep.

3.06 CLEANING

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.07 CURING

- A. Sealants shall cure in accordance with manufacturer's printed recommendations. Do not disturb seal until completely cured.

3.08 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 07920

SECTION 08111

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior hollow-metal doors and frames.
2. Exterior hollow-metal doors and frames.
3. Fire-rated hollow-metal door assemblies.

B. Related Requirements:

1. Section 06105 "Miscellaneous Rough Carpentry".
2. Section 08710 "Door Hardware" for door hardware for non-fire-rated hollow-metal doors.

C. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.2 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.

7. Details of anchorages, joints, field splices, and connections.
 8. Details of accessories.
 9. Details of moldings, removable stops, and glazing.
- C. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.
- D. Samples for Verification:
1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
 2. Fabrication: Prepare Samples approximately 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.
1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
 3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.
- B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly fire-rated window assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.
- C. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.
- D. Field quality control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies to meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAl) certification.
 - B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAl) certification.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 1. Provide additional protection to prevent damage to factory-finished units.
 - B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
 - C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new fire rated metal door and frames is based upon Titan Builders Series 20-90 Minute Doors and Frames and Titan 45 Minute Window. Metal doors are based upon De La Fontaine. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 1. Ceco Door; ASSA ABLOY.
 2. TruDoor
 3. Or approved equal

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

- B. Fire-Rated, Borrowed-Lite and Window Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. when tested in accordance with ASTM C518.

2.3 INTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Hollow-Metal Doors and Frames: NAAMM-HMMA 860; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: As indicated in the Door and Frame Schedule.
 - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Core: Steel stiffened.
 - 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Construction: Knock down.
 - 3. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Commercial Doors and Frames: NAAMM-HMMA 861; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.064 inch, with minimum G60 or A60 coating.
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: Steel stiffened, polystyrene
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.064 inch, except 0.067 inch for openings exceeding 4 ft. wide; with minimum G60 or A60 coating.
 - b. Construction: Knock down

3. Exposed Finish: Prime.

2.5 FIRE-RATED HOLLOW-METAL DOOR ASSEMBLIES

- A. Source Limitations: Obtain all components of fire-rated hollow-metal doors and frames, including framing, fire-rated glazing, door hardware, and accessories, from single manufacturer.
- B. Basis-of-Design Product: Subject to compliance with requirements provide Titan Metal Products; Builders Series 20-90 Minute Doors.
- C. Fire-Rated Hollow-Metal Doors and Frames: NAAMM-HMMA 860, NAAMM-HMMA 861, and NAAMM-HMMA 850.
 1. Door Profile: 2-inch frame with 6-inch rail
 2. Face: Uncoated steel sheet, minimum thickness of 0.053 inch.
 3. Thickness: Minimum 1-3/4 inches
 4. Opening Size: As indicated on Drawings.
 5. Construction: Knocked down
 6. Glazing: Refer to other elements of this specification section.
 7. Exposed Finish: Prime.
- D. Fire-Rated Door Assembly Hardware:
 1. Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
 2. General: Provide fire-rated door assembly hardware and fire-rated door assembly hardware sets indicated in door and frame schedule each fire-rated door assembly, to comply with requirements in this Section.
 - a. Fire-Rated Door Assembly Hardware Sets: Provide quantity, item, size, finish, or color indicated, as well as named manufacturers' products.
 - b. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

2.6 FRAME ANCHORS

- A. Jamb Anchors:
 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 ft..
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.7 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 08811 "Laminated Glass Glazing"

2.8 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
 1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.

2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.9 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard fluoropolymer finish.
 1. Color and Gloss: As selected by Architect from manufacturer's full range.
- C. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils. Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.
 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with NAAMM-HMMA 840.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.

- b. Install frames with removable stops located on secure side of opening.
- 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
- 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- 4. Solidly pack mineral-fiber insulation inside frames.
- 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
- 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
 - 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 - 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08111

SECTION 08212
WOOD DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION:

This section covers all wood doors.

A. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, the Contract, AIA 201, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers: Qualified to affix each door with National Woodwork Manufacturers' Association (NWMA), Seal of Approval or qualify certification stamp.

B. Requirements of Regulatory Agencies:

1. Underwriter's Laboratories, Inc. (UL), Fire Doors (120 IDO) for fire classification marking.
2. National Fire Protection Association (NFPA), "Standard fire Doors and Windows", NFPA No. 80 for installation of fire-rated doors.

C. Testing Requirements:

1. Adhesives - NWMA 1.S.I-69
 - a. Waterproof bond test for exterior doors (when applicable).
 - b. Water-resistant bond test for interior doors (when applicable).
2. Warp - NWMA 1.S.I-69
3. Fire Test: Underwriter's Laboratories, Inc., Standard UL 10(b), Fire Tests of Door Assemblies.

1.03 SUBMITTALS:

A. Samples: Submit samples showing face veneers and finish

B. Shop Drawings - Show details and door configuration.

1. Full-size moulding section detail and door configuration.
2. Glazing material and louver thickness, when applicable.

C. Certificates: Certificates of compliance with fabrication and test requirements signed by authorized representative of door manufacturing company.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver doors to site after plaster and cement are dry and building has reached average prevailing relative humidity of locality.
- B. Deliver doors in manufacturer's original unopened protective material or container, clearly marked with manufacturer's name, brand name, size, thickness, and identifying symbol on covering.
- C. Seal all four edges of doors when delivered to project site.
- D. Stack flat on 2 × 4 lumber, laid 12 inches from ends and across center.
- E. Under bottom door and over top of stack, provide plywood or corrugated cardboard to protect door surface.
- F. Store doors in area where there will be no great variations in heat, dryness and humidity.
- G. Do not drag doors across one another.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Specific products or materials manufactured by any of the following listed manufacturers are "acceptable" (not approved) only if the specific product or material can evidence exact compliance with the Contract Documents.
 - 1. Masonite Architectural
 - 2. Eggers, Neenah, Wisconsin
 - 3. Graham Manufacturing Corporation, Marshfield, Wisconsin.
 - 4. Weywehauser Company, Marshfield, Wisconsin.
- B. Provide the product of one manufacturer.

2.02 MATERIALS:

- A. Doors: Flush Wood Doors:
 - 1. Door standards: NWMAI-S: - 69
 - 2. Clear Maple Veneer
 - 3. Provide Plain Sliced, seamless "Book Match" with hardwood edge on all surfaces
 - 4. Finish: Doors shall be UV-cured factory finished.
 - 5. Refer to door schedule.
 - 6. Field verify all dimensions and field conditions.
 - 7. All doors shall be manufactured to suit new frame assembly conditions.
 - 9. Core: Solid wood core glued block or framed-block glued core.
 - 10. UL Approved "C" and "B" Labeled Fire rated doors: Edge bands of KILN-DRIED Hardwood treated with fire retardant treatment.
- B. Hollow Metal Frames: See Interior Aluminum Framed Entrances and Storefronts
 - 1. Provide and install rubber door silencers in all interior door frames. (Not less than two (3) silencers on the lock side of single doors, and one (2) silencer for each leaf in heads of double door frames).

2.04 FABRICATION:

- A. Moisture Content: 12% maximum at time of fabrication for all wood material.
- B. Solid Core:
 - 1. Glued Block Core: Core blocks 2-1/2 inches maximum width, bonded together; end joints staggered in adjacent rows.
 - 2. Bond face panels of core.
- C. Face Panels:
 - 1. Book match veneers for grain and color for doors hung in pairs.
- D. Light Openings: Mouldings and glass stops of matching wood.
- E. Louvers: Factory-install matching wood louvers into prepared openings.
- F. Clearances:
 - 1. Allow maximum of 1/8 inch at jamb and head for job fit doors.
 - 2. Allow maximum of 3/16 inch at jamb and head for pre-fit doors.
 - 3. Allow maximum of 3/16 inch over threshold or saddle.
 - 4. Allow maximum of 1/2 inch over decorative floor coverings, unless otherwise noted on drawings or in the Project Manual.
 - 5. Maximum 3/8 inch between door bottoms and decorated floor for pairs of doors unless otherwise noted on drawings or in the Project Manual.
 - 6. Maximum Warp: 1/4 inch.
- A. Finishing:
 - 1. Factory finish doors, faces and side edges on site. Finish shall be as noted herein or on the drawings and shall be approved by the Architect.

2.05 PREPARATION FOR FINISH HARDWARE AND GLAZING:

- A. Prepare doors and frames to receive hardware.
 - 1. Hardware supplier shall furnish hollow metal manufacturer approved hardware schedule, hardware templates, and samples of physical hardware where necessary to insure correct fitting and installation.
 - 2. Coordinate all electrified hardware/security components with doors and frames and prepare doors and frames to receive any required components.
 - 3. Preparation includes sinkage and cutouts for mortise and concealed hardware.
- B. Prepare doors to receive glazing. Comply with requirements in Section 08811 "Laminated Glass Glazing."
 - 1. Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
 - 2. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.

3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Verify that doors are of type required for frame and are installed as required for proper installation of doors.
- B. Fire-rated doors shall be installed in corresponding fire rated frames.

3.02 INSTALLATION:

- A. Follow door manufacturer's written instruction for all installation work.
- B. Do not install doors in frames which would hinder the operation of the doors.

3.03 ADJUST AND CLEAN:

- A. Replace or re-hang doors which are hinge-bound and do not swing or operate freely.
- B. Replace doors damaged during installation.

END OF SECTION 08212

SECTION 08332
ROLLING COUNTER DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rolling Counter Doors, manually operated.
- B. Rolling Counter Doors, power operated.

1.2 RELATED SECTIONS

- A. Section 05500 - Metal Fabrications: Support framing and framed opening.
- B. Section 06200 - Finish Carpentry: Wood jamb and head trim.
- C. Section 08710 - Door Hardware: Product Requirements for cylinder core and keys.
- D. Section 09900 - Painting: Field applied finish.

1.3 REFERENCES

- A. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- C. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- D. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- E. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- G. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
- H. NEMA MG 1 - Motors and Generators.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01330.

- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Details of construction and fabrication.
 - 4. Installation methods.
- C. Shop Drawings: Include detailed plans, elevations, details of framing members, required clearances, anchors, and accessories. Include relationship with adjacent construction.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.
- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Install in areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship and installation is approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 COORDINATION

- A. Coordinate Work with other operations and installation of adjacent finish materials to avoid damage to installed materials.

1.9 WARRANTY

- A. Warranty: Manufacturer's limited door warranty for 2 years for all parts and components.
- B. PowderGuard Finish.
 - 1. PowderGuard Premium Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Premium Finish warranty for 2 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new rolling counter door is based upon Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. C.H.I. Overhead Doors
 - 2. Cornell
 - 3. Or Approved Equal

2.2 ROLLING METAL COUNTER DOORS WITH INTEGRAL FRAME

- A. Stainless Steel Counter Doors with Integral Frame: Overhead Door Corporation, 657 Series.
 - 1. Curtain: Interlocking roll-formed stainless steel slats with a #4 finish and with endlock for curtain alignment. Slats, 22 gauge stainless steel with stainless steel tubular bottom bar with neoprene astragal.
 - 2. Integral Frame and Sill: Integral stainless steel frame with a #4 finish and a stainless steel sill. Frame consists of 16 gauge jambs and header, with 14 gauge sill.

3. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch (0.8 mm) per foot of span. Counterbalance shall be adjustable by means of an adjusting tension wheel.
4. Hood: Stainless steel with a #4 finish and provided with intermediate support brackets as required.
5. Operation:
 - a. Manual push up.
 - b. Crank operation.
6. Locking:
 - a. Padlockable slide bolts on coil side.
 - b. Cylinder lock.
7. Wall Mounting Condition:
 - a. Between jambs mounting installed in an existing opening.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07920.
- G. Install perimeter trim and closures.

3.4 ADJUSTING

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION 08332

SECTION 08360

SECTIONAL OVERHEAD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulated Sectional Overhead Doors.
- B. Operating Hardware, tracks, and support.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 05500 - Metal Fabrications.
- C. Section 06100 – Rough Carpentry
- D. Section 07920 – Sealants and Caulking
- E. Section 260500 - Common Work Results for Electrical.

1.3 REFERENCES

- A. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Wiring Connections: Requirements for electrical characteristics.
 - 1. 115 volts, single phase, 60 Hz.
 - 2. 230 volts, single phase, 60 Hz.
 - 3. 230 volts, three phase, 60 Hz.
 - 4. 460 volts, three phase, 60 Hz.
- B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01330 – Submittals-Shop Drawings, Product Data and Samples.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened labeled packaging until ready for installation.
- B. Protect materials from exposure to moisture until ready for installation.
- C. Store materials in a dry, ventilated weathertight location.

1.8 PROJECT CONDITIONS

- A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.9 WARRANTY

- A. Warranty: Manufacturer's limited door and operators System warranty for 10 years against delamination of polystyrene foam from steel face.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. To establish a level of quality and performance characteristics the desired specified new sectional overhead doors assembly is based upon Overhead Door (tm) Brand, which is located at: 2501 S. State Hwy. 121 Suite 200; Lewisville, TX 75067; Toll Free Tel: 800-275-3290; Tel: 469-549-7100; Fax: 972-906-1499; Email: request info (info@overheaddoor.com); Web: <https://www.overheaddoor.com>. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

- i. Clopay Corporation
- ii. Hass Door Co.
- iii. Or Approved Equal

2.2 ADVANCED PERFORMANCE ROLLING SERVICE DOORS

- A. RapidSlat Model 626 Stormtite Insulated Rolling Service Doors by Overhead Door Corporation.
 - 1. Curtain: Interlocking roll-formed metal slats as specified with endlocks attached to each end of alternate slats to prevent lateral movement.

- a. Flat Profile insulated type F-265i with 24 gauge back covering steel or stainless steel; .024 inch (.06 mm) aluminum, for doors up to 20 feet wide fabricated of:
 - i. .040 inch (1 mm Aluminum).
 - b. Insulation: Slat cavity shall be filled with CFC-free, foamed-in-place, polyurethane insulation.
 - i. R-Value: 7.7, U-Value: 0.13.
 - ii. Sound Rating: STC-21.
 - c. Slat Finish:
 - i. Color as selected by Architect.
2. Bottom Bar: Two metal angles, minimum thickness 3/16 inch, bolted back to back to reinforce curtain in the guides.
 - i. Steel
3. Guides: Three Structural steel angles provided with high usage guide wear strip to minimize wear and reduce sound.
 - a. Material:
 - i. Steel
4. Brackets:
 - a. Galvanized steel to support counterbalance, curtain and hood.
5. Finish; Bottom Bar, Guides, Headplate and Brackets:
 - a. PowderGuard Premium powder coat color as selected by the Architect.
6. Motor: Direct drive, integrated gear motor/brake assembly sized for openings. Provide with a manual hand chain for operation during power outages. Operator and drive assembly is factory pre-assembled and provided with all wiring harnesses needed direct from the factory.
 - a. Supply Voltage: 220/240V AC, 1-phase, operating range 220/240V.
 - b. Left hand mount
7. Control Panel: Provide electronic Variable Frequency drive controller with microprocessor self-diagnostics. LCD readout indicates door action, alarm conditions, and fault conditions. Timer to close programming options and non-resettable cycle counter are included. Enclosure is NEMA 4X rated. Control system is UL508A certified. Junction box is IP67 rated.
8. Door Roll: Directly driven, springless roll shall be steel tube with integral shafts, keyed on the Drive End and supported by self-aligning greaseable sealed bearings. Door shall not require any counterbalance device.
9. Hood: Protecting drive motor, barrel, chain, and sprocket from dirt and debris and extending between the support brackets. Fabricated of:
 - a. Material:
 - i. Steel
 - b. Steel Finish:
 - i. PowderGuard Premium powder coat, color as selected by Architect.

10. Safety Devices: Provide door with following safety devices:
 - a. Photoelectric sensors that cast an invisible beam across the door opening and reverses the downward motion of the door when an object enters the path of the beam.
 - b. Wireless, monitored safety edge reverses downward motion upon impact.
 - c. Built-in (to motor assembly) brake mechanism eliminates uncontrolled curtain travel independent of other safeties.
11. Actuators:
 - a. One Open/Close/Stop push button station incorporated into Control Panel.
 - b. Interior Push buttons.
 - c. Interior Key switch.
 - d. Motion detectors.
12. Wind Load Design:
 - a. Standard wind load shall be 30 PSF.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean adjacent surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with electrical specifications. Complete wiring from disconnect to unit components.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07920.
- G. Install perimeter trim and closures.

- H. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

- A. Clean doors, frames, glass and polycarbonate according to manufacturer's instructions.
- B. Remove temporary labels and visible markings. Do not remove polycarbonate care and maintenance label required to maintain warranty
- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

- A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- B. Protect installed products until completion of project.

END OF SECTION 08360

SECTION 08411

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, including Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Architectural Aluminum Storefront Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units.
 - 1. Framing
 - 2. Impact Glazing
 - 3. Thermal Entrance Door, medium stile entrance door
- B. Related Sections
 - 1. 07920 – Sealants and Caulking
 - 2. 08810 – Solar Control Coated Insulating Glass

1.3 DEFINITIONS

- A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 PERFORMANCE REQUIREMENTS

- A. Storefront System Performance Requirements
 - 1. Wind loads: Provide storefront system; include anchorage, capable of withstanding wind load design pressures of 50 lbs./sq. ft. inward and 65 lbs./sq. ft. outward. The design pressures are based on the International Building Code; 2018 Edition and ASCE-7-16.
 - 2. Air Leakage: The test specimen shall be tested in accordance with ASTM E 283. Air Leakage rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 6.2 psf (300 Pa) with interior seal, or, rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 1.6 psf (75 Pa) without interior seal.
 - 3. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 15 psf (720 Pa) as defined in AAMA 501.
 - 4. Uniform Load: A static air design load of 30 psf (1436 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

- a. Thermal Entrance Door: 60.15 psf (2880 Pa) for single doors and 50.13 psf (2400 Pa) for pairs of doors. Shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 for typical application or L/180 for Small-Missile and Large-Missile impact, of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
 5. Forced Entry: Tested in accordance with AAMA 1304.
 6. Energy Efficiency: Aluminum Framed Entrance and Storefront
 - a. Thermal Transmittance (U-Factor): When tested to AAMA specification 507 or NFRC100 the thermal transmittance (U-Factor) shall not be more than:
 - 1) 1-inch insulating glass:
 - a) U-Factor not more than .38 BTU/hr/ft²/°F per AAMA 1503 with exterior 1/4" clear with e=0.035 low-e coating on surface #2, 1/2" air space with warm edge spacer and 90% argon gas fill, and interior 1/4" clear glass.
 7. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than:
 - a. 68 frame and 70glass (low-e).
 8. Windborne-Debris-Impact Resistance Performance: Shall be tested in accordance with ASTM E 1886, information in ASTM E 1996 and TAS 201/203.
 - a. Large-Missile Impact: For aluminum-framed systems located within 30 feet (9.1 m) of grade.
 9. Material Ingredient Reporting: Shall have a complete list of chemical ingredients to at least 100ppm (0.01%) that covers 100% of the product, acceptable documentation includes:
 - a. Manufacturer's inventory with Chemical Abstract Service Registration Number (CASRN or CAS#).
 - b. Cradle to Cradle certification:
 - 1) Cradle to Cradle Certified™ with Material Health section Silver or above.
 - 2) Silver level or above Material Health Certificate.
 - c. Red List Free DECLARE label.
 10. Energy Efficiency: Thermal Entrance Door
 - a. Thermal Transmittance (U-Factor): When tested to AAMA specification 1503, the thermal transmittance (U-factor) shall not be more than:
 - 1) 350T: .24 CoG low-e Insulated Glass – 0.51 system U-value per AAMA 507
 - b. Solar Heat-Gain Coefficient (SHGC) : Glazed thermally broken aluminum door and frame shall have a Solar Heat Gain Coefficient (SHGC) of no greater than .22 using glass with a .38 SHGC as determined according to NFRC 200.
 - c. Visible Transmittance (VT): Glazed thermally broken aluminum door and frame shall have a Visible Transmittance (VT) of no greater than .36 > as determined according to NFRC 200.
 - d. Condensation Resistance Factor (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than:
 - a. 350T: Insulated Glass – 49 frame and 68 glass (low-e).
- B. Environmental Product Declaration (EPD): Shall have a Type III Product-Specific EPD created from a Product Category Rule.

1.5 ACTION SUBMITTALS

- A. Product Data: Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum-framed storefront system indicated.
1. Recycled Content:
 - a. Provide documentation that aluminum has a minimum of 50% mixed pre- and post-consumer recycled content with a sample document illustrating project specific information that will be provided after product shipment.
 - b. Once product has shipped, provide project specific recycled content information, including:
 - 1) Indicate recycled content; indicate percentage of pre- and post-consumer recycled content per unit of product.
 - 2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - 3) Indicate location recovery of recycled content.
 - 4) Indicate location of manufacturing facility.
 2. Environmental Product Declaration (EPD):
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.
- C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- D. Samples for Verification: For aluminum-framed storefront system and components required.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, of aluminum-framed storefront.
- F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:
1. Joinery, including concealed welds.
 2. Anchorage.
 3. Expansion provisions.
 4. Glazing.
 5. Flashing and drainage.
- G. Other Action Submittals:
1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of providing aluminum-framed storefront system that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

- C. Source Limitations: Obtain aluminum-framed storefront system through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed storefront system and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements". Do not modify size and dimensional requirements.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Pre-installation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication and indicate field measurements on Shop Drawings.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

1.8 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new aluminum framed entrance and storefront is based upon Kawneer Company, Inc., Model IR501T Framing-Impact Glazing and 350T Insulpour for Entrance Doors. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. EFCO Corporation
 - 2. YKK
 - 3. Or approved equal
- B. Substitutions: Refer to Substitutions Section for procedures and submission requirements.
 - 1. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
 - 2. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid storefront installation and construction delays.
 - 3. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
 - 4. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for storefront system performance criteria, and

- (2) has been engaged in the design, manufacture and fabrication of aluminum storefront for a period of not less than ten (10) years. (Company Name)
5. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.
 6. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.
- C. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

2.2 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.
- B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- E. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
- F. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.
- G. Slide-In-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.
 1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.
- H. Thermal Barrier: Shall be IsoPour utilizing two continuous rows of polypropylene with a nominal 7/32" (5.5 mm) separation consisting of a two-part, chemically curing high density polyurethane which is mechanically and adhesively bonded to the aluminum at door rails and stiles.

2.3 STOREFRONT FRAMING SYSTEM

- A. Thermal Barrier:
 1. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
 2. IR 501T - Kawneer SINGLE IsoLock™ Thermal Break with one (1) 1/4" (6.4 mm) separations consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.

- a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
- B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- C. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- D. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- E. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Solar Control Coated Insulating Glass".
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
 - 1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
 - 2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
 - 3. Color: Matching structural sealant.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Kawneer 350T Insulpour Thermal Entrance will be as follows:

Door	Vertical Stile	Top Rail	Select Optional Bottom Rail
350T:	3-1/2" (88.9 mm)	3-1/2" (88.9 mm)	10" Standard Bottom Rail

*Major portions of the door members to be 0.125" nominal thickness and glazing molding to be 0.05" thick

- B. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.

- C. Provide adjustable glass jacks to help center the glass in the door opening.

2.6 FABRICATION

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fit joints; make joints flush, hairline and weatherproof.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- B. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- C. Storefront Framing: Fabricate components for assembly using manufacturer's standard installation instructions.
- D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

- 1. Kawneer Permanodic™ AA-M10C21A44 / AA-M45C22A44, AAMA 611, Architectural Class I Color Anodic Coating Color #29, Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight sliding door installation.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
 - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum framed storefront system, accessories, and other components.

- B. Install aluminum-framed storefront system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.
- D. Install aluminum-framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within aluminum-framed storefront system to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Field Tests: Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.
 - 1. Testing: Testing shall be performed by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements. Testing Standard per AAMA 503, including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 Water Infiltration Test.
 - a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
 - b. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.2 psf (300 Pa).
- B. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean aluminum surfaces immediately after installing aluminum-framed storefronts. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08411

SECTION 08412

INTERIOR ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, including Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Architectural Aluminum Storefront Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units.
 - 1. Framing
 - 2. Laminated Glass Glazing
- B. Related Sections
 - 1. 07920 – Sealants and Caulking
 - 2. 08811 – Laminated Glass Glazing

1.3 DEFINITIONS

- A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 PERFORMANCE REQUIREMENTS

- A. Storefront System Performance Requirements
 - 1. Wind loads: Provide storefront system; include anchorage, capable of withstanding wind load design pressures of 10 psf lbs./sq. ft. inward and 10psf lbs./sq. ft. outward.

1.5 ACTION SUBMITTALS

- A. Product Data: Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum-framed storefront system indicated.
 - 1. Recycled Content:
 - a. Provide documentation that aluminum has a minimum of 50% mixed pre- and post-consumer recycled content with a sample document illustrating project specific information that will be provided after product shipment.
 - b. Once product has shipped, provide project specific recycled content information, including:
 - 1) Indicate recycled content; indicate percentage of pre- and post-consumer recycled content per unit of product.
 - 2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.

- 3) Indicate location recovery of recycled content.
 - 4) Indicate location of manufacturing facility.
- 2. Environmental Product Declaration (EPD):
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.
- C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- D. Samples for Verification: For aluminum-framed storefront system and components required.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, of aluminum-framed storefront.
- F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
- G. Other Action Submittals:
 - 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of providing aluminum-framed storefront system that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum-framed storefront system through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed storefront system and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements". Do not modify size and dimensional requirements.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Pre-installation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication and indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new interior aluminum framed entrance and storefront is based upon Kawneer Company, Inc., Model Trifab VG 451 Framing System. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. EFCO Corporation
 - 2. YKK
 - 3. Or approved equal
- B. Substitutions: Refer to Substitutions Section for procedures and submission requirements.
 - 1. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
 - 2. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid storefront installation and construction delays.
 - 3. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
 - 4. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for storefront system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum storefront for a period of not less than ten (10) years. (Company Name)
 - 5. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.
 - 6. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.
- C. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

2.2 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.

- B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- E. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
- F. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 STOREFRONT FRAMING SYSTEM

- A. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- C. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- D. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- E. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08811 Section "Laminated Glass Glazing".
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:

1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
3. Color: Matching structural sealant.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: As specified in Division 084113 Section "Aluminum-Framed Entrances and Storefronts".
- B. Entrance Door Hardware: As specified in Division 08710 Section "Door Hardware".

2.6 FABRICATION

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fit joints; make joints flush, hairline and weatherproof.
 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- B. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- C. Storefront Framing: Fabricate components for assembly using manufacturer's standard installation instructions.
- D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

1. Kawneer Permanodic® AA-M12C22A31, AAMA 611, Architectural Class II Clear Anodic Coating (Color #17 Clear) (Standard).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight sliding door installation.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum framed storefront system, accessories, and other components.
- B. Install aluminum-framed storefront system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.
- D. Install aluminum-framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within aluminum-framed storefront system to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Field Tests: Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.
 1. Testing: Testing shall be performed by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements. Testing Standard per AAMA 503, including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 Water Infiltration Test.
 - a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
 - b. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.2 psf (300 Pa).
- B. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean aluminum surfaces immediately after installing aluminum-framed storefronts. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08412

SECTION 08450

TRANSLUCENT WALL AND ROOF ASSEMBLIES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes requirements for translucent wall and roof assemblies.

1.2 WORK INCLUDED

- A. Engineer, manufacture, and installation of translucent wall and/or roof assemblies.
- B. All anchors, brackets, hardware and all flashing up to but not penetrating adjoining work are also required as part of the system and shall be included.
- C. Trained and factory authorized labor and supervision to complete the installation.

1.3 RELATED WORK ELSEWHERE

- A. Sheet Metal and Flashing, Section 07620
- B. Sealants and Caulking, Section 07920

1.4 QUALITY ASSURANCE

- A. Products shall be manufactured by a company continuously and regularly employed in the engineering and manufacturing of translucent wall and roof assemblies for a period of at least ten (10) years.
- B. Product manufacturer shall be ISO-9001 accredited
- C. Erection shall be by a factory-approved installer who has been in the business of erecting similar material for at least five (5) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope, and type.
- D. The manufacturer shall be responsible for the configuration and fabrication of the complete translucent system in accordance with this specification.

1.5 SUBMITTALS

- A. Submit color samples of colors specified or the manufacturers standard range.
- B. Submit Shop drawings indicating dimensions, tolerances, profiles, connections, drainage, flashing, color selections, and coordination with adjacent scope.
- C. The manufacturer shall submit substantiating data, stating that the products to be furnished are in accordance with or exceed these specifications.
- D. The manufacturer shall submit full warranty terms and conditions for verification of compliance with the requirements of this specification.
- E. Include structural analysis data signed and sealed by a professional engineer licensed in the state of the project's location.
- F. The manufacturer shall submit performance data based on the following standards:
 - 1. Self-Ignition Temperature (ASTM D 1929)
 - 2. Burning Extent (ASTM D 635)
 - 3. Smoke Density or Development (ASTM E 84, UL 723, or ASTM D 2843)
 - 4. Interior Flame Spread Index (ASTM E 84)
 - 5. ICC Evaluation Service Report (ICC-ESR)
 - 6. Insulation U-factor (NFRC 100)
 - 7. Solar Heat Gain Coefficient (SHGC) (NFRC 201)
 - 8. Visible Transmittance (VT) (NFRC 202)
 - 9. Condensation Resistance (NFRC 500)

10. Air Infiltration (ASTM E 283)
11. Water Penetration (ASTM E 331)
12. Load Bearing Ability (ASTM E 330)
13. Large and Small Missile Impact (TAS 201)
14. Resistance to Static Pressure (TAS 202)
15. Resistance to Cyclic Wind Pressure (TAS 203)

1.6 MAINTENANCE DATA

- A. The manufacturer shall provide recommended maintenance procedures, schedule of maintenance and materials required or recommended for maintenance.

1.7 WARRANTY

- A. Submit manufacturer's written warranty covering failures in materials and workmanship that lead to leaking into the building within ten (10) years from date of delivery.
- B. Provide a ten (10) warranty on the glazing covering change in light transmission of no more than 6% per ASTM D-1003.
- C. Metal Finish Warranty:
 1. Anodize: Provide manufacturer's standard 5 year warranty
- D. Submit installer's written warranty agreeing to repair installation workmanship, defects and leaks within two years from date of delivery.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new translucent wall and roof assemblies is based upon Kingspan Light + Air, Inc., a. Phone: (800) 759-6985, Address: 28662 N Ballard Dr Lake Forest, IL 60045, Website: <https://www.kingspan.com/us/en>, Email: info@kingspanlightandair.us, Model UniQuad Window. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 1. Kalwall Coporation
 2. Or Approved Equal

2.2 TRANSLUCENT WALL AND ROOF ASSEMBLY DESCRIPTION AND PERFORMANCE

- A. Description: Translucent glazing assemblies
 1. A factory assembled double-glazed panel assembly incorporated into a complete aluminum frame system tested and warranted by the manufacturer as a single source system. Overall glazing assembly thickness shall be a minimum 2.75".
 2. Design shall provide for the replacement of the exterior glazing, independently of the interior glazing without exposing the building's interior or compromising the weather tightness of interfering with the normal working functions of the building. Single layer glazing systems are not acceptable.
 3. Translucent polycarbonate glazing must be constructed of tight cell sizes not exceeding 0.18". Wider cells shall not be acceptable.
 4. Glazing must be manufactured with a permanent integral ultra-violet protective layer.
- B. Flammability
 1. Interior Glazing Sheet:

- a. Self-Ignition Temperature per ASTM D 1929: 950°F
 - b. Smoke Development Index per ASTM E 84: 62.7
 - c. Burning Rate per ASTM D 635: ZERO
- 2. Exterior Glazing Sheet:
 - a. Self-Ignition Temperature per ASTM D 1929: 950°F
 - b. Smoke Development Index per ASTM E 84: 62.7
 - c. Burning Rate per ASTM D 635: ZERO
- 3. Currently Listed ICC-ES Report confirming compliance with IBC Chapter 26: [ESR-4745 - ICC Evaluation Service, LLC \(ICC-ES\)](#)
- C. Air, Water, Structural, and Impact
 - 1. Air Permeability for each product per ASTM E 283:
 - a. UniQuad Window: .02 CFM/SF @1.57 PSF
 - 2. No water leakage for each product per ASTM E 331:
 - a. UniQuad Window: 15 PSF
 - 3. Proof wind loading per ASTM E 330/TAS 202:
 - a. UniQuad Window: up to +/-40 PSF design load
- D. Energy Performance
 - 1. Product must be currently listed and certified by the NFRC as required in Section R303.1.3 of the IECC; listed products receive an identifying CPD#
 - a. Basis of Design CPD#:
 - i. UniQuad Window KLA-M-2
 - 2. Exterior glazing color:
 - a. STANDARD: Ice White Matte
 - 3. Interior glazing color:
 - a. STANDARD: Ice White Matte
 - 4. NFRC Certified System Performance Values
 - a. U-factor per NFRC 100: 0.32
 - b. Solar heat gain per NFRC 201: 0.33
 - c. Visible Transmittance per NFRC 202: 0.24
 - d. Condensation Resistance per NFRC 500: 40
 - 5. Panel and perimeter framing to be thermally broken

2.3 METAL FRAME STRUCTURE

- A. Design criteria shall be per ASCE-7 requirements
- B. Aluminum structural profiles shall be limited to a deflection of L/120 IBC Table 1604.3.
- C. Panel and perimeter framing to be thermally broken

2.4 METAL MATERIALS

- A. Extruded aluminum shall be ANSI/ASTM B-221; 6063-T5/T6, 6005-T5 or 6061-T5/T6
- B. Flashing: 5005 H34 Aluminum .040" thick
- C. All fasteners for aluminum framing to be stainless steel or cadmium plated steel
- D. All exposed Aluminum shall be finished:
 - 1. Painted finish as per performance requirement
 - a. 2 coat AAMA 2605
 - 2. Paint color to be selected from Manufacturer's standards
 - 3. Anodized finish as per performance requirement:
 - a. Hard Coat Class I Colored Anodized.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. The installer shall examine the area of installation to verify readiness of site conditions. Do not work until conditions are satisfactory.

3.2 INSTALLATION

- A. Install components in strict accordance with manufacturer's instructions on approved shop drawings.

END OF SECTION 08450

SECTION 08584
PASS-THRU WINDOWS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush-mount pass-thru windows.

1.2 RELATED SECTIONS

- A. Section 07620 – Sheet Metal Flashing and Trim.
- B. Section 07920–Sealants and Caulking

1.3 REFERENCES

- A. ASTM A 240 – Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
- B. ASTM A 653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM B 209 – Aluminum and Aluminum-Alloy Sheet and Plate.
- D. ASTM B 221 – Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- E. ASTM C 1048 – Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.

1.4 SUBMITTALS

- A. Comply with Section 01330 – Submittal Procedures.
- B. Product Data: Submit manufacturer's product data, including materials, components, fabrication, finish, and installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, fabrication, glazing, fasteners, hardware, finish, electrical wiring diagrams, options, and accessories.
- D. Samples: Submit manufacturer's samples of standard finishes.
- E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- F. Manufacturer's Project References: Submit list of successfully completed pass-thru window projects, including project name and location, name of architect, and type and quantity of pass-thru windows installed.

- G. Operation and Maintenance Manual: Submit manufacturer's operation and maintenance manual, including operation, maintenance, adjustment, and cleaning instructions, trouble shooting guide, parts list.
- H. Warranty: Submit manufacturer's standard warranty.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Minimum of 5 years successful experience continuously manufacturing pass-thru windows.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finish from damage during handling and installation.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. To establish a level of quality and performance characteristics the desired specified new pass-thru window assembly is based upon Ready Access, Inc., 1815 Arthur Drive, West Chicago, Illinois 60185. Toll Free (800) 621-5045. Phone (630) 876-7766. Fax (630) 876-7767. Web Site www.ready-access.com. E-Mail ready@ready-access.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - a. Andersen Windows & Doors
 - b. Kolbe Windows & Doors
 - c. Or approved equal.

2.2 FLUSH-MOUNT PASS-THRU WINDOWS

- A. Flush-Mount Pass-Thru Windows: 275 Single Panel Manual Open/Self-Closing Slider Window.
 - 1. Service Opening: 19 inches wide by 35 inches high
 - 2. Door Operation:
 - a. Open: Manual.
 - b. Close: Manual or self-closing.
 - 3. Door Type: Sliding, 1 door panel.
 - 4. Opening Direction: Left to right. Customer View – Outside
 - 5. Frame: Extruded aluminum, ASTM B 221, Alloy 6063-T6 and 6063-T52.
 - 6. Aluminum Sheet: ASTM B 209, Alloy 5005-AQ-H34.
 - 7. Bottom Sill: Angled downward, track-free.
 - 8. Security Lock: Aluminum bar extrusion with sliding spring-loaded locking clip.
 - 9. Fasteners: Stainless steel rivets and hex-head zinc-plated self-threading machine screws.
 - 10. Handle: Black Delrin handle with pressed-in stainless steel spring pins. Stainless steel handle mounting bracket. Stainless steel spring-loaded mounting base.
 - 13. Glazing: 1/4-inch tempered glass, ASTM C 1048, clear.

14. Silicone Glazing Sealant: Refer to section 07920. Color selected by Architect from manufacturer standard colors.

2.4 FABRICATION

- A. Assembly: Factory assembled, factory glazed.

2.5 ALUMINUM FINISH

- A. Anodized:
 1. Statuary Bronze, AA-M10-C12-C22-A44, ASTM B 580.
 2. Clear, AA-M10-C12-C22-A31, ASTM B 680.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive pass-thru windows. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Ensure openings to receive pass-thru windows are plumb, level, square, accurately aligned, correctly located, and in tolerance.

3.3 INSTALLATION

- A. Install pass-thru windows in accordance with manufacturer's instructions.
- B. Install pass-thru windows plumb, level, square, true to line, and without warp or rack.
- C. Install pass-thru window components weathertight.
- D. Anchor pass-thru windows securely in place to supports. Use attachment methods permitting adjustment for construction tolerances, irregularities, alignment, and expansion and contraction.
- E. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.
- F. Sheet Metal Flashing: Install sheet metal flashing as specified in Section 07620.
- G. Joint Sealants: Install joint sealants as specified in Section 07920.
- I. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
- J. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.4 ADJUSTING

- A. Adjust doors to be weathertight in closed position.

- B. Adjust doors and operating hardware to function properly and for smooth operation without binding.

3.5 CLEANING

- A. Clean pass-thru windows promptly after installation in accordance with manufacturer's instructions.
- B. Remove excess joint sealant in accordance with sealant manufacturer's instructions.
- C. Do not use harsh cleaning materials or methods that would damage glazing or finish.

3.6 PROTECTION

- A. Protect installed pass-thru windows to ensure that, except for normal weathering, pass-thru windows will be without damage or deterioration at time of substantial completion.

END OF SECTION 08584

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Door hardware for doors specified in "Hardware Sets" and required by actual conditions. Include screws, bolts, expansion shields, electrified door hardware, and other devices for proper application of hardware.
- B. Products supplied but not installed under this Section:
 - 1. Hardware for aluminum doors will be furnished under this Section, but installed under Division 08 Openings.
 - 2. Electrified hardware will be furnished under this Section, but installed by the security contractor.
 - 3. Final replacement of cylinder cores shall be installed by Owner.
 - 4. Hold open wall magnets.

1.2 RELATED DIVISIONS

- A. Division 08 - Openings.
- B. Division 26 - Electrical.
- C. Division 28 - Fire Detection and Alarm.

1.3 REFERENCES

- A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI):
 - 1. ANSI/BHMA A156.1 Butts & Hinges.
 - 2. ANSI/BHMA A156.2 Bored & Preamsembled Locks & Latches.
 - 3. ANSI/BHMA A156.3 Exit Devices.
 - 4. ANSI/BHMA A156.4 Door Controls - Closers.
 - 5. ANSI/BHMA A156.5 Cylinders and Input Devices for Locks.
 - 6. ANSI/BHMA A156.6 Architectural Door Trim.
 - 7. ANSI/BHMA A156.7 Template Hinge Dimensions.
 - 8. ANSI/BHMA A156.8 Door Controls - Overhead Stops and Holders.
 - 9. ANSI/BHMA A156.12 Interconnected Locks & Latches.
 - 10. ANSI/BHMA A156.13 Mortise Locks & Latches.
 - 11. ANSI/BHMA A156.14 Sliding & Folding Door Hardware.
 - 12. ANSI/BHMA A156.15 Closer Holder Release Devices.
 - 13. ANSI/BHMA A156.16 Auxiliary Hardware.
 - 14. ANSI/BHMA A156.17 Self Closing Hinges & Pivots.
 - 15. ANSI/BHMA A156.18 Materials & Finishes.
 - 16. ANSI/BHMA A156.19 Power Assist & Low Energy Power Operated Doors.
 - 17. ANSI/BHMA A156.21 Thresholds.
 - 18. ANSI/BHMA A156.22 Door Gasketing Systems.
 - 19. ANSI/BHMA A156.23 Electromagnetic Locks.
 - 20. ANSI/BHMA A156.25 Electrified Locks.
 - 21. ANSI/BHMA A156.26 Continuous Hinges.
 - 22. ANSI/BHMA A156.28 Keying Systems.
 - 23. ANSI/BHMA A156.29 Exit Locks and Alarms.
 - 24. ANSI/BHMA A156.31 Electric Strikes.

25. ANSI/BHMA A156.32 Integrated Door Assemblies.
 26. ANSI/BHMA A156.36 Auxiliary Locks.
 27. ANSI/BHMA A156.115 Hardware Preparation in Steel Doors and Steel Frames.
 28. ANSI/BHMA A156.115W Hardware Preparation in Wood Doors with Wood or Steel Frames.
- B. International Code Council/American National Standards Institute (ICC/ANSI)/ADA:
 1. ICC/ANSI A117.1 Standards for Accessible and Usable Buildings and Facilities.
 2. Americans with Disabilities Act Accessibility Guidelines (ADAAG).
 - C. Underwriters Laboratories, Inc. (UL):
 1. UL 10C Positive Pressure Fire Test of Door Assemblies.
 2. UL 1784 Air Leakage Test of Door Assemblies.
 3. UL/ULC Listed.
 - D. Door and Hardware Institute (DHI):
 1. DHI Publication - Keying Systems and Nomenclature (1989).
 2. DHI Publication - Abbreviations and Symbols.
 3. DHI Publication - Installation Guide for Doors and Hardware.
 4. DHI Publication - Sequence and Format of Hardware Schedule (1996).
 - E. National Fire Protection Agency (NFPA)
 1. NFPA 70 National Electrical Code, current version.
 2. NFPA 80 Standard for Fire Doors and Other Opening Protective's, current version.
 3. NFPA 101 Life Safety Code current version.
 4. NFPA 105 Standard for the Installation of Smoke Door Assemblies, current version.
 - F. Building Codes
 1. IBC International Building Code 2015 with Massachusetts amendments .

1.4 SUBMITTALS

- A. Submit in accordance with Conditions of the Contract and provisions of Section 01300 – Submittals, Shop Drawings, Product Data and Samples.
- B. Shop Drawings: Hardware schedule shall be organized in vertical format illustrated in DHI Publications Sequence and Formatting for the Hardware Schedule. Include abbreviations and symbols page according to DHI Publications Abbreviations and Symbols. Complete nomenclature of items required for each door opening as indicated
 1. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of hardware.
 2. Architectural Hardware Consultant (AHC), as certified by DHI, who shall affix seal attesting to completeness and correctness, shall review hardware schedule prior to submittal.
- C. Submit manufacturer's catalog sheet on design, grade and function of items listed in hardware schedule. Identify specific hardware item per sheet, provide index, and cover sheet.
- D. Coordination: Distribute door hardware templates to related divisions within fourteen days of receiving approved door hardware submittals.
- E. Electrified Hardware: Provide electrical information to include voltage, and amperage requirements for electrified door hardware and description of operation.
 1. Description of operation for each electrified opening to include description of component functions including location, sequence of operation and interface with other building control systems.
 2. Wiring Diagrams: Detail wiring for power, signal, and control system and differentiate

- between manufacturers installed and field installed wiring. Include the following:
 - a. System schematic.
 - b. Point to point wiring diagram.
 - c. Riser diagram.
 - d. Elevation of each door.
- 3. Detail interface between electrified door hardware and fire alarm, access control, security, and building control systems.
- F. Upon door hardware submittal approval, provide for each electrified opening, three copies of point to point diagrams.
- G. Maintenance Tool and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, removal and replacement of door hardware.
- H. Closeout Submittals: Submit to Owner in a three ring binder or USB if requested.
 - 1. Warranties.
 - 2. Maintenance and operating manual including list of maintenance tools.
 - 3. Maintenance service agreement.
 - 4. Record documents.
 - 5. Copy of approved hardware schedule.
 - 6. Copy of approved keying schedule with bitting list.
 - 7. Door hardware supplier name, phone number and fax number.

1.5 QUALITY ASSURANCE

- A. Electrified door hardware shall be Listed and Labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authority having jurisdiction.
- B. Hardware supplier shall employ an Architectural Hardware Consultant (AHC) as certified by DHI and a member of the seal program who shall be available at reasonable times during course of work for Project hardware consultation.
 - 1. Electrified Door Hardware Supplier Qualifications: Experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in service performance.
- C. Door hardware shall conform to ICC/ANSI A117.1. Handles, Pulls, Latches, Locks and operating devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
- D. Fire Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C, unless otherwise indicated.
- E. Fire Door Inspection: Prior to receiving certificate of occupancy have fire rated doors inspected by an independent certified Fire and Egress Door Assembly Inspector (FDAI), as certified by Intertek (ITS), a written report shall be submitted to Owner and Contractor. Doors failing inspection shall be adjusted, replaced or modified to be within appropriate code requirements.
- F. Door hardware shall be certified to ANSI/BHMA standards as noted, participate and be listed in BHMA Certified Products Directory.
- G. Pre-installation Meeting: Comply with requirements in Division 1 Section "Project Meetings".
 - 1. Convene meeting seven days before installation. Participants required to attend:
 - 2. Contractor, installer, material supplier, manufacturer representatives, electrical

- contractor, security consultant and fire alarm consultant.
 - 3. Include in conference decisions regarding proper installation methods and procedures for receiving and handling hardware.
 - 4. Review sequence of operation for each type of electrified door hardware, inspect, and discuss electrical roughing-in and other preparatory work performed by other trades.
 - 5. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
- H. Within fourteen days of receipt of approved door hardware submittals contact Owner with representative from hardware supplier to establish a keying conference. Verify keyway, visual key identification, number of master keys and keys per lock. Provide keying system per Owners instructions.
- I. Installer Qualifications: Specialized in performing installation of this Section and shall have five years minimum documented experience.
- J. Hardware listed in Par.: Hardware Schedule is intended to establish a type and grade.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Provide a clean, dry and secure room for hardware delivered to Project but not yet installed.
- B. Furnish hardware with each unit marked and numbered in accordance with approved finish hardware schedule. Include door and item number for each type of hardware.
- C. Pack each item complete with necessary parts and fasteners in manufacturer's original packaging.
- D. Deliver permanent key, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to Owner shall be established at "Keying Conference."
- E. Waste Management and Disposal: Separate waste materials for reuse or recycling in accordance with Division 1.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 WARRANTY

- A. General Warranty: Owner may have under provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by Contractor under requirements of the Contract documents.
- B. Special Warranty: Warranties specified in this article shall not deprive Owner of other rights. Contractor, hardware supplier, and hardware installer shall be responsible for servicing hardware and keying related problems.
 - 1. Ten years for manual door closers.
 - 2. Five years for mortise, auxiliary and bored locks.
 - 3. Five years for exit devices.
 - 4. Two years for electromechanical door hardware.
- C. Products judged defective during warranty period shall be replaced or repaired in accordance with manufacturer's warranty at no cost to Owner. There is no warranty against defects due to improper installation, abuse and failure to exercise normal maintenance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Obtain each type of door hardware from a single manufacturer.
- B. The following is a list of acceptable manufacturers for door hardware:
 - 1. Bommer
 - 2. Hager
 - 3. McKinney
 - 4. Stanley
 - 5. PPB
 - 6. Corbin/Ruswin
 - 7. Sargent
 - 8. Schlage
 - 9. Von Duprin
 - 10. LCN
 - 11. Rockwood
 - 12. Ives
 - 13. Trimco
 - 14. N.G.P.
 - 15. Pemko
 - 16. Reese
 - 17. Or approved equal.

2.2 HINGES

- A. Hinges, including electric hinges when scheduled, shall be of one manufacturer as listed for continuity of design and consideration of warranty and shall be certified and listed by the following:
 - 1. Butts and Hinges: ANSI/BHMA A156.1
 - 2. Template Hinge Dimensions: ANSI/BHMA A156.7
 - 3. Self-Closing Hinges: ANSI/BHMA 156.17
- B. Butt Hinges:
 - 1. Hinge weight and size unless otherwise indicated in hardware sets:
 - a. Doors up to 36 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of .134 inch and a minimum of 4-1/2 inches in height.
 - b. Doors from 36 inches wide up to 42 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of .145 inch and a minimum of 4-1/2 inches (114 mm) in height.
 - c. Doors greater than 1-3/4 inches thick provide hinges with a minimum thickness of 0.180 inch and a minimum of 5 inches in height.
 - d. Width of hinge is to be minimum required to clear surrounding trim.
 - 2. Base material unless otherwise indicated in hardware sets:
 - a. Exterior Doors: 304 Stainless Steel, Brass or Bronze material.
 - b. Interior Doors: Steel material.
 - c. Fire Rated Doors: Steel or 304 Stainless Steel materials.
 - d. Stainless Steel ball bearing hinges shall have stainless steel ball bearings. Steel ball bearings are unacceptable.
 - 3. Quantity of hinges per door unless otherwise stated in hardware sets:
 - a. Doors 60 inches up to 90 inches in height provide 3 hinges.
 - b. Doors over 120 inches in height add 1 additional hinge per each additional 30 inches in height.
 - 4. Hinge design and options unless otherwise indicated in hardware sets:
 - a. Hinges are to be of a square corner five-knuckle design, flat button tips and have ball bearings unless otherwise indicated in hardware sets.
 - b. Out-swinging exterior and out-swinging access controlled doors shall have non-

- c. removable pins (NRP) to prevent removal of pin while door is in closed position.
- d. When full width of opening is required, use hinges that are designed to swing door completely from opening when door is opened to 95 degrees.
- e. Electric Through Wire (ETW) to have appropriate number of wires to transfer power through door frame to door for proper connection of finish hardware and certified to handle an amperage rating of 3.5AMPS/continuous duty with 16.0AMPS/intermittent duty.
- f. Provide mortar boxes for frames that require any electrically modified hinges if not an integral part of frame.
- f. When shims are necessary to correct frame or door irregularities, provide metal shims only.

2.3 FLUSH BOLTS AND COORDINATORS

- A. Flushbolts shall be of one manufacturer as listed for continuity of design and consideration of warranty. Manufacturer to be listed for Auxiliary Hardware: ANSI/BHMA A156.16
- B. Labeled openings: Provide automatic or constant latching flush bolts per hardware schedule for inactive leaf of pairs of doors. Provide dust proof strikes for bottom bolt.
- C. Non-Labeled openings: Provide two flush bolts for inactive leaf of pairs of doors per hardware schedule. Top bolt shall not be more than 78 inches centerline from floor. Provide dust proof strike for bottom bolt.
- D. Coordinators: Provide for labeled pairs of doors with automatic flush bolts or with vertical rod exit device with a mortise-locking device per hardware schedule. Provide filler piece to extend full width of stop on frame. Provide mounting brackets for closers and special preparation for latches where applicable.

2.4 ELECTRIC STRIKES

- A. Provide for use with type of locks shown on hardware schedule and telecommunications drawings. Manufacturer shall meet the following:
 - 1. ANSI/BHMA A156.31 Electric Strikes and Frame Mounted Actuators Grade 1.
 - 2. UL Tested 1500 lb (static strength.
 - 3. UL listed for Fire Doors and Frames where applicable.
 - 4. UL 1034 Burglary Resistance.
 - 5. UL10C.3H fire rated, 4 feet by 8 feet (1219 mm by 2438 mm) door.
- B. Material and Design:
 - 1. To accept up to 3/4 inch latch bolt and 1 inch deadbolt.
 - 2. Field reversible, Fail Safe or Fail Secure
 - 3. Dual voltage 12/24 VDC.
 - 4. Tamper resistant, stainless steel corrosion resistance parts, and cast body and keeper.
- C. Options:
 - 1. Latch Bolt Monitoring (LBM) Signals the door is closed and latched or unlatched and open.
 - 2. Door Secure Monitor (DSM) Door secure and unlocked monitoring.
 - 3. Deadbolt Monitoring (DBM) Signals deadbolt projected or retracted.
 - 4. Plug in buzzer (BUZZ) Indicates Fail Secure strike is energized and unlocked.
 - 5. Rectifier (RECT) Converts AC to DC

2.5 LOCKS AND LATCHES (GRADE 1 CYLINDRICAL)

- A. Locks and latches shall be of one manufacturer as listed for continuity of design and consideration of warranty. Product to be certified and listed by following:

1. ANSI/BHMA A156.2 Series 4000 Certified to Grade 1.
 2. ANSI/BHMA A250.13 Certified for a minimum design load of 860lbf (80psf) for single out swinging doors measuring 36 inches in width and 84 inches in height and a minimum design load of 860lbf for out swinging single doors measuring 48 inches in width and 84 inches in height.
 3. UL/cUL Labeled and listed for functions up to 3 hours for single doors up to 48 inches in width and up to 96 inches in height.
 4. UL10C/UBC 7-2 Positive Pressure Rated.
 5. ICC/ANSI A117.1.
- B. Lock and latch function numbers and descriptions of manufacturer's series as listed in hardware sets. Material and Design:
1. Lock and Latch chassis to be Zinc dichromate for corrosion resistance.
 2. Keyed functions to be of a freewheeling design to help resist against vandalism.
 3. Non-handed, field reversible.
 4. Thru-bolt mounting with no exposed screws.
 5. Levers shall be Zinc cast and plated to match finish designation in hardware sets.
 6. Roses shall be of solid Brass or Stainless Steel material.
- C. Latch and Strike:
1. Stainless Steel latch bolt with minimum of 1/2 inch throw and deadlocking for keyed and exterior functions. Standard backset to be 2-3/4 inches and faceplate shall be adjustable to accommodate a square edge door or a standard 1/8 inch beveled edge door.
 2. Strike is to fit a standard ANSI A115 prep measuring 1-1/4 inches by 4-7/8 inches with proper lip length to protect surrounding trim.
 3. Provide knurled levers on entry side of doors that are potentially dangerous to visually impaired persons.

2.6 DEADBOLTS (GRADE 1)

- A. Deadbolts shall be of one manufacturer as listed for continuity of design and consideration of warranty. Manufacturer to be certified by the following:
1. Auxiliary Locks: ANSI/BHMA A156.5 Grade 1.
 2. UL/cUL listed for functions up to 3 hours for "A" label.
 3. UL10C/UBC 7-2 Positive Pressure Rated.
- B. Deadbolt function numbers and descriptions of manufacturer's series as listed in hardware sets. Material and Design:
1. Latch bolt 1 inch throw, material brass with concealed harden steel roller to prevent sawing or cutting.
 2. Freewheeling collar design to help resist against vandalism.
 3. Non-handed, field reversible.
 4. Deadbolts to be 1-3/4 inches total length with a minimum of a 1 inch throw and 3/4 inch internal engagement when fully extended and made of Stainless Steel material.

2.7 EXIT DEVICES (GRADE 1)

- A. Shall be touch pad type, finish to match balance of door hardware. Exit Devices shall be of one manufacturer as listed for continuity of design and consideration of warranty. Manufacturer to be certified and or listed by the following:
1. BHMA Certified ANSI A156.3 Grade 1.
 2. UL/cUL Listed for up to 3 hours for "A" labeled doors.
 3. UL10C/UBC 7-2 Positive Pressure Rated.
 4. UL10B Neutral Pressure Rated.
 5. UL 305 Listed for Panic Hardware.
 6. ANSI/BHMA A250.13 Severe Windstorm Resistant Component.

- B. Material and Design:
 - 1. Touch pad shall extend a minimum of one half-door width. Freewheeling lever design shall match design of locks levers. Exit device to mount flush with door.
 - 2. Latchbolts: Rim device - 3/4 inch throw, Pullman type with automatic dead-latching, stainless steel. Surface vertical rod device - Top 1/2 inch throw, Pullman type with automatic dead-latching, stainless steel. Bottom 1/2 inch throw, Pullman type, held retracted during door swing, stainless steel.
 - 3. Fasteners: Wood screws, machine screws and thru-bolts.
- C. Lock and Latch Functions: Function numbers and descriptions of manufacturer's series and lever styles indicated in door hardware sets.
- D. Electric Modifications:
 - 1. Electric Latch Retraction: Continuous duty solenoids retract the latch bolt for momentary or maintained periods of time.
 - 2. Provide Request to Exit (REX) switches as scheduled.
 - 3. Electrified Trim: Outside trim locked (EL) or unlocked (EU) by electric current.
 - 4. Delayed Egress with Wall Mounted Controller (4501 DE).

2.8 CYLINDERS AND KEYING

- A. Cylinders shall be of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Manufacturer shall meet the following:
 - 1. Auxiliary Locks: ANSI/BHMA A156.5
 - 2. DHI Handbook "Keying systems and nomenclature", current version.
- C. Cylinders:
 - 1. Manufacturer's standard tumbler type, seven-pin IC core and seven-pin conventional core supported by the Hager H1 keyway.
 - 2. Shall be furnished with cams/tailpieces as required for locking device that is being furnished for project.
- D. Keying:
 - 1. Copy of Owners approved keying schedule shall be submitted to Owner and Architect with documentation of which keying conference was held and Owners sign-off.
 - 2. Provide a biting list to Owner of combinations as established, and expand to twenty five percent for future use or as directed by Owner.
 - 3. Key into Owner's existing keying system if applicable.
 - 4. Keys to be shipped to Owner's representative, individually tag per keying conference.
 - 5. Provide visual key control identification on keys.
 - 6. Provide interchangeable cores with construction cores as required per hardware schedule.
 - 7. Single seven-pin key shall operate both conventional cores and SFIC small format interchangeable cores.

2.9 CLOSERS (ALUMINUM BODY GRADE 1)

- A. Shall be product of one manufacturer. Unless otherwise indicated on hardware schedule, comply with manufacturer's recommendations for size of closer, depending on width of door, frequency of use atmospheric pressure, and fire rating. Manufacturer to be certified by the following:
 - 1. BHMA Certified ANSI A156.4 Grade 1.
 - 2. UL/cUL Listed up to 3 hours.
 - 3. UL10C Positive Pressure Rated.
 - 4. UL10B Neutral Pressure Rated.

- B. Material and Design:
 - 1. Provide aluminum non-handed bodies with pinion cap cover.
 - 2. Closer shall have separate staked adjustable valve screws for latch speed, sweep speed, adjustable backcheck valve optional.
 - 3. Provide Tri-Pack arms and brackets for regular arm, top jamb, and parallel arm mounting.
 - 4. Double heat-treated steel tempered springs.
 - 5. Precision machined, heat-treated steel piston.
 - 6. Triple heat-treated steel spindle.
- C. Mounting: Out swing doors shall have surface parallel arm mount closers except where noted on hardware schedule.
 - 1. In swing doors shall have surface regular arm mount closers except where noted on hardware schedule.
 - 2. Provide brackets and shoe supports for aluminum doors and frames to mount fifth screw.
 - 3. Furnish drop plates where top rail conditions on door do not allow for mounting of closer and where backside of closer is exposed through glass.
- D. Fire rated and exterior openings shall have minimum opening force allowable by authority having jurisdiction.
- E. Fasteners: Provide self-reaming and tapping wood and machine screws and sex nuts and bolts for each closer.

2.10 PROTECTIVE TRIM

- A. Size of protection plate: Single doors, size two inches less door width (LDW) on push side of door, and one inch less on pull side of door. For pairs of doors, size one inch less door width (LDW) on push side of door, and 1/2 inch on pull side of door. Kick plates 10 inches high or sized to door bottom rail height. Mop Plates 4 inches high. Armor Plates 36 inches high. Manufacturer shall meet requirements for:
 - 1. Architectural Door Trim: ANSI/BHMA A156.6.
 - 2. UL.
- B. Material and Design:
 - 1. .050 inch gage stainless steel.
 - 2. Corners shall be square. Polishing lines or dominant direction of surface pattern shall run across the door width of plate.
 - 3. Bevel top, bottom and sides uniformly leaving no sharp edges. Edges shall be de-burred.
 - 4. Countersink holes for screws. Screws holes shall be spaced equidistant eight inches CTC, along a centerline not over 1/2 inch in from edge around plate. End screws shall be a maximum of 0.53 inch from corners.
- C. UL label stamp required on protection plates when top of plate is more than 16 inches above bottom of door on fire rated openings. Verify door manufacturers UL listing for maximum height and width of protection plate to be used.

2.11 STOPS AND HOLDERS

- A. Wall Stops: Provide door stops wherever necessary to prevent door or hardware from striking an adjacent partition or obstruction. Provide wall stops when possible. Door stops and holders mounted in concrete floor or masonry walls shall have stainless steel machine screws and lead expansion shields. Manufacturer shall meet requirements for Auxiliary Hardware: ANSI/BHMA A156.16.

2.12 POWER SUPPLIES (for ELR exit devices)

- A. Shall be of one manufacturer as listed for continuity of design and consideration of warranty. Manufacturer shall meet requirements for UL listed power supply. Design:
 - 1. Use with 4500 and 4600 Series Electric Latch Retraction (ELR) exit devices.
 - 2. Automatic operator interface.
 - 3. 24VDC and 12VDC constant voltage outputs.
 - 4. Adjustable time delay.

2.13 POWER SUPPLY (for fail safe or fail secure locking devices)

- A. Shall be of one manufacturer as listed for continuity of design and consideration of warranty. Manufacturer shall meet requirements for UL listed power supply. Design:
 - 1. Interface with building alarm controls, card readers, keypads, and other door controls.
 - 2. Filtered and regulated 24 VDC constant voltage; 2 AMP load capacity; Over voltage/short circuit protection; Surge protection for locking devices.
 - 3. Interface relay; Adjustable time delay.

2.14 POWER SUPPLY (for electrified locking devices and automatic door operator)

- A. Shall be of one manufacturer as listed for continuity of design and consideration of warranty. Manufacturer shall meet requirements for UL listed power supply. Design:
 - 1. Power and control for openings with electrified locking device and automatic door operator.
 - 2. Filtered and regulated 24 VDC constant voltage; 2 AMP load capacity.
 - 3. Voltage overload/short circuit protection; Surge protection for locking devices.
 - 4. Interface relay; Adjustable time delay.
 - 5. Separate inputs for activation switch on entry and egress and ingress side of opening.
 - 6. Relay contact output to automatic operator.
 - 7. Input optional emergency release switch.
 - 8. Auxiliary 24 VDC output and separate 24VDC outputs for Fail SAFE and FAIL SECURE electrified locking devices.

2.15 DOOR GASKETING AND WEATHERSTRIP

- A. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing where indicated on hardware schedule. Provide non-corrosive fasteners for exterior applications.
 - 1. Perimeter gasketing: Apply to head and jamb, forming seal between door and frame.
 - 2. Meeting stile gasketing: Fasten to meeting stiles, forming seal when doors are in closed position.
 - 3. Door bottoms: Apply to bottom of door, forming seal with threshold or floor when door is in closed position.
 - 4. Sound Gasketing: Cutting or notching for stop mounted hardware not permitted.
 - 5. Drip Guard: Apply to exterior face of frame header. Lip length to extend 4 inches (102 mm) beyond width of door.
- B. Standards: Manufacturer shall meet requirements for:
 - 1. Door Gasketing and Edge Seal Systems: ANSI/BHMA A156.22.
 - 2. Shall be BHMA certified for door sweeps, automatic door bottoms, and adhesive applied gasketing. (721).
- C. Smoke-Labeled Gasketing: Comply with NFPA 105 listed, labeled, and acceptable to authorities having jurisdiction, for smoke control indicated. Provide smoke labeled gasketing on 45 minute rated doors and on smoke rated doors.
- D. Fire-Rated Gasketing: Comply with NFPA 80 listed, labeled, and acceptable to Authorities

Having Jurisdiction, for fire ratings indicated.

- E. Refer to Wood Doors specification for Category A or Category B. Comply with UBC 7-2 and UL10C positive pressure where frame applied intumescent seals are required. Provide Hager # 720 for single and 720 by 724 for a pair of doors.

2.16 THRESHOLDS

- A. Set thresholds for exterior and acoustical openings in full bed of sealant with lead expansion shields and stainless steel machine screws complying with requirements specified in Division 7 Section "Sealants and Caulkings". Notched in field to fit frame by hardware installer. Refer to Drawings for special details. Manufacturer to be certified by the following:
 - 1. Thresholds: ANSI/BHMA A156.21.
 - 2. Americans with Disabilities Act Accessibility Guidelines (ADAAG).

2.17 SILENCERS

- A. Where smoke, light, or weather seal are not required, provide three silencers per single door frame, two per double door frame and four per Dutch door frame. Manufacturer shall meet requirements for: Auxiliary Hardware: ANSI/BHMA A156.16.

2.18 FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if within range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples.
- B. Comply with base material and finish requirements indicated by ANSI/BHMA A156.18 designations in hardware schedule.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install hardware per manufacturer's instructions and in compliance with the following as applicable:
 - 1. NFPA 80; NFPA 105; ICC/ANSI A117.1; ANSI/BHMA A156.115 Hardware Preparation in Steel Doors and Steel Frames; ANSI/BHMA A156.115W Hardware Preparation in Wood Doors with Wood or Steel Frames; DHI Publication - Installation Guide for Doors and Hardware; UL10C/UBC7-2; Local building code.
 - 2. Approved shop drawings.
 - 3. Approved finish hardware schedule.
- B. Do not install surface mounted items until finishes have been completed on substrates involved. Set unit level, plumb and true to line location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

3.3 FIELD QUALITY CONTROL

- A. Material supplier to schedule final walk through to inspect hardware installation ten business days before final acceptance of Owner. Material supplier shall provide a written report detailing discrepancies of each opening to General Contractor within seven calendar days of walk through..

3.4 ADJUSTMENT, CLEANING AND DEMONSTRATING

- A. Adjustment: Adjust and check each opening to ensure proper operation of each item of finish hardware. Replace items that cannot be adjusted to operate freely and smoothly or as intended for application at no cost to Owner.
- B. Cleaning: Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no cost to Owner.
- C. Demonstration: Conduct a training class for building maintenance personnel demonstrating the adjustment, operation of mechanical and electrical hardware. Special tools for finished hardware to be turned over and explained usage at this meeting.

3.5 PROTECTION

- A. Leave manufacturer's protective film intact and provide proper protection for all other finish hardware items that do not have protective material from the manufacture until Owner accepts Project as complete.

3.6 HARDWARE SET SCHEDULE

- A. Leave manufacturer's protective film intact and provide proper protection for all other finish hardware items that do not have protective material from the manufacture until Owner accepts Project as complete.

3.7 PROTECTION

- A. Guide: Door hardware items have been placed in sets which are intended to be a guide of design, grade, quality, function, operation, performance, exposure, and like characteristics of door hardware, and may not be complete. Provide door hardware required to make each set complete and operational.
- B. Hardware schedule does not reflect handing, backset, method of fastening and like characteristics of door hardware and door operation.
- C. Review door hardware sets with door types, frames, sizes and details on drawings. Verify suitability and adaptability of items specified in relation to details and surrounding conditions.

END OF SECTION 08710

SECTION 08810

SOLAR CONTROL COATED INSULATING GLASS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Double-Glazed Solar Control Insulating Glass Units.

1.2 REFERENCES

- A. ANSI Z 97.1 - Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test.
- B. ASTM C 1036 - Standard Specification for Flat Glass.
- C. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.
- D. ASTM C 1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Glass.
- E. ASTM E 2188 – Standard Test Method for Insulating Glass Unit Performance.
- F. ASTM E 2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- G. CPSC 16CFR-1201 - Safety Standard for Architectural Glazing Materials.
- H. Glass Association of North America (GANA) Glazing Manual.

1.3 DEFINITIONS

- A. Sealed Insulating Glass Unit Surfaces:
 - 1. Surface No. 1: Exterior surface of outer lite.
 - 2. Surface No. 2: Interior surface of outer lite.
 - 3. Surface No. 3: Exterior surface of inner lite.
 - 4. Surface No. 4: Interior surface of inner lite.
- B. Airspace: Space between lites of an insulating glass unit that contains dehydrated air or other inert specified gas.

1.4 SUBMITTALS

- A. Comply with Section 01350 - Submittal Procedures.
- B. Product Data: Submit manufacturer's product data, including performance characteristics and installation instructions.

- C. Shop Drawings: Submit manufacturer's or fabricator's shop drawings, including plans, elevations, sections, and details, indicating glass dimensions, tolerances, types, thicknesses, and coatings.
- D. Samples: Submit manufacturer's samples of each type, thickness, and coating.
- E. Fabricator's Certification: Submit fabricator's certification by manufacturer.
- F. Cleaning Instructions: Submit manufacturer's cleaning instructions.
- G. Warranty: Submit manufacturer's standard warranty for sealed insulating glass units.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Minimum of 5 years experience manufacturing solar control coated glass.
- B. Fabricator's Qualifications:
 - 1. Minimum of 5 years experience manufacturing sealed insulating glass units meeting ASTM E 2190.
 - 2. Certified by coated glass manufacturer.
- C. Mock-Ups:
 - 1. Comply with Section 01450 - Quality Control.
 - 2. Obtain acceptance of mock-ups by Architect before proceeding with work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver glass to site in accordance with manufacturer's instructions.
 - 2. Deliver glass in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage:
 - 1. Store glass in accordance with manufacturer's instructions.
 - 2. Store glass in clean, dry area indoors.
 - 3. Protect from exposure to direct sunlight and freezing temperatures.
 - 4. Apply temporary coverings loosely to allow adequate ventilation.
 - 5. Protect from contact with corrosive chemicals.
 - 6. Avoid placement of glass edge on concrete, metal, and other hard objects.
 - 7. Rest glass on clean, cushioned pads at 1/4-points.
- C. Handling:
 - 1. Handle glass in accordance with manufacturer's instructions.
 - 2. Protect glass from damage during handling and installation.
 - 3. Do not slide 1 lite of glass against another.
 - 4. Do not use sharp objects near unprotected glass.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new glazing is based upon Guardian Glass, LLC, 2300 Harmon Road, Auburn Hills, Michigan 48326. Toll Free (866) 482-7374. Phone (248) 340-1800, www.guardianglass.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
1. Or Approved Equal

2.2 FABRICATORS

- A. Sealed Insulating Glass Units, Heat-Strengthened Glass, Tempered Glass, and Spandrel Glass:
1. Acceptable Fabricators: Certified by Guardian Glass, LLC to fabricate SunGuard Solar Control Coated Glass products.

2.3 SOLAR CONTROL INSULATING COATED GLASS

- A. Double-Glazed Sputter-Coated Insulating Glass Units:
1. Conformance: ASTM E 2190.
 2. Outboard Lite: Sputter-coated clear float glass.
 - a. Annealed Clear Float Glass: ASTM C 1036, Type 1, Class 1, Quality q3.
 - b. Vacuum Deposition Sputtered Coating: ASTM C 1376.
 - c. Coating on Surface No. 2: SunGuard Super Neutral 68 (SN68).
 - d. Glass Thickness: 6 mm (1/4 inch).
 - e. Heat Treatment: Heat-strengthened, ASTM C 1048, Kind HS and both lites tempered as required by code/application [Tempered; ASTM C 1048, Kind FT; CPSC 16CFR-1201; ANSI Z 97.1.
 3. Air Space: 12 mm (1/2 inch) wide, hermetically sealed, dehydrated air space. 90% Argon fill
 4. Inboard Lite: Guardian Clear HS float glass.
 - a. HS/tempered Clear Float Glass: ASTM C 1036, Type 1, Class 1, Quality q3.
 - b. Vacuum Deposition Sputtered Coating: ASTM C 1376.
 - c. Coating on Surface No. 4: SunGuard IS 20.
 - d. Glass Thickness: 6 mm (1/4 inch).
 5. Glass Unit Performance Characteristics:
 - a. Visible Light Transmittance: 66 percent
 - b. Visible Light Reflectance Outdoors: 12 percent
 - c. Direct Solar Energy Transmittance: 32 percent
 - d. Direct Solar Energy Reflectance Outdoors: 33 percent
 - e. Winter U-Value Nighttime: 0.20
 - f. Summer U-Value Daytime: 0.18
 - g. Solar Heat Gain Coefficient: 0.36
 - h. Summer Relative Heat Gain: 86
 6. Edge Seals: ASTM E 2188, with aluminum spacers, dual-sealed with a primary seal of polyisobutylene and a secondary seal of silicone sealant for glass-to-spacer seals.
 7. Sealant: Approved by glass manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive glass. Notify Architect of conditions that would adversely affect installation. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Verify glazing openings are correct size and within tolerance.
- B. Verify glazing channels, recesses, and weeps are clean and free of obstructions.

3.3 GLAZING

- A. Install glass in accordance with manufacturer's instructions, except where local codes or GANA Glazing Manual indicate more stringent requirements.

3.4 FIELD QUALITY CONTROL

- A. Coated glass, when viewed from minimum of 10 feet, exhibiting slightly different hue or color not apparent in hand samples, will not be cause of rejection of glass units, as determined by Architect.
- B. Verify glass is free of chips, cracks, and other inclusions that could inhibit structural or aesthetic integrity.

3.5 CLEANING

- A. Clean glass promptly after installation in accordance with manufacturer's instructions.
- B. Remove labels from glass surface.
- C. Do not use harsh cleaning materials or methods that would damage glass.

3.6 PROTECTION

- A. Protect installed glass from damage during construction.
- B. Protect installed glass from contact with contaminating substances resulting from construction operations.
- C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.

END OF SECTION 08411

SECTION 08811
LAMINATED GLASS GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes solar control coated laminated glass units.
- B. Related Sections:
 - 1. Division 02-49 Sections specifying glass and glazing by reference to this Section.

1.2 REFERENCES

- A. ASTM C 1036 - Standard Specification for Flat Glass.
- B. ASTM C 1172 – Standard Specification for Laminated Architectural Flat Glass.
- C. CPSC 16CFR-1201 - Safety Standard for Architectural Glazing Materials.
- D. GANA Glazing Manual.
- E. GANA Laminated Glazing Reference Manual

1.3 DEFINITIONS

- A. Laminated Glass Unit Surfaces:
 - 1. Surface No. 1: Exterior surface of outer lite.
 - 2. Surface No. 2: Interior surface of outer lite.
 - 3. Surface No. 3: Exterior surface of inner lite.
 - 4. Surface No. 4: Interior surface of inner lite.
- B. Interlayer: Bonding layer of a laminated glass unit that adheres the outer and inner lites together.

1.4 SUBMITTALS

- A. Comply with Division 01 Section "Submittal Procedures."
- B. Product Data: Submit manufacturer's product data, including performance characteristics and installation instructions.
- C. Shop Drawings: Submit manufacturer's or fabricator's shop drawings, including plans, elevations, sections, and details, indicating glass dimensions, tolerances, types, thicknesses, and coatings.
- D. Samples: Submit manufacturer's samples of each type, thickness, and coating.
- E. Fabricator's Certification: Submit fabricator's certification by manufacturer.
- F. Cleaning Instructions: Submit manufacturer's cleaning instructions.

- G. Warranty: Submit manufacturer's standard warranty for sealed insulating glass units.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Minimum of 5 years experience manufacturing solar control coated glass.
- B. Fabricator's Qualifications:
 - 1. Minimum of 5 years experience manufacturing Laminated glass units meeting ASTM C 1172 and CPSC 16CFR-1201.
 - 2. Certified by manufacturer.
- C. Samples:
 - 1. Comply with Division 01 Section "Quality Control."
 - 2. Obtain acceptance of mock-ups by Architect before proceeding with work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver glass to site in accordance with manufacturer's instructions.
 - 2. Deliver glass in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage:
 - 1. Store glass in accordance with manufacturer's instructions.
 - 2. Store glass in clean, dry area indoors.
 - 3. Protect from exposure to direct sunlight and freezing temperatures.
 - 4. Apply temporary coverings loosely to allow adequate ventilation.
 - 5. Protect from contact with corrosive chemicals.
 - 6. Avoid placement of glass edge on concrete, metal, and other hard objects.
 - 7. Rest glass on clean, cushioned pads at 1/4-points.
- C. Handling:
 - 1. Handle glass in accordance with manufacturer's instructions.
 - 2. Protect glass from damage during handling and installation.
 - 3. Do not slide one lite of glass against another.
 - 4. Do not use sharp objects near unprotected glass.

1.7 WARRANTY

- A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 10 years from date of manufacture

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new laminated glass glazing is based upon Guardian Glass, LLC, 2300

Harmon Road, Auburn Hills, Michigan 48326. Toll Free (866) 482-7374. Phone (248) 340-1800, www.guardianglass.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

a) Or approved equal

2.2 FABRICATORS

- A. Laminated Glass:
- B. Acceptable Fabricators: Certified by glass manufacturer.

2.3 SOLAR CONTROL LAMINATED COATED GLASS

- A. Uncoated Laminated Glass Units:
 - 1. Conformance: ASTM C 1172 and complying with testing requirements in CPSC 16CFR-1201 for Category II materials Paragraph in "Quality Assurance" Article.
 - 2. Outboard Lite: Clear Specifier Notes: Use the first sentence when specifying clear glass.
 - a. Annealed Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3.
Glass Thickness: 6 mm (1/4 inch)
 - 3. Interlayer: Polyvinyl butyral (PVB) plastic interlayer, clear, 0.060 inch
 - 4. Inboard Lite: clear float glass.
 - a. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3.
 - b. Glass Thickness: 6 mm (1/4 inch)
 - 5. Sealant: Approved by glass manufacturer.

2.4 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive glass. Notify Architect of conditions that would adversely affect installation. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Verify glazing openings are correct size and within tolerance.
- B. Verify glazing channels, recesses, and weeps are clean and free of obstructions.

3.3 GLAZING

- A. Install glass in accordance with manufacturer's instructions, except where local codes or GANA Glazing Manual indicate more stringent requirements.

3.4 FIELD QUALITY CONTROL

- A. Coated glass, when viewed from minimum of 10 feet, exhibiting slightly different hue or color not apparent in hand samples, will not be cause of rejection of glass units, as determined by Architect.
- B. Verify glass is free of chips, cracks, and other inclusions that could inhibit structural or aesthetic integrity.

3.5 CLEANING

- A. Clean glass promptly after installation in accordance with manufacturer's instructions.
- B. Remove labels from glass surface.
- C. Do not use harsh cleaning materials or methods that would damage glass.

3.6 PROTECTION

- A. Protect installed glass from damage during construction.
- B. Protect installed glass from contact with contaminating substances resulting from construction operations.
- C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.

END OF SECTION 08811

SECTION 09290

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Cement backer board
 - 3. Texture finishes.
- B. Related Requirements:
 - 1. Division 06 -Rough Carpentry

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch long length for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Regional Materials: Products shall be manufactured within 500 miles of Project site.
- B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Mold-Resistant, Abuse & Impact Resistant Gypsum Board: ASTM C1396/C1396M and ASTM C1658/C1658M. With moisture- and mold-resistant core and laminated paper surfaces from one of the following manufacturers;
 - a. CertainTeed Gypsum.
 - b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
 - d. National Gypsum Company
2. Core: 5/8 inch, Type X
3. Long Edges: Tapered
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
5. Surface Abrasion: Level 3
6. Indentation: Level 1
7. Soft-Body Impact: Level 2
8. Hard-Body Impact: Level 1
- B. Gypsum Ceiling Board: ASTM C1396/C1396M. Provide one of the following manufacturers;
 - a. National Gypsum Company
 - b. CertainTeed Gypsum.
 - c. Georgia-Pacific Gypsum LLC.
 - d. USG Corporation.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

2.4 CEMENT BOARD

- A. Basis-of Design: PermaBASE Cement board manufactured by PermaBASE Building Products, LLC provided by National Gypsum Company or approved equal.
- B. Panel Physical Characteristics
 1. Core: Cementitious, water-durable
 2. Surface: Fiberglass mesh on front and back
 3. Long Edges: Tapered
 4. Overall Thickness: ½ inch
 5. Panel complies with requirements of ASTM C1325 and ANSI A118.9
 6. Density: 72 lbs. per cu. Ft.
 7. Water Absorption: Not greater than 8 percent when tested for 24 hours in accordance with ASTM C473.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc
 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flannery, Inc.
 - b. Fry Reglet Corporation.
 - c. Gordon, Inc.
 - d. Pittcon Industries.
 - e. Tamlyn.
 - f. Or approved equal
 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified
- C. Fasteners for 5/8" thick gypsum wall panels:
 1. Metal Framing: 1-1/4" minimum corrosion resistant sharp point or drill point bugle head screw.

- D. Fasteners for use with cement board:
 - 1. PermaBASE screws (#8-18, #10-16 Drill Point) by PermaBASE Building Products, LLC or approved equal.
 - a. Wafer head, corrosion-resistant
 - b. Overall thickness: 1-1/4 inch

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Thermal Insulation: As specified in Section 07210 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: As indicated on Drawings.
 - 2. Mold-Resistant Type: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

- a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
- b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 APPLYING TILE BACKER PANELS FOR WALLS

- A. Install panels horizontal or vertical to supports spaced a maximum of 16-inches on center without blocking or 24-inches on center with blocking at all joints for ½-inch thick panels.
- B. Space fasteners 8-inches on center along all support members. Drive fasteners flush with the panel surface, do not countersink.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim in accordance with manufacturer's written instructions.
- B. Control Joints: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. Bullnose Bead: Use at outside corners.
 - 3. LC-Bead: Use at exposed panel edges.
 - 4. L-Bead: Use where indicated.
 - 5. U-Bead: Use at exposed panel edges
 - 6. Curved-Edge Cornerbead: Use at curved openings.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:
 - 1. Level 4: At all interior spaces.
 - a. Primer and its application to surfaces are specified in Section 09900 "Painting and Coating."

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09290

SECTION 09310
GLAZED PORCELAIN TILE

PART 1 – GENERAL

- A. Attention is directed to the Contract, AIA201, and all SECTIONS within DIVISION 1 – general requirements which are hereby made a part of this section of Specifications.

1.01 DESCRIPTION:

- A. Provide ceramic tile and all related materials and accessories where indicated on the drawings and herein and as required for a complete and proper job.
- B. Related Work:
1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

1.03 SUBMITTALS:

- A. Comply with pertinent provisions of Section 01300.
- B. Samples - Submit in duplicate:
1. Glazed porcelain wall, floor & base tiles.
 2. Trim Shapes - each color, type, and shape
 3. Accessories - each color, type and style
- C. Certificates:
1. Master Grade Certificate:
 - a) Conform to ANSI A137-1
 - b) Furnish for standard grade tiles
 - c) State grade, kind of tile, identification marks for tile packages, and name and location of project.
 - d) Issued and signed by manufacturer when tile is shipped.
 - e) Furnish the Architect and Owner each with one (1) copy of all certificates issued.
 2. Manufacturers of mortars, adhesives, and grouts to certify that materials:
 - a) Are suitable for intended use,
 - b) Meet or exceed the standards of American National Standards Institute (ANSI) and Tile Council of America Inc. (T.C.A.)
- D. Manufacturer's Instruction - Furnish manufacturer's instructions for the use of Tile Council of America (T.C.A.)

1.04 PRODUCT LABELING, DELIVERY & HANDLING:

- A. Deliver materials in manufacturer's original sealed containers.
 - 1. Labels legible and intact, identifying brand name and contents.
 - 2. Tile cartons grade-sealed by manufacturer in accordance with ANSI A137.
 - 3. Grade-seals unbroken.
 - 4. Manufactured mortars and grouts shall contain hallmarks certifying compliance with reference standards and be the types recommended by the tile manufacturer for application.
 - 5. Adhesives in containers labeled with hallmarks certifying compliance with reference standards.
- B. Deliver mastic grout ready for use.
- C. Deliver dry set mortar in sealed, moisture-proof containers.
- D. Store materials under cover in manner to prevent damage or contamination.
- E. All materials will be stored in an area where the temperature does not go below 50°F at any time. Materials stored at lower temperatures will not be used on this project.

1.05 JOB CONDITIONS:

- A. Environmental - Set and grout tile when ambient temperature is at least 50°F (10°C) and rising.
- B. Protection - Protect adjoining work surfaces before tile work begins.

1.06 EXTRA STOCK:

- A. Deliver to the Owner for his use in future modifications, an extra stock of approximately 10% of each color and pattern in each material installed under this Section, packaging each type of material separately, distinctly marked, and adequately protected against deterioration.

Note: Bidders are to provide the greater of the value of Extra stock noted above and in Part 1.07 of this specification.

PART 2 – PRODUCTS

2.01 BASIS OF DESIGN

- A. To establish a level of quality and performance characteristics the desired specified tile is based upon Daltile Corporation Tile. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance, style, characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance.

2.02 MANUFACTURER:

- B. American Olean Tile Co.
- C. Roca Tile USA.
- D. Or Approved Equal

2.03 GLAZED PORCELAIN MOSAICS:

A. GPT-1 (Glazed Porcelain Tile – Type 2) Glazed Porcelain Tile: (Water Closet Walls)

1. Material: Glazed Porcelain
2. Series: Volume 1.0
3. Pattern: Stack Bond
4. Size: 6x6
5. Color: Stereo Grey VL 73

2.04 GROUTING MATERIALS:

A. Comply with pertinent recommendations contained in the Tile Council of America “Handbook for Ceramic Tile Installation” in colors selected by the Architect from standard colors available from the approved manufacturers.

B. Non-Staining Epoxy Grout:

1. Provide an engineered non-staining epoxy grout system for interior use which, upon curing, is resistant to staining, moisture, mildew, cracking, crazing, and shrinking.
2. Secure the Architect’s specific approval of the proposed product prior to use.
3. Colors: As selected by Architect from manufacturer’s standard colors.

2.05 SETTING MATERIALS:

A. Dry Set:

1. Provide a commercially prepared mixture of Portland cement, sand, and additives imparting water-retentivity, for use as a bond coat for setting tile in wet and dry applications.

2.06 ACCESSORIES:

A. Tiled Edge:

1. Anodized aluminum tile wall edge similar or equal to Schuler Rondec-DB, satin anodized aluminum finish.

2.07 OTHER MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.01 INSPECTION OF SURFACES:

A. Inspection:

1. Examine surfaces to receive ceramic tile, settling beds, or accessories before tile installation begins for:
 - a.) Defects of conditions adversely affecting quality and execution of tile installation.
 - b.) Deviations beyond allowable tolerance of surfaces to receive tile:

- (1) Dry-set - Maximum variation in vertical surfaces 1/4 inch in 8 feet.
- c.) Subcontractor is to notify Contractor and A/E in writing of any surfaces that are not ready to receive ceramic tile, and he will then be responsible to correct, at no cost to the Owner, any defective ceramic tile work attributed to improperly prepared sub-surfaces.

- 2. Grounds, anchors, plug, hangers, bucks, electrical and mechanical work in or behind tile to be installed prior to processing with tile work.

3.02 INSTALLATION:

- A. Ceramic tile - Prepare surface, fit, set, or bond, grout and clean in accordance with applicable requirements of ANSI Standards for setting method specified, except as otherwise noted.
- B. As recommended by Tile Council of American Handbook - latest edition.

3.03 CLEAN UP:

- A. Remove all debris.
- B. Clean and make all ceramic tile work acceptable to the A/E and/or Owner, according to manufacturer's recommendations.

END OF SECTION 09310

SECTION 09513
ACOUSTICAL TILE CEILINGS

PART 1 – GENERAL

- A. Attention is directed to the Contract, AIA 201 and all sections within Division 1 which are hereby made a part of this section of Specifications.

1.01 DESCRIPTION

- A. Work Included: Provide U.L.-approved fire-resistant, Class A acoustical ceiling assembly where shown on the drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Work:
1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Provide identification affixed to the building materials (ceiling tiles and grid) with the Underwriters Laboratories, Inc., Test No. indicated that the product has been tested, approved and rated for compliance of requirements herein.

1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01300.
- B. Product Data: After the Contractor has received the Owner's Notice To Proceed, submit:
1. Materials list of items proposed to be provided under this Section.
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
 3. Shop drawings in sufficient detail to show suspension, layout, lateral restraint, installation, anchorage, and interface of the work of this Section with the work of adjacent trades;
 4. Manufacturer's recommended installation procedures which, when approved by the A/E, will become the basis for accepting or rejecting actual installation procedures used on the work.

1.04 PRODUCT HANDLING:

- A. Comply with pertinent provisions of Section 01600.

1.05 EXTRA STOCK:

- A. Deliver to the Owner for his use in future modifications, an extra stock of 1 sealed case of each type of acoustical material installed, packaging each type of material separately, distinctly marked, and adequately protected against deterioration.

PART 2 - PRODUCTS

2.01 2.01 BASIS OF DESIGN

- A. To establish a level of quality and performance characteristics the desired specified high speed rolling overhead door assembly is based upon Armstrong Ultima Tegular Ceiling Systems. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance, style, characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance.

2.02 ACCEPTABLE MANUFACTURERS

- A. Armstrong World Industries
- B. Celotex Corporation, Post Office Box 22502, Tampa, Florida, 33622.
Phone: (813) 871-4543, or approved equal.
- C. USG Interiors, or approved equal.
- D. Both grid and panels are to be of one manufacturer unless otherwise approved by A/E.

2.03 ACOUSTICAL CEILING PANEL:

- A. Provide a complete system of supporting members, anchors, wall cornices, adapters for light fixtures and grilles, and accessories of every type required for a complete suspended 24x24 Beveled Tegular Edge System panels of the arrangements shown on the drawings; in color or colors selected by the Architect from standard colors of the approved manufacturer, and complying with pertinent requirements of Underwriter's Laboratories, Inc. and the governmental agencies having jurisdiction.

B. Panel Qualities

1. Finish:	Fine Texture
2. Panel Size:	24x24
3. Edge:	Beveled Tegular 15/16
4. Acoustics:	0.75 NRC/35 CAC
5. Color:	White
6. Flame spread classification:	Class A
7. Light Reflectance:	90%
8. Sag/Humidity Resistance:	Yes

- C. Secure all ceiling tiles with manufacturers ceiling clips in quantity recommended by manufacturer in conformance with U.L. Tested and approved assemblies (minimum four clips per ceiling tile).

2.04 OTHER MATERIALS: (all U.L. tested and approved for Fire Classification A assembly)

A. Ceiling Grid:

- 1. Provide U.L. Tested and Approved Grid Assembly conforming to Class A Fire Classification.

B. Cold-Rolled Channels

1. No. 16 MSG. Cold-rolled steel channels 1-1/2" deep with 1" flanges.
2. Secure to lower chord of joints, in a perpendicular direction.

C. Hanger Wires

1. No. 12 SWG Galvanized steel wire compatible with U.L. tested and approved Class A Fire Classification Assembly.
2. Twist-tie to cold-rolled channels.

D. Field verify and become familiar with the intended work prior to submitting bid.

E. Submit shop drawings and grid and tile samples to the Architect for approval.

F. Provide other materials, not specifically described but required for complete and proper installation, as selected by the Contractor, subject to approval of A/E.

G. Provide mineral wool and gypsum board smoke and fire barriers as specified on the drawings and herein, in conjunction with the work of this section.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION - GENERAL:

- A. Except as modified by requirements of governmental agencies having jurisdiction, recommendations of the manufacturer as approved by the A/E, or specific directions of the A/E, installation shall be in accordance with ASTM C636 and the pertinent UL design requirements.
- B. Lateral Bracing:
1. Provide lateral bracing as required by pertinent codes and regulations.
 2. Secure lateral bracing to structural members. Secure at right angles to the direction of the partition and four ways in large ceiling areas.
- C. Provide minimum of four (4) hold-down clips for each ceiling panel and additional clips when so required by governmental agencies having jurisdiction if not otherwise specified elsewhere, herein.
- D. Make all grid level within a tolerance of one-in-1000 and straight within a tolerance of one-in-1000.

3.03 INSTALLATION OF ACOUSTICAL MATERIALS:

- A. Install acoustical ceiling boards so linearity of facing is as directed by the A/E.

3.04 CLEANING UP

- A. In addition to other stipulated requirements for cleaning, completely remove finger prints and traces of soil from the surfaces of grid and acoustical materials, using only those cleaning materials recommended for the purpose by the manufacturer of the material being cleaned.

END OF SECTION 09513

SECTION 09651

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Resilient tile flooring and rubber cove base found in the drawings and schedules of the contract that meet the requirements of this section for installation with surface flooring.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's published technical data describing materials, construction and recommended installation instructions. Submit technical data and installation instructions for each adhesive material.
- B. Maintenance Instructions: Submit manufacturer's recommendations for maintenance, care and cleaning of base.
- C. Samples: Submit Samples of top set base in each available color. Following color selections, submit Samples, not less than 12 inches long of each selected color and type. Submit pint cans of each type adhesive.
- D. Maintenance Materials: Before Substantial Completion, deliver at least 50 lineal feet and five outside corner units of each color of rubber base installed. Deliver the materials in unopened factory containers or in sealed cartons with labels identifying the contents, matching installed materials. Include unopened cans of adhesives adequate to install the maintenance materials.
- E. Warranty: Provide manufacturer's warranty certificate.

1.03 QUALITY ASSURANCE

- A. Qualifications of Installer: Minimum five years experience in successfully installing the same or similar flooring materials.
- B. Comply with the following as a minimum requirement:
 1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM F1861: Standard Specification for Resilient Wall Base.
 3. ASTM E 648: Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

4. ASTM E 84: Class II (26-75)
5. ASTM F 1861: Conforms
6. UL 992: <2.0
7. Chemically based products such as sealers, primers, fillers, adhesives, etc. must be approved by Owner's Office of Environmental Health and Safety (OEHS).
8. Each selected color and configuration shall be from same dye lot and color.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the Project site in original unopened manufacturer's packaging clearly labeled with manufacturer's name and project name.
- B. Store materials inside, sheltered from extreme hot or cold temperatures. Place the material on a smooth level floor or where there is uniform solid support in a clean, dry well-ventilated area. Unstack the pallets. The long-term storage temperature must be maintained between 65°F (18°C) and 85°F (29°C). Protect adhesive and flooring material from freezing, extreme heat and direct sun exposure.
- C. Acclimatize the subfloor, all flooring material and adhesive for 48 hours before, during and after the installation by maintaining the room temperature between 65°F (18°C) and 85°F (29°C). The pallets should be unstacked 24 hours prior to use.
- D. Maintain the room temperature between 65°F (18°C) and 85°F (29°C). Protect the material from direct sources of heat such as air vents and other types of heaters.

1.05 PROJECT CONDITIONS

- A. Ventilation and Temperature: Verify areas that are to receive rubber base are ventilated to remove fumes from installation materials, and areas are within temperature range recommended by the various material manufactures for site installation conditions.

1.06 WARRANTY

- A. Manufacturer shall provide a five year material warranty.
- B. Installer shall provide a two year fabrication and installation warranty.

1.07 EXTRA STOCK

- A. Extra Materials: Provide minimum three cartons of extra materials for the LVT flooring.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the resilient tile flooring is based upon Mohawk Group, 160 S. Industrial Blvd, Calhoun, GA 30701, (tel) 800-241-4494. www.mohawkgroup.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

1. Ceco Door; ASSA ABLOY.
2. Or Approved Equal

2.02 MATERIALS

- A. Luxury Vinyl Tile Flooring (LVT): Complies with ASTM F1700, Class III, Type A – Smooth, Type B – Embossed.

1. Style Name: Large and Local Wood Collection C0128
2. Product Type: Glue Down LVT
3. Overall Thickness: 4.5 mm (0.18")
4. Wear Layer: 20 mil (0.51 mm)
5. Finish: M-Force Ultra
6. Size: 234.95 mm x 1498.6 mm (actual)
9.25" W x 59" L (nominal)
7. Installation Method: Glue Down
8. Color: Color to be selected by Owner from manufacturer's standard options

- B. LVT Adhesive:

1. M99 Adhesive (up to 99% in-situ RH and a pH of 12.0)
2. M95.0 Adhesive (up to 95% in-situ RH and a pH of 8 - 10.0)
3. M700 Adhesive (up to 95% in-situ RH and a pH of 7 – 9)

2.03 ACCESSORIES

- A. Rubber Cove Base: Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the vinyl cove base is based upon Armstrong Flooring. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

1. Roppe Corporation, USA
2. Or Approved Equal

- B. Product
1. Style Name: Coved wall base
 2. Thickness: 1/8" (3.18mm)
 3. Size: 120' Length Rolls, 4" Height
 4. Installation Method: Glue
 5. Color: Color to be selected by Owner from manufacturer's standard options
 6. Adhesive: Low emitting Adhesive (S-725)

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate the Work of this section with other sections to provide a level, smooth and clean finish surfaces to receive rubber base.

3.02 EXAMINATION

- A. Field verify dimensions and other conditions affecting the Work of this section before commencing the Work of this section.
- B. Before Work is started, examine surfaces that are to receive resilient flooring and rubber cove base. Deficiencies shall be corrected before starting the Work of this section. Examine the subfloor before installation to ensure that the surface is clean, dry, smooth, structurally sound and free from foreign substances that may adversely affect adhesion or cause discoloration. Furthermore, ensure that the subfloor is free of paint, varnish, adhesive, oil, grease, solvent and other foreign substances, including treatment compounds, sealers and curing compounds that may adversely affect adhesion or alter the appearance or durability of the rubber flooring.

3.03 PREPARATION

- A. Do not start preparation until adjacent concrete floor slabs are at least 90 days old and finish flooring is installed.
- B. Install resilient floor and rubber cove base when ambient temperature is 65 degrees F. or higher.
- C. Level all rough surfaces and fill cracks and marks with a Portland cement-based patching compound modified with latex.
- D. Mechanically remove all surface contaminants such as paint, oil, grease, varnish, adhesive as well as various other products such as treatment compounds.
- E. Ensure Moisture, Relative Humidity and pH tests have all been conducted and measurements meet manufacturer's recommendations.

3.04 INSTALLATION

- A. Install the flooring according to manufacturer's installation instructions. Use the tools, adhesives, trowel types and procedures recommended in the instructions.
- B. Acclimatize the subfloor, all flooring material and adhesive for 48 hours before, during and after the installation by maintaining the room temperature between 65°F (18°C) and 85°F (29°C). Afterwards, maintain the temperature between 65°F (18°C) and 85°F (29°C)..
- D. Base and outside corners shall be rolled with a seam roller before adhesive sets.

3.05 CLEANING

- A. Maintain surfaces of base clean as installation progresses. Clean rubber base when sufficiently seated and remove foreign substances.
- B. Clean adjacent surfaces of adhesive or other defacement. Replace damaged and/or defective Work to the specified condition.

3.06 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.07 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 09656

RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Sheet vinyl resilient athletic flooring.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Manufacturer Certifications:
 - 1. Provide certification that accurately identifies the Original Equipment Manufacturer (OEM) of flooring furnished for this project including manufacturer's name, address and factory location.
 - a. Suppliers of Private-Label flooring for this project must identify themselves as such and fully disclose the OEM information listed above.
 - b. All "manufacturer" requirements in these specifications must be complied with by the OEM, including warranties, certifications, qualifications, product data, test results, environmental requirements, performance data, etc.
 - 2. Provide ISO 9001 quality certification for the OEM of the specified products.
 - 3. Provide ISO 14001 environmental certification for the OEM of the specified products.
 - 4. Provide ISO 50001 energy certification for the OEM of the specified products.
- C. Laboratory Test Results:
 - 1. Provide certification of testing per ASTM F2772-11 indicating the product being furnished complies with all requirements of ASTM Indoor Sport Floor Classification, including CLASS 3 shock absorption. Third-party testing certification required; sales literature is not sufficient.
- D. Shop Drawings: Showing installation details and locations of borders, patterns, game lines, locations of floor inserts and seams.
- E. Samples:
 - 1. Manufacturer's color chart for selection of available floors with a minimum of 10 standard colors available, including 3 wood visuals.
 - 2. Color samples:
 - a. Wood visual samples Minimum 24 inches by 36 inches to show that the appearance of wood plank pattern complies with these specifications
 - b. Solid color samples: Minimum 6 inches by 9 inches.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For a qualified resilient athletic flooring Manufacturer.
2. For a qualified resilient athletic flooring Installer.

1.4 CLOSEOUT SUBMITTALS

A. Submit three copies of the following:

1. Manufacturer maintenance instructions.
2. Manufacturer warranty for material defects, high moisture tolerance and not promoting mold growth on, within and directly under the installed flooring.
3. Installer installation warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. ISO 9001 Certified.
2. ISO 14001 Certified.
3. ISO 50001 Certified.
4. At least ten years active experience in the manufacture and marketing of indoor resilient athletic flooring.
5. A provider of authorized installer training.

B. Installer Qualifications:

1. At least five years of experience in the installation of resilient athletic flooring.
2. Experience on at least five projects of similar size, type and complexity as this project.
3. Employer of workers for this Project who are competent in techniques required by manufacturer for resilient athletic flooring installation indicated.

C. Fire Test Characteristics: As determined by testing identical products according to ASTM E648, Class 1, by a qualified testing agency acceptable to authorities having jurisdiction.

D. Athletic Performance Properties: Comply with ASTM F2772-11 Performance Level CLASS 3 for force reduction, ball bounce, vertical deformation and surface friction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store flooring and installation materials in protected dry spaces, with ambient temperatures maintained within range recommended by manufacturer, but not less than 55 deg F (13 deg C) nor more than 85 deg F (29 deg C).

- B. Store the indoor resilient athletic surfacing rolls in an upright position on a smooth flat surface immediately upon delivery to Project.

1.7 FIELD CONDITIONS

A. Product Installation:

1. Maintain temperatures during installation within range recommended by manufacturer, but not less than 65 deg F in spaces to receive flooring 48 hours prior to installation, during installation, and maintained thereafter.
2. After installation, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 85 deg F.
3. Prohibit traffic during flooring installation and for at least 72 hours after flooring installation.
4. Refer to the adhesive technical datasheet for appropriate time for traffic after installation.

- B. Install flooring only after other finishing work, including painting and overhead work, has been completed.

1.8 WARRANTY

A. Special Limited Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace sports flooring that fails within specified warranty period.

1. Material warranty must be direct from the product manufacturer.
 - a. Material warranties from private label distributors are not valid.
2. Failures include, but are not limited to, the following:
 - a. Material and manufacturing defects.
 - b. Failure due to high moisture vapor emissions from the concrete slab. Capable of tolerating up to 100% relative humidity (RH) per ASTM F2170 or 25 pounds moisture vapor emission rate per ASTM F1869.
 - c. System is warranted not to promote mold growth on, within and directly under the installed flooring.
3. Manufacturer's warranty to be valid regardless of the following being performed:
 - a. Moisture testing of the concrete slab is not required.
 - b. pH testing of the concrete slab is not required.
 - c. Below concrete moisture vapor retarder is not required.
4. Warranty Period: 15 years from date of Substantial Completion.

B. Special Limited Warranty: Installer's standard form in which installer agrees to repair or replace sports flooring that fails due to poor workmanship or faulty installation within the specified warranty period.

1. Warranty Period: 1 years from date of Substantial Completion.

1.9 COORDINATION

- A. Coordinate layout and installation of flooring with other gymnasium equipment.

PART 2 - PRODUCTS

2.1 SHEET VINYL ATHLETIC FLOORING

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new sheet vinyl gymnasium floor is based upon Gerflor Taraflex Sport M Plus DRY-TEX Sports Flooring installed with Gerflor's GERPUR high-moisture tolerant full-spread adhesive. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. Tarakett Omni-Sport
 - 2. Or Approved Equal
 - 3. Approval by Architect of other manufacturers does not relieve Contractor of responsibility to provide products which comply with all requirements of this specification including full-spread adhesive coverage.
- B. Product Description: Dual-durometer foam-backed sheet vinyl flooring designed for fully adhered athletic flooring applications.
 - 1. Overall Thickness: Not less than 0.3 inch (7.5 mm).
 - 2. Wear-Layer Thickness: Not less than 0.08 inch (2.1 mm)
 - 3. Backing:
 - a. Very high density, two layer, dual-durometer, closed cell foam
 - b. Two (2) layers of fiberglass reinforcement for dimensional stability and indentation resistance. One layer of woven grid fiberglass and an additional layer of non-woven fiberglass.
 - 4. Seaming Method: Heat welded.
 - 5. Adhesive Method:
 - a. Full-spread adhesive coverage to completely adhere flooring to substrate.
 - b. Complete adhesive coverage to eliminate the possibility of gaps or space between the slab and flooring material where moisture could accumulate and create an environment conducive to mold growth.
 - c. Flooring to be fully adhered to the concrete slab in all locations eliminating the possibility of waves or wrinkles forming caused by the floor shifting, moving or by rolling loads displacing it.

6. Traffic-Surface Texture: Wood visual shall have wood grain embossed texture for a genuine wood appearance and Solid colors to have "pebbled" embossed texture for an attractive appearance.
7. Bacteriostatic and Fungicidal Treatment: Manufacturer's factory-applied permanent treatment throughout the flooring material which can improve indoor air quality and reduce asthma and allergy risks associated with bacterial and mold growth.
 - a. Basis-of-Design Product: Gerflor Taraflex
8. Applied Finish: Manufacturer's, factory-applied, permanent and UV-cured.
 - a. No-Wax finish: Published product literature identifying factory applied finish as, "No-Wax-Just clean and rinse"
 - b. Basis-of-Design Product: Gerflor ProtecSol.
9. Field-Applied Finishes: None required and not allowed.
10. Roll Size:
 - a. Roll Width: Rolls to a minimum width of 59 inches (1.5 m) wide.
 - b. Roll Length:
 - 1) Wood visual rolls to be a minimum length of 86 feet, 6 inches (26.4 m) to minimize the number of end-seams.
 - 2) Solid color rolls to be a minimum length of 67 feet, 3 inches (20.5 m) to minimize the amount of waste if accent colors are selected for borders, keys or center circle.
 - c. Roll length of wood visual flooring shall be sufficient to cover the full length of a high school main basketball court (84'-0") without splicing or end-of-roll (butt) seams within main court boundary.
11. Color and Pattern:
 - a. As selected by Owner from manufacturer's standard colors and patterns.
 - b. Wood pattern shall accurately simulate the true visual appearance of natural athletic wood strip flooring.
 - 1) Pattern shall replicate random-length stock by simulating non-uniform board lengths ranging from 18 inches to 48 inches with a maximum board width of 2-1/2 inches.
 - 2) Wood pattern shall not include a dark line simulating edges or ends of individual boards.
 - 3) Surface texture shall simulate realistic wood grain and not be raised or "pebbled" embossing.

C. Performance Criteria:

1. ASTM F2772-11 Indoor Sport Floor Standard:

- a. Provide certification of compliance for the four ASTM F2772 Indoor Sport Floor Standard performance categories:
 - 1) Shock Absorption/Force Reduction:
 - a) Class C3 (34% to 46%): Pass
 - 2) Ball Bounce:
 - a) Minimum 90%: Pass
 - 3) Surface effect/Coefficient of Friction:
 - a) Between 80-110: Pass
 - 4) Vertical deformation:
 - a) Maximum 3.5mm: Pass
 2. Resistance to Rolling Load: EN 1569; Pass.
 3. Chemical Resistance: ASTM D 543; OK.
 4. Impact Resistance: EN 1517; Pass.
 5. Abrasion Resistance: EN ISO 5470; Pass.
 6. Sound Insulation: EN ISO 717; 18 dB.
 7. Gloss/Brightness: EN ISO 2813; Pass.
 8. Organic Emission: ASTM D 5116; Pass
 9. Fire Performance: ASTM E 648; Greater than 0.45 W/cm², Class 1.
 10. Surface Maintenance Requirements: No-wax surface requiring only cleaning and rinsing.
 11. Slab Moisture Design Tolerance: Capable of tolerating up to 100% relative humidity (RH) per ASTM F2170 or 25 pounds moisture vapor emission rate per ASTM F1869.
- D. Telescoping Bleacher Surface:
1. BleacherBlox SV: 5mm sheet underlayment to be installed under telescoping bleacher locations and coordinated and installed with Taraflex Sport M Plus DTX flooring.
 - a. Size: 5ft x 5ft tiles
 - b. Weight: 20.8 oz per sqft
 - c. Static Load Resistance: ASTM F970 (Modified), 750 psi
 - d. Fire Rating – Flame Spread: ASTM E648, Class 1
 - e. Resistance to Rolling Loads: ATM F2753, 1,500 cycles at 400lbs.
 - f. Adhesives:
 - g. Adherence of BleacherBlok underlayment to substrate: Gerfix 100 Adhesive
 - h. Adherence of BleacherBlok to Taraflex Surface: Gerfix T-111 Adhesive

2.2 ACCESSORIES

- A. Patching Compound: High-moisture tolerant trowelable patching compound for standard slab surface preparation:
 - a. Slab moisture tolerance: Capable of same slab moisture tolerance as the adhesive.
- B. Adhesives: Water-resistant type recommended by athletic flooring manufacturer for substrate and conditions indicated.
 - 1. Basis-of-Design Product: Gerflor GERPUR adhesive for Dry-TEX.
 - a. Moisture Resistance Limit: No maximum limit for high moisture vapor emissions from the concrete slab; capable of tolerating up to 100% RH Per ASTM F2170
 - b. Concrete testing: Moisture and pH testing of the concrete slab is not required.
 - c. Coverage Type: Full-spread application for 100% coverage.
- C. Heat Welding Rod: As supplied by indoor resilient athletic flooring manufacturer. Color shall blend with resilient athletic flooring color.
- D. Game-Line and Marker Paint: Complete system including primer, compatible with flooring and recommended by flooring and paint manufacturers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify the Following:
 - 1. The area in which the indoor resilient athletic flooring will be installed is dry, weather-tight and in compliance with specified requirements.
 - 2. Permanent heat, lighting and ventilation systems are installed and operable.
 - 3. Other work, including overhead work, that could cause damage, dirt, dust or otherwise interrupt installation has been completed or suspended.
 - 4. No foreign materials or objects are present on the substrate and that it is clean and ready for preparation and installation.
 - 5. The concrete slab surface deviation is no greater than 3/16 inch within 10 feet when measured according to ASTM F710.
 - 6. The concrete slab complies with ACI 302.2R for concrete design.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure proper adhesion of resilient athletic flooring system.
- B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of sealers, curing compounds and other additives. Remove coatings and other substances that are incompatible with adhesives using mechanical methods to create porosity as recommended by manufacturer.
 2. Alkalinity testing: Proceed with installation if the pH readings are within the specifications given by the adhesive manufacturer.
- C. Use high-moisture trowelable concrete based patching compound with the same moisture vapor tolerance as the adhesive to fill depressions, holes, cracks, grooves or other irregularities in substrate.
- D. Place flooring and installation materials into spaces where they will be installed at least 48 hours before installation. Install flooring materials only after they have reached the same temperature as space where they are to be installed.
- E. Mechanically prepare the surface of the concrete slab to achieve a CSP 1+, clean and porous substrate.
- F. Sweep and then vacuum substrates immediately before installation. After cleaning, examine substrate for moisture, alkaline salts, grit, dust or other contamination. Proceed with installation only after unsatisfactory conditions have been corrected.
- G. Acclimate Sport Vinyl underlayment in area to be installed for a minimum of 24-hours.

3.3 SHEET ATHLETIC FLOORING INSTALLATION

- A. General:
1. Comply with resilient athletic flooring manufacturer's installation instructions.
 2. Take necessary precautions to minimize noise, odors, dust and inconvenience during installation.
 3. Fit flooring neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
 4. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- B. Lay out flooring as follows:
1. Minimize the number of seams and place them inconspicuous areas.
 2. Locate seams as shown on approved shop drawings.
- C. Adhered Flooring: Attach products to substrates using Gerflor's full-spread adhesive applied to substrate to comply with adhesive and flooring manufacturer instructions.
- D. Vinyl Sheet Flooring Seams: Finish seams to produce surfaces flush with adjoining flooring surfaces. Comply with ASTM F1516. Rout joints and use heat welding rod to permanently and seamlessly fuse sections together.

3.4 BLEACHERBLOK SV

A. General

1. Comply with resilient athletic flooring manufacturer's installation instructions.
2. Take necessary precautions to minimize noise, odors, dust and inconvenience during installation.
3. Fit flooring neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
4. Install the sport vinyl underlayment stippled side face down.
5. BleacherBlok system requires the use of a two-part polyurethane adhesive, recommended to install the Sport vinyl underlayment first, then the spot flooring in the playing area and finally the Surface on the Sport Vinyl Underlayment to match the planks alignment as much as possible.
6. Treat all seams between the BleacherBlok System and the sports flooring the same as regular seams to be heat welded.

B. INSTALLING VINYL UNDERLAYMENT USING GERIX 100 ADHESIVE

1. Use only Gerfix 100 adhesive (No moisture testing required)
2. Always refer to the Gerfix 100 Adhesive Technical Data Sheet
3. Gerfix 100 is rated at 100% RH, 25 lbs.CC., and is unaffected by concrete pH
4. The recommended trowel size is 1/32" x 1/16" x 1/32" 'U' notch, covering up 170 -220 sq. ft. per US gallon.
5. Starting from the center line and working outward and apply the adhesive to the subfloor.
6. Maintain a uniform spread rate. Replace trowel (or trowel blade) with every pail used.
7. Once the Sport Vinyl Underlayment is placed into the adhesive, immediately roll thoroughly with a 3 section 100-lbs roller in both directions.
8. The **use of kneeling boards is mandatory** when on top of the freshly installed underlayment.
9. Adhesive transfer must be 100% wet transfer to the back of the underlayment.
10. Continually check for bubbles. To verify there are no bubbles, look down and across the underlayment from both a standing and prone position with the lights on and off. The use of a light source at floor level can be helpful in finding any air pockets or bubbles.
11. Avoid adhesive displacement by prohibiting traffic for a period of 6 hours for light traffic, and 8 hours for heavy static & dynamic loads.
12. Inspect the Sport Vinyl Underlayment once installed and fill any gaps or uneven seams with Gerfix T-111 and allow to dry overnight.
13. Verify for any smudges of adhesive or lippage at the seams. Using a sander, sand as needed to obtain a smooth surface for the next step.
14. Smooth the seams of the Sport Vinyl Underlayment using a belt or orbital sander once the T- 111 is cured. **VERIFY ALL SEAMS OF THE SPORT VINYL UNDERLAYMENT ARE PROPERLY ADJUSTED AND LEVELED. ANY VARIATION IN HEIGHT OR SMOOTHNESS WILL VISIBLY TELEGRAPH THROUGH THE SURFACE VINYL MATERIAL.**

C. DRY LAY OF SURFACE SHEETGOODS

1. When installing BleacherBlok System side by side with sport flooring, adjust the seams of the Surface flooring so the planks are aligned with the planks of the court already installed.
2. Acclimate Surface Vinyl in area to be installed for a minimum of 24 hours.
3. Unroll flooring following roll sequence numbers.
4. Mark the center starting line.
5. Unroll the first length of material along this chalk line and then work progressively outward, leaving a 1/4" gap between the sheets to allow the material to relax for at least 16-24 hours.
6. Seaming should be kept to a minimum and avoid cross seams as much as possible. Place seams in areas exposed to the least amount of traffic.
7. Surface sheet good seams shall offset BleacherBlok seams by a minimum of 6". Do not stack seams.
8. Before applying the adhesive, bring the loose sheets close together with a gap no greater than 1/32".

9. The 1/32" gap is the space needed to groove the flooring for heat welding. This gap must be consistent in width.

D. INSTALLING SURFACE VINYL TO UNDERLAYMENT USING T-111

1. The recommended trowel size is 1/32" x 1/16" x 1/32" 'U' notch, covering 170 – 220 sq. ft. per US gallon.
2. Mix polyurethane adhesive part A and part B as recommended by the adhesive manufacturer.
3. Installers must be familiar with the use of polyurethane adhesives.
4. Starting from the center line and working outward, fold the sheets back halfway and apply the adhesive to the subfloor.
5. Installer may also use the "roll back" method. With the roll back method, do not pre-cut material as if to be the final trim. Leave material 2"-3" longer for trimming after placement.
6. To ensure uniform adhesion of the entire surface, only spread a workable amount of adhesive at one time. Maintain a uniform spread rate. Replace trowel (or trowel blade) with every pail used.
7. There is no 'open time' needed with this type of adhesive; the flooring must be applied into the wet adhesive within 40 minutes.
8. While installing, always work to have complete sheets glued at the end of the day.
9. To reduce the risk of bubbles, the roll back method is the most recommended.
10. By keeping the roll tight and maintaining a constant pressure while unrolling into the adhesive, the risk for bubbles will be minimal.
11. The fold back method is acceptable, but care must be taken to not flap it back too quickly.
12. Always roll seams, at the walls, and under toe kicks with a hand roller to ensure 100% transfer of adhesive.
13. **Cement bricks will be needed to weigh down ALL end seams, or cross seams until the adhesive fully cures. Bricks must be used in any are within the installation that is not lying flat in the adhesive.**
14. **Do not stand, kneel, or walk on the sheet vinyl flooring. The use of kneeling board and walking board is mandatory to eliminate adhesive displacement.**
15. Adhesive transfer must be **100% wet transfer** to the backing of the flooring. Trowel ridge marks should not be visible on the back of the flooring or on the subfloor. If the adhesive skins over or dries it must be scraped up and new adhesive applied.
16. Care must be taken to avoid flopping the sheets into the adhesive as this may cause air to become entrapped.
17. Continue laying sheets by keeping the edges spaced no greater than 1/32", trimming each side with a straight edge or scribing. The goal is to produce a uniformly 1/32" spaced seam for welding.
18. Using a 100-lbs sectional steel roller, roll the flooring in the width first and then the length to ensure adhesive transfer and to evacuate all air that can lead to bubbles. Optimally there should be an individual tasked solely with this responsibility.
19. Continually check the flooring for bubbles. To verify there are no bubbles, look down and across the flooring from both a standing and prone position with the lights on and off. The use of a light source at floor level can be helpful in finding any air pockets or bubbles.
20. Prohibiting ALL traffic for a period of 16 hours and 36 hours for rolling loads.
21. The use of walking 4' x 8' x 1/4" kneeling boards are mandatory to protect from adhesive displacement during installation.

3.5 GAME LINES AND LOGOS

- A. Lay out game lines and logos to comply with rules and diagrams published by National Federation of State High School Association for the sports activities indicated.
- B. Mask flooring at game lines and logos, and apply paint of color indicated to produce clean, sharp and distinct edges.

3.6 HEAT WELDING

- A. ASTM F1516 Standard Practices for Sealing Seams of Resilient Flooring by the Heat Weld Method.
- B. Seams
 - 1. The seam must not be gapped more than 1/32" (1mm).
 - 2. When the gap is too wide, there will not be proper fusion. This will lead to premature weld Failure.
- C. Grooving the Seams
 - 1. For a heterogeneous flooring with comfort backing or a sport flooring, the groove should reach the top of the foam but must never groove into the foam.
- D. Manual Welding
 - 1. Verification of welder temperature and speed must be performed daily. Confirm temperature and speed by practicing on scrap material first before deploying the welder to the finished floor. Doing so will prevent failures.
 - 2. Grooving and welding may proceed after the adhesive has been permitted to cure a minimum of 16 hours.
 - 3. Use a heat welding gun with variable temperature control and a speed weld nozzle by Leister or equal.
 - 4. Turbo Precision Nozzle # 22-3 <http://turboheatweldingtools.com> or Leister Nozzle 05433 (5mm) is also highly recommended for proper welding.
 - 5. The use of a non-recommended tip may jeopardize proper welding and could damage the Flooring.
 - 6. Always remember to keep the nozzle tip clean and free of debris.
- E. Trimming Welded Rod
 - 1. Trimming is done once the welding rod and material have completely cooled.
 - 2. Trimming is done in two passes with the Mozart tool.
 - 3. Using the Mozart tool, make an initial pass with the thickness guide in place.
 - 4. After completing the first pass, a final pass must be made after the weld has completely cooled.
 - 5. The finished weld must be equal to the surface of the flooring.
 - 6. Weld after the final trim.
 - 7. Check for the fusion between the weld and the flooring on the final trim leftover, this will confirm proper fusion.

3.7 CLEANING AND PROTECTION

- A. Perform the following operations after completing resilient athletic flooring installation:
 - 1. Remove marks and blemishes from flooring surfaces.
 - 2. Sweep and then vacuum flooring.
 - 3. Damp-mop flooring with pH neutral cleaner to remove soiling.
- B. Protect flooring from abrasions, indentations, and other damage from subsequent operations and placement of equipment, during remainder of construction period.

END OF SECTION 09656

SECTION 09672
RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, including Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resinous flooring system as shown on the drawings and in schedules.
- B. Related Requirements:
 - 1. Cast-in-Place Concrete, Section 033000

1.3 SYSTEM DESCRIPTION

- A. The work shall consist of preparation of the substrate, the furnishing and application of a cementitious urethane based self-leveling seamless flooring system with decorative quartz aggregate broadcast and Epoxy broadcast and topcoats.
- B. The system shall have the color and texture as specified by the Owner with a nominal thickness of 1/4 inch. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.
- C. Cove base (if required) to be applied where noted on plans and per manufacturers standard details unless otherwise noted

1.4 ACTION SUBMITTALS

- A. Product Data: Product Data: Latest edition of Manufacturer's literature including performance data and installation procedures.
- B. Manufacturer's Safety Data Sheet (SDS) for each product being used.
- C. Samples: A 3 x 3 inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping
 - 1. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.

- B. Storage and Protection
 - 1. The Applicator shall be provided with a dry storage area for all components. The area shall be between 60 F and 85 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.
 - 2. Copies of Safety Data Sheets (SDS) for all components shall be kept on site for review by the Engineer or other personnel.
- C. Waste Disposal
 - 1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.6 PERFORMANCE CONDITIONS

- A. Site Requirements
 - 1. Application may proceed while air, material and substrate temperatures are between 60 F and 85 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
 - 2. The relative humidity in the specific location of the application shall be less than 85% and the surface temperature shall be at least 5 F above the dew point.
 - 3. The Applicator shall ensure that adequate ventilation is available for the work area. This shall include the use of manufacturer's approved fans, smooth bore tubing and closure of the work area.
 - 4. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.
- B. Conditions of new concrete to be coated with cementitious urethane material
 - 1. Concrete shall be moisture cured for a minimum of 3 days and have fully cured a minimum of 5 days in accordance with ACI-308 prior to the application of the coating system pending moisture tests.
 - 2. Concrete shall have a flat rubbed finish, float or light steel trowel finish (a hard steel trowel finish is neither necessary nor desirable).
 - 3. Sealers and curing agents should not to be used.
 - 4. Concrete shall have minimum design strength of 3,500 psi. and a maximum water/cement ratio of 0.45
 - 5. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect against the effects of vapor transmission and possible delamination of the system.
- C. Safety Requirements
 - 1. All open flames and spark-producing equipment shall be removed from the work area prior to commencement of application.
 - 2. "No Smoking" signs shall be posted at the entrances to the work area.
 - 3. The Owner shall be responsible for the removal of foodstuffs from the work area.
 - 4. Non-related personnel in the work area shall be kept to a minimum.

1.7 WARRANTY

- A. Manufacturer shall provide a two year material warranty.
- B. Installer shall provide a two year installation warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new resinous flooring system is based upon Dur-A-Flex, Inc., 95 Goodwin Street, East Hartford, CT 06108, Phone: (860) 528-9838, Fax: (860) 528-2802, model Hybri-Flex EQ (self leveling broadcast quartz), epoxy/aliphatic urethane topcoat seamless flooring system. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
1. Stonhard
 2. Or Approved Equal

2.2 FLOORING, GENERAL

- A. Dur-A-Flex, Inc, Hybri-Flex EQ (self leveling broadcast quartz), epoxy/aliphatic urethane topcoat seamless flooring system.
1. System Materials:
 - a. Topping: Dur-A-Flex, Inc, Poly-Crete SL resin, hardener and SL aggregate.
 - b. The broadcast aggregate shall be Dur-A-Flex, Inc. Q28 quartz aggregate.
 - c. Broadcast: Dur-A-Flex, Inc. Dur-A-Glaze #4, epoxy based two-component resin.
 - d. Grout Coatcoats: Dur-A-Flex, Inc Dur-A-Glaze #4 Water Clear, epoxy-based, resin and Hardener
 - e. Top coat: Dur-A-Flex, Inc. Armor Top aliphatic urethane two-component resin.

2.3 PRODUCT REQUIREMENTS

A.	Topping	Poly-Crete SL
1.	Percent Reactive	100 %
2.	VOC	0 g/L
3.	Bond Strength to Concrete ASTM D 4541	400 psi, substrates fails
4.	Compressive Strength, ASTM C 579	9,000 psi
5.	Tensile Strength, ASTM D 638	2,175 psi
6.	Flexural Strength, ASTM D 790	5,076 psi
7.	Impact Resistance @ 125 mils, MIL D-3134,	160 inch lbs
a.	No visible damage or deterioration	
B.	Broadcast Coat	Dur-A-Glaze #4 Resin
1.	Percent Reactive,	100 %
2.	VOC	<4 g/L
3.	Water Absorption, ASTM D 570	0.04%
4.	Tensile Strength, ASTM D 638	4000psi
5.	Coefficient of thermal expansion	ASTM D 696
6.	Flammability ASTM D-635	Self-Extinguishing
7.	Flame Spread/ NFPA 101 ASTM E-84	Class A

C.	Topcoat	Armor Top
1.	VOC	0 g/L
2.	60 Degree Gloss ASTM D523	75+/-5
3.	Mixed Viscosity, (Brookfield 25oC)	500 cps
4.	Tensile strength, ASTM D 638	7,000 psi
5.	Abrasion Resistance, ASTM D4060	Gloss Satin
	a. CS 17 wheel (1,000 g load) 1,000 cycles	4 8 mg loss with grit
6.	Pot life @ 70o F 50% RH	2 hours
7.	Full Chemical resistance	7 days

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.
 - 1. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

3.2 PREPARATION

- A. GENERAL
 - 1. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
 - 2. Moisture Testing: Perform tests recommended by manufacturer and as follows.
 - a. Perform relative humidity test using is situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 99% relative humidity level measurement.
 - b. If the vapor drive exceeds 99% relative humidity or 20 lbs/1,000 sf/24 hrs then the Owner and/or Engineer shall be notified and advised of additional cost for the possible installation of a vapor mitigation system that has been approved by the manufacturer or other means to lower the value to the acceptable limit.
 - 3. Mechanical surface preparation
 - a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.

- b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
- c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
- d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.
- e. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

3.3 APPLICATION

A. GENERAL

- 1. The system shall be applied in five distinct steps as listed below:
 - a. Substrate preparation
 - b. Topping/overlay application with quartz aggregate broadcast.
 - c. Resin application with quartz aggregate broadcast.
 - d. Grout coat application
 - e. Topcoat application.
- 2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
- 3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
- 4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
- 5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

B. TOPPING

- 1. The topping shall be applied as a self-leveling system as specified by the Architect. The topping shall be applied in one lift with a nominal thickness of 1/8 inch.
- 2. The topping shall be comprised of three components, a resin, hardener and aggregate as supplied by the Manufacturer.
- 3. The hardener shall be added to the resin and thoroughly dispersed by suitably approved mechanical means. SL Aggregate shall then be added to the catalyzed mixture and mixed in a manner to achieve a homogenous blend.

4. The topping shall be applied over horizontal surfaces using ½ inch “V” notched squeegee, trowels or other systems approved by the Manufacturer.
5. Immediately upon placing, the topping shall be degassed with a loop roller.
6. Q28 Quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.8 lbs/sf.
7. Allow material to fully cure. Sweep and vacuum to remove all loose aggregate.

C. BROADCAST

1. The broadcast coat resin shall be applied at the rate of 90 sf/gal.
2. The broadcast coat shall be comprised of liquid components, combined at a ratio of 2 parts resin to 1 part hardener by volume and shall be thoroughly blended by mechanical means such as a high speed paddle mixer.
3. Q 28 Quartz aggregate shall be broadcast into the wet resin at the rate of 0.5 lbs/sf.
4. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.

D. GROUT COAT

1. The grout coat shall be squeegee applied with a coverage rate of 90 sf/gal.
2. The grout coat shall be comprised of liquid components, combined at a ratio of 2 parts resin to 1 part hardener by volume and shall be thoroughly blended by mechanical means such as a high speed paddle mixer.
3. The grout coat will be back rolled and cross rolled to provide a uniform texture and finish.

E. TOPCOAT

1. The topcoat shall be roller applied with a coverage rate of 500 sf/gal.
2. The finished floor system will have a nominal thickness of 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Tests, Inspection

1. The following tests shall be conducted by the Applicator:
 - a. Temperature
 - 1) Air, substrate temperatures and, if applicable, dew point.
 - b. Coverage Rates
 - 1) Rates for all layers shall be monitored by checking quantity of material used against the area covered.

3.5 CLEANING AND PROTECTION

- A. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
- B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

END OF SECTION 09672

SECTION 09681

TILE CARPETING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Tile carpeting.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03300 - Cast-In-Place Concrete.
3. Section 09651 – Resilient Tile Flooring.

1.02 SUBMITTALS

A. Shop Drawings: Submit dimensioned layout of carpet tile and details for binder bars.

B. Samples:

1. Submit minimum three labeled carpet tile actual size with proper backing. Carpet style and color as selected by the Owner.
2. Trim and accessories: Submit 12-inch long Samples of each type trim proposed for the Work.

C. Product Data: Submit the following:

1. Carpet tile manufacturer's published technical data fully describing carpet materials, construction, and recommended installation directions.
2. Technical data and installation instructions for each adhesive and sealer material.
3. Carpet tile manufacturer's published instructions for maintenance, care, cleaning and repair of carpet.
4. MSDS on Manufacturers recommended adhesives and primers.

D. Certificate:

1. Submit a certificate from carpet tile manufacturer that materials supplied comply with fire hazard resistance standards specified.
2. Submit a manufacturer certification that the installer is approved by the manufacture to install the specified product.

- E. Installer's Experience Qualifications: Submit list of not less than five projects with similar scope of work, extending over period of not less than five years, indicating installer's experience record.

1.03 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. Manufacturer's installation instructions
 - 2. Comply with current CHPS requirements for low emitting materials, www.chps.net.
 - 3. Chemically based products such as sealers, primers, fillers, adhesives, etc. must be approved by owner's office of the Environmental Health and Safety (OEHS).
 - 4. Carpet tile must be free of Anti-Microbial Protection.
 - 5. Comply with ASTM F1869 for moisture testing.
- B. Requirements of Regulatory Agencies: Carpet tile shall meet requirements of federal, state and local regulatory agencies for flammability, static control, or other properties as specified with testing documentation from the manufacturer by a third party laboratory.
- C. Carpet Tile Installation: Comply with CRI 104 - Standard for Installation of Textile Floor Covering Materials.
- D. Each color of carpet tile shall be of the same dye lot.
- E. Qualifications of Installer: Minimum five years experience in successfully installing the same or similar flooring materials.
- F. Pre-Installation and Progress meetings: Prior to start of work of this section and after approval of submittals, schedule an on site Pre-Installation and progress meetings between Contractor, Supervising Installer, Architect, Owner's Project Manager and Project Inspector to review construction, drawings and installation procedures in accordance with the requirements of this specification.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Full cartons of carpet tile shall be packaged and identified by the flooring manufacturer. Distributor, dealer, or vendor cutting, re-packaging, and re-labeling is not permitted.
- B. Store material at least 48 hours at room temperature prior to installation and in accordance to manufacturer's instructions.
- C. Deliver fire-rated materials with testing agency labels and required fire classification numbers attached and legible.

1.05 JOB CONDITIONS

- A. Ventilation and Temperature: Verify areas to be carpeted are ventilated to remove any off gassing from installation materials, and areas are within temperature range recommended by the various material manufacturers for Project site installation conditions. The temperature of a concrete slab must be stabilized above 65 degrees both 12 hours prior to and after the installation. The following environmental conditions inside the building are critical for proper

installation. Temperature must be between 65 degrees F and 95 degrees F and the humidity between 10 percent and 65 percent for at least 72 hours before and 72 hours after installation. In addition, any adhesives and primers should be stored under these conditions for a minimum of 24 hours prior to installation.

- B. Protection: Prohibit traffic on carpet for at least 12 hours after installation. Cover carpet with heavy non-staining Kraft paper in areas where the Work of other trades is to be performed and traffic and passage areas. Protect carpet from damage or soiling. Maintain protection in place until Substantial Completion.

1.06 WARRANTY

- A. Contractor shall provide a two year installation warranty.

- B. Manufacturer shall provide a 30 year material warranty as described below:

1. Delamination Warranty: Carpet tile will not delaminate for a minimum of 30 years from the date of installation.
2. Zippering Warranty: Carpet tile will not zipper or develop continuous pile yarn runners in the body of the carpet for a minimum of 30 years from the date of Substantial Completion.
3. Edge Ravel: Carpet tile will not have continuous pile yarn coming out at seams for a minimum of 30 years from the date of Substantial Completion.
4. Cup, Dish or Dome Warranty: The manufacturer warrants that the carpet tile will not cup, dish or dome for 30 years from the date of Substantial Completion.
5. Dimensional Stability Warranty: The manufacturer warrants that the carpet tile will not lose its dimensional stability (namely: growth or shrinkage with glue-down installations) for 30 years due to normal variations in atmosphere, temperature, or humidity
6. Wear Warranty: The manufacturer warrants that the carpet tile will lose no more than 10 percent by weight of the pile fiber during the life of the carpet from the date of Substantial Completion.

- C. Manufacturer shall provide a 10 year material warranty for colorfastness and texture retention.

1. Stain and Soil Protection: 10 year stain removal written guaranty.
2. Texture Retention Warranty: The manufacturer warrants that the carpet tile will substantially maintain its physical surface texture against crushing, matting and walking out for 10 years from the date of Substantial Completion.
3. Colorfastness to light: Carpet tile will not fade for 10 years due to exposure to sunlight.
4. Colorfastness to atmospheric contaminants: Carpet tile will not fade for 10 years due to atmospheric contaminants.

1.07 MAINTENANCE

- A. Extra Materials: Provide minimum three cartons of extra materials for each color, pattern, and dye lot of carpet.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new carpet floor tile is based upon Mohawk Group, 160 S. Industrial Blvd, Calhoun, GA 30701, (tel) 800-241-4494. www.mohawkgroup.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
1. Shaw Contract Group, Style: No Rules Collection.
 2. Mannington Commercial, Style: Centerfield III, Everywear III and The Committee Collection.
 3. Or Approved Equal
- B. Adhesives and Primers: As recommended by tile carpeting manufacturer and approved by OEHS.

2.02 MATERIALS

- A. Carpet tile shall meet the following minimum standards:
1. Collection: Optic Resist
 2. Style: Shifted Focus (GT448)
 3. Size: 12 inch x 36 inch
 4. Construction: Tufted
 5. Surface Appearance: Textured Patterned Multi-Colored Loop
 6. Fiber: Duracolor Tricor Premium Nylon
 7. Dye Method: Solution Dyed
 8. Stain Release Technology: Permanent, Built into Fiber
 9. Soil Release Agent: EcoSentry Soil Protection
 10. Backing: Ecoflex One
 11. Pile Weight: 18 oz/yd² (610g/m²)

- 12. Gauge: 1/12 (47.00 rows per 10cm)
- 13. Stitches per Inch: 12.4 (48.8 per 10cm)
- 14. Installation: Glue Down, FlecLok
- 15. Installation Method: Brick Ashlar
- 16. Adhesive: M700 Plus

- B. Carpet tile shall be from one dye lot.
- C. Full cartons of carpet tile shall be cut, packaged, and identified by the factory. Distributors, dealers and vendor cutting, re-packaging, and re-labeling are not permitted.
- F. Leveling Compound: 100 percent cementitious binder type (as defined by ASTM C150), shall be approved by Owner's Office of Environmental Health and Safety (OEHS). The following manufacturers are currently listed as approved by OEHS:
 - 1. Leveling Compound shall meet or exceed 200 pounds when tested in accordance with ASTM 1583.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Before installation is started, examine surfaces to receive carpet tile. Deficiencies shall be corrected before starting Work of this section.
- B. Field verify dimensions and other conditions affecting this Work before commencing carpet tile installation.

3.02 PREPARATION

- A. Provide concrete moisture vapor emission and pH testing to concrete specified to be covered with carpet tile. Includes concrete placed below, on and above grade. For replacement projects, concrete slabs not in direct contact with ground may be excluded from this requirement. Comply with requirements of ASTM F1869.
- B. Testing shall take place after allowing concrete to dry for a minimum of 90 days. Testing to be scheduled no less than one or more than three weeks prior to scheduled flooring installation.
- C. Quantification of Concrete Moisture Vapor Emissions
 - 1. The test site should be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels should be maintained for 48 hours prior and during test period. If meeting this criteria is not possible, then minimum conditions should be 75 plus or minus 10 degrees F and 50 plus or minus 10 percent relative humidity. When a building is not under HVAC control, a recording hygrometer or data logger shall be in place recording conditions during the test period. A transcript of this information must be included with the test report.

2. The number of vapor emission test sites is determined by the square footage of the facility. The minimum number of tests to be placed is equal to three in the first 1,000 square feet and one per each additional 1,000 square feet.
3. Tests sites are to be cleaned of adhesive residue, curing compounds, paints, sealers, floor coverings, etcetera 24 hours prior to the placement of test kits.
4. Weigh test dish on site prior to start of test. Scale must report weight to 0.1 grams. Record weight and start time.
5. Expose Calcium Chloride and set dish on concrete surface.
6. Install test containment dome and allow test to proceed for 72 hours.
7. Retrieve test dish by carefully cutting through containment dome. Close and reseal test dish.
8. Weigh test dish on site recording weight and stop time.
9. Calculate and report results as "pounds of emission per 1,000 square feet per 24 hours".
10. Follow manufacturer's corrective measures accordingly. Moisture vapor emission must meet manufacture's recommendation prior to installation.

D. Quantification of pH Level

1. At each vapor emission test site, after removal of test containment dome, perform pH test.
 - a. Place several drops of water onto the concrete surface to form a puddle approximately 1 inch in diameter.
 - b. Allow the water to set for approximately 60 seconds
 - c. Dip the pH paper into the water and remove immediately, compare color to chart provided by paper supplier to determine pH reading
 - d. Acceptable range is pH5 to pH9. Excessive alkalinity shall be neutralized prior to installation of the carpet tile.
 - e. Record and report results.
 - f. Follow manufacturer's corrective measures accordingly.

E. Preparation of Subfloors: Any leveling compound used over a vapor or moisture barrier will be warranted to be installed in a wet or moist environment without moisture limitations.

1. Delay application of flooring until sub-floors are sufficiently dry according to flooring manufacturer's recommendations, or perform remedial measures as recommended by flooring materials manufacturer.

F. Cleaning and Drying: Clean concrete floor slabs of oil, grease, waxes, curing compounds, dust, dirt, debris, paint, and other deleterious substances. Failure to remove or seal old adhesives or other floor coatings may result in installation failure. Provide a commercial

vacuum cleaner to remove dust and dirt. Do not furnish oiled or chemical treated sawdust or any similar product for dust removal.

- G. Leveling: Verify floor slabs true to level and plane within a tolerance of 3/16 inch in 10-feet. Test floor areas both ways with a 10-foot straightedge and repair high and low areas exceeding allowable tolerance. Pop ups shall be hammered out and floor filled with an approved cementitious leveling compound. Remove high areas by power sanding, stone rubbing or grinding, chipping off and filling with an approved cementitious leveling compound, or equivalent method. Fill low areas with an approved cementitious leveling compound. Repair and level the surfaces having abrupt changes in plane, such as trowel marks or ridges, whether or not within the allowable tolerance. Again clean areas where repairs are performed and prime floor using recommended primer by manufacture. Do not sand, stone rub grind or power chip floor adhesives that contain asbestos.
- H. Conditioning of Materials: Carpet tile and adhesives shall be conditioned at the Project site at not less than 65 degrees F and relative humidity between 10 percent and 65 percent for 48 hours prior to installation and in accordance to manufacturer's instructions.
- I. Floors should be level and sound. Any trowel marks from old adhesives must be sanded smooth, creating a level surface prior to the application of adhesives and primers.

3.03 CARPET TILE INSTALLATION

- A. General: Install carpet tile in accordance with requirements of CRI 104, except where more stringent requirements are specified herein or recommended by carpet materials manufacturers.
- B. Install carpet tiles in each dye lot in the number sequence as furnished by manufacturer. Measure the area to find the best starting point that will utilize a maximum size perimeter tile. After selecting the starting point, snap a chalk line that bisects this point by at right angles. To achieve a perfect angle form a triangle by measuring 6-inch up from the center point. Then measure 8-inch out from the center point. Then, find a 10-inch angle between these two points. (See manufacturers written instructions for complete details).
- C. Color Control: Install dye lot in the number sequence at locations indicated to prevent shading variations. Install only one dye lot for each area of building unless otherwise reviewed. If more than one dye lot is required, obtain prior review of color match between dye lots by Owner and its representative's written approval.
- D. Carpet Tile Fit: Refer to the layout Shop Drawings. The corners of the carpet tiles should be flat to assure a proper fit. Install the carpet tiles snugly. Be careful to not to over tighten the installation.
- E. Laying and Seaming: Cut carpet tiles for seams between rows and prevent damage to loops, prevent edge ravels, and preserve uniform row alignment and spacing on both sides and across seams. Install carpet tiles with loop rows in straight lines both ways, free of offsets, waviness, distortion, or misalignment. Cut seam edges straight and square with backing. Trim carpet tiles at walls, columns, and penetrations for a compressed fit.
- F. Doorways: Extend carpet tiles into doorways without piecing in and seam to the carpet on other side of door under door centerline except where metal thresholds occur; no small filler pieces of carpet tiles will be permitted at doorways.
- G. Adhesive Installation: Provide proper equipment as required by manufacturer. Evenly spread adhesive free of excess or thin areas. Place and lay carpet tile within open time of adhesive.

- H. Binder Bars: Provide bars at edges of carpet tiles not abutting walls or other construction, securely fastened in place by using aluminum drive nails. Precisely align splices and tightly miter angles.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion. Limit rolling traffic on carpet tiles for at least 12 hours after installation. Cover carpet tiles with heavy non-staining Kraft paper in areas where the Work of other trades is to be performed and/or traffic and passage areas. Protect carpet from damage or soiling. Maintain protection in place until Substantial Completion.

3.05 CLEANING

- A. As each carpeted area is completed, clean up dirt and debris, remove spots and soiling with proper cleaner, trim off loose threads with sharp scissors, and vacuum entire area clean.

3.06 CLEAN-UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.07 INSTRUCTION

- A. Before Substantial Completion of the Work, should the district request and at the districts discretion, provide a four hour Owner instruction period for proper maintenance of carpeting. Instructions shall be provided by technical representative of manufacturer.

END OF SECTION 09681

SECTION 09810

ACOUSTICAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Acoustical insulation and sealants.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 07210 - Thermal Insulation.

1.02 SUBMITTALS

- A. Product Data:
 - 1. Provide manufacturer's printed Product Data for each product.
 - 2. Provide manufacturer's printed installation instructions.

1.03 QUALITY ASSURANCE

- A. Fire Ratings: Comply with fire-resistance and flammability ratings specified.
- B. Acoustic Performance: Acoustic Insulation shall be tested in accordance to ASTM C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method, with Type A (#4) mounting.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation from physical damage and from becoming wet or soiled.
- B. Comply with manufacturer's recommendations for handling, storage and protection during installation.

PART 2 - PRODUCTS

2.01 ACOUSTICAL INSULATION

- A. Unfaced Mineral/Glass Fiber Blanket/Batt Acoustical Insulation: Acoustical insulation produced by combining mineral/glass fibers with thermosetting resins to comply with ASTM C665, Type I.
 - 1. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50 when tested in accordance with ASTM E84.
 - 2. Manufacturers: Johns Manville "Sound Control Batts", Owens Corning "Sound Attenuation Batts", Rockwool "Comfortbatt" or approved equal.

3. Thickness: 3-1/2-inch unless otherwise indicated.

2.02 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Concealed Joints: Non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound:
 1. Pecora Corp. "BA-98".
 2. Tremco Inc. "Tremco Acoustical Sealant".
 3. Hilti, Inc. "CP 506".
 4. Or Approved Equal.
- B. Acoustical Sealant for Exposed Joints: Non-oxidizing, skinnable, paintable, gunnable sealant recommended for sealing interior exposed joints to reduce transmission of airborne sound.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's instructions for installation conditions.
- B. Do not install insulation until building is sufficiently enclosed or protected against absorption of moisture by the insulation, and do not install insulation unless supporting framing and construction is in a thoroughly dry condition.
- C. Install snugly between framing members with ends snugly fitted between units and against adjacent construction.
- D. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations.
- E. Where door and window frames occur in framing; cut additional strips of insulation and hand-pack as required to fill voids in and around such frames.
- F. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications and conditions indicated. Install sealants in accordance with manufacturer's instructions.

3.02 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose off of Project site.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 09810

SECTION 09910

PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Unless otherwise directed, paint all exposed surfaces indicated on the drawings and herein.
- B. Related Work:
 - 1. Documents affecting work of this section include, but are not necessarily limited to, Contract, AIA 201, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

- A. Include on Label of Containers:
 - 1. Manufacturer's name;
 - 2. Type of paint;
 - 3. Manufacturer's stock number;
 - 4. Color;
 - 5. Instructions for reducing, where applicable;
 - 6. Label analysis;
 - 7. Federal Specification number
- B. Sampling of Materials:
 - 1. When requested by the A/E, obtain test samples from materials stored at project site or source of supply.
 - 2. Select samples at random from sealed containers.
- C. Fungus Control: Organic coating shall show no fungus growth when tested as specified in Federal Test Method Standard 141, Method 6271.1.
- D. Field Quality Control:
 - 1. Request review of first finished room, space, or item of each color scheme required by A/E for color, texture, and workmanship.
 - 2. Use first acceptable room, space, or item as project standard for each color scheme.
 - 3. For spray application, paint surface not smaller than 100 sq. ft. as project standard.
- E. Paint Coordination:
 - 1. Provide finish coats, which are compatible with the prime coats actually used.
 - 2. Review other sections of these specifications as required verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrata.
 - 3. Upon request, furnish information of the characteristics of the specific finish materials to assure that compatible prime coats are used.
 - 4. Provide barrier coats over noncompatible primers, or remove the primer and re-prime as required.

5. Prior to ordering paint materials, notify the Architect in writing of anticipated problems in using the specified coating systems over prime-coatings supplied under other sections.

1.03 SUBMITTALS:

- A. Color samples;
- B. Manufacturer's literature and recommendations, including flame spread ratings, fuel contribution and smoke density factors, including each wood specimen to be used.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver sealed containers with labels legible and intact.
- B. Store only acceptable project materials on project site.
- C. Store in a suitable location.
- D. Restrict storage to paint materials and related equipment.
- E. Comply with health and fire regulations.
- F. Comply with pertinent other provisions of Section 01640.

1.05 JOB CONDITIONS:

- A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.
- B. Do not apply finish in areas where dust is being generated.
- C. Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not to be painted.
- D. Do not apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperatures are below 45°F, unless otherwise permitted by the manufacturer's printed instructions as approved by the A/E.
- E. Weather Conditions:
 1. Do not apply paint when the relative humidity exceeds 85%; or to damp or wet surfaces, unless otherwise permitted by the manufacturer's printed instructions as approved by the A/E.
- F. This Contractor shall move appliances and such, to paint behind same. Re-install when painting is completed.

1.06 EXTRA STOCK:

- A. Upon completion of the work of this section, deliver to the Owner, as extra stock equaling 1 gallon of each unused color, type, and gloss of paint used in the work, tightly sealing each container, and clearly labeling with contents and location where used.

- B. Each new container shall be clearly marked as to the type of paint or stain, color name (and number), manufacturer's name, and where used. Said containers shall be clean of excessive paint and have airtight covers.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. To establish a level of quality performance characteristics, the paint specified herein is based on Sherwin-Williams. Except as otherwise specified, materials shall be the products of the following manufacturer. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance, style, characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Acceptable manufacturers:
 - 1. Glidden Coatings
 - 2. Pratt & Lambert
 - 3. Benjamin Moore
 - 4. Or approved equal
- B. Materials selected for coating systems for each type surface shall be the product of a single manufacturer, unless otherwise indicated by the A/E.
- C. Where products are proposed other than those specified by name and number in the painting schedule, provide submittals and a new painting schedule compiled in the same format used for the painting schedule in this section.
- D. Undercoats and Thinners:
 - 1. Provide undercoat paint produced by the same manufacturer as the finish coat.
 - 2. Use only the thinners recommended by the paint manufacturer, and use only to the recommended limits.
 - 3. Insofar as practicable, use undercoat, finish coat, and thinner materials as parts of a unified system of paint finish.

2.02 MATERIALS:

- A. Materials shall be delivered to Project site in original unopened manufacturer's packaging clearly labeled with manufacturer's name.
- B. Paint shall be first quality of types and brands herein specified. The term "paint" as used herein includes enamels, primers, epoxy, fillers, transparent coatings, paint emulsions, stains, varnishes, sealers, and other coatings, organic or inorganic, whether used as prime, intermediate finish coats. Paint shall be well ground and shall be of such composition that it can be easily broken up with a paddle to smooth consistency.
- C. Linseed oil, shellac, turpentine and other materials shall be of the highest quality as approved by the A/E.
- D. Tints and all other additives or thinners shall be used only as recommended by the manufacturer of the paint as approved.

2.03 COLORS:

- A. Colors of paints, including stain shades, shall be from manufacturer's standard colors. Architect shall select all colors.

2.04 MIXING AND TINTING:

- A. Deliver paints and enamels ready-mixed to job site.
- B. Accomplish job mixing and job tinting only when acceptable to the A/E.
- C. Mix only in mixing pails placed in suitably sized non-ferrous or oxide-resistant metal pans.
- D. Use tinting colors recommended by manufacturer for the specific type of finish.
- E. Fungicidal agent shall be incorporated into the paint by the manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence, or quality of work and which cannot be put into an acceptable condition through preparatory work as include in Article 3.02 - PREPARATION OF SURFACES.
- B. Do not proceed with surface preparation or coating application until conditions are suitable for timely and proper completion of this section.

3.02 PREPARATION OF SURFACES:

A. General:

1. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's recommendations as approved by the A/E and these Specifications.
2. Remove removable items, which are in place and are not scheduled to receive paint finish, or provide surface-applied protection prior to surface preparation and painting operations.
3. Following completion of painting in each space or area, reinstall the removed items by using workers who are skilled in the necessary trades.
4. Clean each surface to be painted prior to applying paint or surface treatment. ALL SURFACES TO BE PAINTED SHALL BE HAND WASHED WITH NON-SAPONIFYING SOLUTION SUCH AS TSP UNTIL ALL TRACES OF DIRT, OIL, OR GREASE HAVE BEEN REMOVED.
5. Before finishing doors and frames, Contractor shall remove all hardware. Re-install in accordance with door schedule and pertinent drawings.

B. Wood Surfaces:

1. Clean soiled surfaced with alcohol wash.
2. Except where rough interior surface is specified, sand to smooth and even surface, and then vacuum off.

3. Apply specified product to all knots, pitch and resinous sapwood before priming coat is applied.
4. Fill nail holes, cracks, open joints, and other defects with oil based putty after priming coat has dried. Color to match finish color.

C. Gypsum Wallboard and Plaster:

1. Fill narrow, shallow cracks and small holes with spackling compound and/or plaster.
2. Allow to dry; sand smooth.
3. Do not raise nap of paper on wallboard.

D. Concrete and Masonry Surfaces:

1. Fill cracks and irregularities with Portland cement grout to provide uniform surface texture.
2. Etch with 5% solution (by weight) of muriatic acid.
3. Fill concrete masonry unit surfaces with block filler.

E. Ferrous Metal Surfaces:

1. Prepare surface in accordance with recommendations and directions of manufacturer with rust-inhibitive primer.
2. Feather edges of sound paint by grinding, if necessary.

F. Galvanized Metal:

1. Clean surface with mineral spirits to remove oily residue.
2. Dry with clean cloth.

3.03 MATERIALS PREPARATION:

A. General:

1. Mix and prepare paint materials in strict accordance with the manufacturer's recommendations as approved by the A/E.
2. When materials are not in use, store in tightly covered containers.
3. Maintain containers used in storage, mixing, and application of paint, in a clean condition, free from foreign materials residue and extreme temperatures.

B. Stirring:

1. Stir materials before application, producing a mixture of uniform density.
2. Do not stir into the material any film, which may form on the surface, but remove the film and, if necessary, strain the material before using.

3.04 PAINT APPLICATION:

A. General:

1. Touch-up shop-applied prime coats which have been damaged, and touch-up bare areas prior to start of finish coats application.
2. Slightly vary the color of succeeding coats.
 - a.) Do not apply additional coats until the completed coat has been inspected and approved.
 - b.) Only the inspected and approved coats of paint will be considered in determining the number of coats applied.

B. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer - Test with moisture meter.

C. Apply paint, stain and varnish with suitable brushes, rollers or spraying equipment.

1. Rate of application shall not exceed that as recommended by paint manufacturer for the surface involved, less 10 percent.
2. Keep brushes, rollers, and spraying equipment clean, dry, free of contaminates and suitable for the finish required.
3. Comply with recommendations of product manufacturer for drying time between succeeding coats.
4. Sand and dust between each coat to remove defects visible from a distance of 5 feet.
5. Finish coats shall be smooth, free of brush marks, streaks, laps, or pile-up of paints, and skipped or missed areas.
6. Removable panels and hinged panels: Paint the back sides to match the exposed sides.
7. Paint both sides and all 4 edges of all doors.
8. Contractor shall be responsible for following manufacturer's written instructions and warnings for all products specified or substitutes herein.

D. Deleted.

E. Leave all parts of moldings and ornamental work clean and true to detail with no undue amount of paint in corners and depressions.

F. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

G. Apply primer on all work before glazing.

H. Refinish whole wall where portion of finish has been damaged or is not acceptable.

I. Back prime all interior and exterior trim.

J. Runs on face are not permitted.

K. Wet Areas:

1. Add an approved fungicide to paints.

2. For oil base paints, use 1% phenolmercuric or 4% tetrachlorophenol.
 3. For water emulsion and glue size surfaces, use 4% sodium tetrachlorophenate.
- L. For completed work, match the approved samples as to texture, color, and coverage. Remove, refinish, or repaint work not in compliance with the specified requirements.
- M. Miscellaneous Surfaces and Procedures:
1. Exposed Mechanical Items:
 - a) Paint electric panels, access doors, conduits, pipes, ducts, grills, registers, vents, and items of similar nature to match the adjacent wall and ceiling surfaces or as directed by the Architect.
 - b) Wash metal with solvent, prime, and apply two coats of the specified paint in accordance with the applicable paint schedule item, herein.

3.05 PAINT DRYING:

- A. Allow sufficient drying time between coats, modifying the period as recommended by the materials manufacturer to suit adverse weather conditions.
- B. Consider oil-base and oleo-resinous solvent-type paint as dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and when the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

3.06 APPLICATION EQUIPMENT:

- A. For application of the approved paint, use only such equipment as is recommended for application of the particular paint by the manufacturer of the particular paint, and as approved by the A/E.
- B. Prior to use of application equipment, verify that the proposed equipment is actually compatible with the materials to be applied, and that the integrity of the finish will not be jeopardized by the use of the proposed equipment.
- C. Brush Applications:
1. Brush out and work the base coats onto the surface in an even film.
 2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, and other surface imperfections will not be acceptable.
- D. Spray Application:
1. Except as specifically otherwise approved by the A/E, confine spray application to metal framework and similar surfaces where hand brush work would be inferior.
 2. Where spray application is used, apply each coat to provide the hiding equivalent of brush coats.
 3. Do not double back with spray equipment to build up film thickness of two coats in one pass.
- E. Roller Application:
1. Rollers may be used on large wall and ceiling surfaces. Keep walls free of roller marks.

3.07 CLEANING:

- A. Touch up and restore finish where damaged.
- B. Remove spilled, splashed, or splattered paint from all surfaces.
- C. Do not mar surface finish of item being cleaned.
- D. Leave storage space clean and in condition required for equivalent spaces in project
- E. Cleaning up process shall proceed with progress of work.

3.08 PAINTING SCHEDULE:

A. Surfaces not to be painted:

- 1. Pre-finished wall, suspended acoustical tile ceiling system, and floor coverings, unless otherwise indicated.
- 2. Items with factory-applied final finish unless otherwise noted.
- 3. Concealed ducts, pipes, and conduits unless otherwise noted.
- 4. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, lead-coated copper, bronze, and similar finished materials will not require painting under this section except as may be so specified.
- 5. Do not paint over required labels or equipment identification performance rating, name, or nomenclature plates.

B. Areas shall be painted as indicated, as directed, and as approved. The kinds of painting materials and number of coats required on various surfaces shall be as indicated in the following schedule. **Certain portions of the Paint Schedule below may not apply to this project.**

NUMBER OF COATS INDICATED HEREINAFTER ARE MINIMUM. COMPLETE COVERAGE IS REQUIRED. PROVIDE ADDITIONAL COATS TO AREAS WHICH DO NOT SHOW COMPLETE COVERAGE WITH SPECIFIED COATS. REFER TO ROOM FINISH AND COLOR SCHEDULE ON DRAWINGS FOR LOCATIONS OF THE FOLLOWING PRODUCTS:

1. New Gypsum Board Ceilings:

- 1st coat: Gypsum Sherwin-Williams ProMar 200 Zero V.O.C. Latex Primer B28 (gypsum board)
- 2nd coat: Sherwin-Williams ProMar Ceiling Paint A27W05050 Series
- 3rd coat: Sherwin-Williams ProMar Ceiling Paint A27W05050 Series

2. New Gypsum Board Walls:

- 1st coat: Gypsum Sherwin-Williams ProMar 200 Zero V.O.C. Latex Primer
- (2) coats: Sherwin-Williams ProMar 200 HP Zero VOC Latex Egg-Shell Finish
Color: SW7064 Passive

3. Interior Priming: (at stains)

Apply coats as required, Sherwin-Williams White Pigmented Shellac Primer

NOTE: All surfaces shall be spot primed as necessary so as to prevent stains from "bleeding" through new paint finish.

4. Interior Painted Metal Doors and Frames:

- 1st coat: Sherwin Williams Pro Cryl Primer B66 Series
- 2nd coat: Sherwin Williams Pro Industrial Waterbased Alkyd Urethane Enamel B53 Series
- 3rd coat: Sherwin Williams Pro Industrial Waterbased Alkyd Urethane Enamel B53
Color: To be selected by Owner from manufacturer standard colors.

5. Exposed Fire Sprinkler Protection System Piping, Hangers, Hanger Rods, Fittings, Etc.:

- 1st coat: Cleaner Manufacturer: Sherwin Williams "ProClean" or "TSP".
Spray-on, thoroughly wipe clean with damp sponge or cloth. In heavily soiled location, rinse with water after wiping. Comply completely with other recommendations of the manufacturer.
- 2nd Coat: Apply (1)-coat Sherwin Williams Pro Cryl Primer B66
- 3rd Coat: Apply (2)-coats Sherwin Williams "DTM" Acrylic Coating: Semi-gloss:
Color shall be selected by the Architect from manufacturer standard colors.

NOTE: Comply fully with the painting procedures specified on the drawings

6. New Interior Wood Doors :

- 1st coat: Sherwin Williams Emerald Interior Acrylic Latex Paint
- 2nd coat: Sherwin Williams Emerald Interior Acrylic Latex Paint
Color shall be selected by the Owner from manufacturer standard colors.

3.09 OTHER SURFACES:

- A. Surfaces for which the type of paint has not been specified shall be painted as specified for surfaces having similar conditions of exposure.

END OF SECTION 09910

SECTION 09971

WATERPROOF WALL PANELS

PART 1 - GENERAL

1.1 SCOPE

- A. Provide waterproof wall panels where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.2 REFERENCE

- A. ASTM D570 – Test Method for Water Absorption of Plastics.
- B. ASTM D2240 – Test Method for Rubber Property – Durometer Hardness.
- C. ASTM E84 – Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

- A. Standards:
 - 1. Comply with USDA Criteria for incidental food contact and ASTM E84, Class C, for surface burning characteristics of flame spread less than 200 and smoke density less than 450.
 - 2. Comply with ASTM D570 and ASTM D2240.
- B. Use of adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for performance of the Work of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Comply with the recommendations and instructions of the Manufacturer.

PART 2 - PRODUCTS

- A. To establish a level of quality and performance characteristics desired the specified new fiber reinforced panels base is based upon Marlite, 202 Harger Street, Dover, OH. 44622. (tel) 330-343-6621 or approved equal. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. Waterloo Paneling
 - 2. Interstate Plastics
 - 3. Or approved equal

2.2 WALL PANELS

A. Marlite FRP (Fiber Reinforced Panels) Panels:

1. Size: 4' – 0" x 8' – 0".
2. Sheet Thickness: 3/32 nominal.
3. Color: P100 White.
4. Finish Texture: Pebble Surface.

2.3 OTHER MATERIALS

- A. Trim: Matching Marlite molding trim as supplied by panel manufacturer for outside/inside corners, vertical joints, openings, outside angles, end caps, and ceiling intersections; all trim accessories required to ensure a complete and proper job.
- B. Fasteners: Manufacturer's standard rivets.
- C. Adhesive: Non-flammable adhesive as recommended by the manufacturer for substrate encountered.
- D. Sealant: As recommended by panel manufacturer.
- E. Provide other materials, not specifically described, but required for a complete and proper installation, as selected by the Contractor, subject to the approval of the Architect.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Installation of panels shall be in strict accordance with the manufacturer's recommendations.
- B. Promptly, upon completion of installation, clean all exposed surfaces with methods and materials recommended by the manufacturer of the panels.

END OF SECTION 09971

SECTION 10211

SOLID PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid plastic toilet compartments including the following: (Eclipse)
 - 1. Floor mounted overhead-braced toilet compartments.
 - 2. Wall mounted urinal screens.

1.2 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry.

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM B 85 - Standard Specification for Aluminum-Alloy Die Castings.
 - 3. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- B. National Fire Protection Association (NFPA) 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- C. United States Green Building Council (USGBC): LEED Green Building Rating System.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Provide layout drawings and installation details with location and type of hardware required.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.
- F. Sustainable Design Submittals:
 - 1. Recycled Content: Certify percentages of post-consumer and pre-consumer recycled content.

2. Regional Materials: Certify distance in miles between manufacturer and Project and between manufacturer and extraction or harvest point.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company regularly engaged in manufacture of products specified in this section, and whose products have been in satisfactory use under similar service conditions for not less than 5 years.
- B. Installer Qualifications: A company regularly engaged in installation of products specified in this Section, with a minimum of 5 years experience.
- C. Performance Requirements:
 1. Fire Resistance: Partition materials shall comply with the following requirements, when tested in accordance with the ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials:
 - a. Class B flame spread/smoke developed rating, tested to ASTM E84.
 2. Material Fire Ratings:
 - a. National Fire Protection Association (NFPA) 286: Pass.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

- A. Manufacturer guarantees its plastic against breakage, corrosion, and delamination under normal conditions for 25 years from the date of receipt by the customer. If materials are found to be defective during that period for reasons listed above, the materials will be replaced free of charge. (Labor not included in warranty.)

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new solid plastic toilet compartments is based upon Scranton Products, which is located at: 801 E. Corey St.; Scranton, PA 18505; Toll Free Tel: 800-445-5148; Fax: 855-376-6161; Email: request info (info@scrantonproducts.com); Web: <http://www.scrantonproducts.com>. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 1. One Point Partition
 2. Hadrian Inc.
 3. Or Approved Equal

2.2 MATERIAL

- A. Plastic Panels: High density polyethylene (HDPE) suitable for exposed applications, waterproof, non-absorbent, and graffiti-resistant textured surface;
 - 1. Fire-resistance Rating: Tested in Accordance with NFPA 286.
 - 2. Fire-resistance Rating: Tested to meet ASTM E84, Class B.
 - 3. Standard Collection, Does not meet NFPA 286 or ASTM E84
 - 4. Recycled Content (Post Industrial): 25 percent.
- B. Aluminum Extrusions: ASTM B221, 6463-T5 alloy and temper.
- C. Aluminum Die Castings: ASTM B85, A380 alloy.
- D. Stainless Steel Castings: ASTM A167, Type 304.
- E. Rubber: Abrasion resistant Styrene Butadiene Rubber, 65 to 80 Shore A durometer, black.

2.3 SOLID PLASTIC TOILET COMPARTMENTS AND SCREENS

- A. Basis of Design: Eclipse Toilet Partitions as manufactured by and supplied by Scranton Products.
 - 1. Style: Floor mounted overhead-braced toilet compartments.
- B. Doors and Panels: High density polyethylene (HDPE), fabricated from SEQ CHAPTER 1 extruded polymer resins, forming single thickness panel.
 - 1. Waterproof and nonabsorbent, with self-lubricating surface, resistant to marks by pens, pencils, markers, and other writing instruments.
 - 2. Thickness: 1 inch (25 mm).
 - 3. Edges: Shiplap.
 - 4. Panel Color: To be selected by Owner and Architect from manufacturer's standard color and finishes.
- C. Doors and Dividing Panels:
 - 1. High Privacy:
 - a. Height: 62 inches (1575 mm) high and mounted at 8 to 14 inches (203 to 356 mm) above the finished floor.
- D. Metal Posts: 82.75 inches (2102 mm) high, heavy duty extruded aluminum, clear anodized finish, fastened to foot with stainless steel tamper resistant screw.
- E. Hidden Shoe (Foot): One-piece molded polyethylene invisible shoe inserted into metal post and secured to metal post with stainless steel tamper resistant screw.
- F. Headrail Cap and Corner Cap: One-piece molded polyethylene secured to metal post with stainless steel tamper resistant screw; adjustable to level headrail to finished floor.
- G. Wall Brackets: Continuous heavy duty extruded aluminum, clear anodized finish, inserted into slotted panel and fastened to panels with stainless steel tamper resistant screws.
 - 1. Type: Double ear bracket aluminum.
 - 2. Length: 61 inches (1550 mm).
- H. Headrail: Heavy duty extruded aluminum, designer anti-grip design, clear anodized finish, fastened to headrail bracket with stainless steel tamper resistant screw and to headrail cap or corner cap with stainless steel tamper resistant screw.
 - 1. Headrail Brackets: Heavy duty extruded aluminum, clear anodized finish, secured to wall with stainless steel tamper screws.

- I. Door Hardware:
 - 1. Hinges:
 - a. Edge-mounted helix style stainless steel continuous hinge.
 - 1) Closing degree: 5 degrees.
 - 2) Comes to a full close on its own weight
 - 2. Occupancy Indicator Latch and Housing:
 - a. Material: Satin stainless steel.
 - b. Occupancy indicators: Green for occupied and red not occupied.
 - c. Slide bolt and button.
 - 3. Coat Hook and Door Bumper Combination:
 - a. Material: Clear Anodized Aluminum
 - b. Handicap Door: Equip with second door pull and door stop.
 - 4. Door Pulls: Clear Anodized Aluminum

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Examine areas to receive toilet partitions, screens, and shower compartments for correct height and spacing of anchorage/blocking and plumbing fixtures that affect installation of partitions. Report discrepancies to the Architect.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Install partitions rigid, straight, plumb, and level.
- C. Locate bottom edge of doors and panels 14 inches above finished floor.
- D. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 3/8 inch.
- E. No evidence of cutting, drilling, and/or patching shall be visible on the finished work.
- F. Finished surfaces shall be cleaned after installation and be left free of imperfections.

3.4 ADJUSTING

- A. Adjust doors and latches to operate correctly.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 10211

SECTION 10222

OPERABLE PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Manually operated, individual panel operable partitions.

- B. Related Sections include the following:

- 1. Division 03 Sections for concrete tolerances required.
 - 2. Division 09 Sections for wall and ceiling framing at head and jambs.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report upon request.
- C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
- D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.
- E. Indoor Air Quality: Operable partition, movable wall manufacturer's non-wood products must meet the SCS Indoor Advantage™ Gold Certification or equivalent. This approval guarantees conformance to indoor air concentrations meeting Indoor Advantage Gold Indoor Air Quality Certified to SCS-105 v4.2-2023 Conforms to ANSI/BIFMA M7.1 and X7.1 and the CDPH/EHLB Standard Method (CA 01350) v1.2-2017 conducted in an independent third-party air quality testing laboratory.

1.4 REFERENCE STANDARDS

- A. ASTM International

- 1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
 - 2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

3. ASTM C1036 - Standard Specification for Flat Glass.
4. ASTM C1048 - Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
5. ASTM E84 - Surface Burning Characteristics of Building Materials.
6. ASTM E413 - Classification for Rating Sound Insulation
7. Health Product Declaration Collaborative

B. Health Product Declaration Open Standard v2.1

C. International Standards Organization

1. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).
2. ISO 14025:2011-10, Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures.
3. ISO 14040:2009-11, Environmental Management - Life Cycle Assessment - Principles and Framework.
4. ISO 14044:2006-10, Environmental Management - Life Cycle Assessment - Requirements and Guidelines.
5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services.

D. Other Standards

1. ADA – Americans with Disabilities Act.
2. ANSI Z97.1 - Safety Glazing Materials Used in Buildings.
3. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
4. NEMA LD3 - High Pressure Decorative Laminates.

1.5 SUBMITTALS

- A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
- B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
- C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
- D. Samples: Color samples demonstrating full range of finishes available to the Architect. Verification samples will be available in same thickness and material indicated for the work.

- E. Reports: Provide a complete and unedited written sound test report indicating test specimen matches product as submitted.
- F. Create spaces that are healthy for occupants.
 - 1. Furnish products and materials with Health Product Declaration (HPD), Manufacturer Inventory, or other material health disclosure documentation. Products without an HPD or other disclosure documentation are not acceptable.
- G. Buy American: Operable partition to be manufactured in the United States in compliance with applicable U.S. Federal Trade Commission (FTC) and U.S. Customs Service and Border Protections regulations and be labeled "Made in America".

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
- B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.7 WARRANTY

- A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
- B. Warranty period: Two (2) years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATION

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified new operational partitions is based upon Modernfold, Inc., Acousti-Seal Legacy. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. Kwik-Wall Company
 - 2. Or Approved Equal
- B. Panels to be manufactured in the U.S.A.

2.2 OPERATION

- A. Acousti-Seal Legacy – Single Panel (931): Series of individual flat panels, manually operated, top supported with operable floor seals.
- B. Final Closure:
 - 1. Horizontally expanding panel edge with removable crank.
 - 2. Dual horizontally expanding panel edges with removable crank.

3. Hinged panel closure.

4. Enclose.

2.3 PANEL CONSTRUCTION

A. Nominal 3-inch thick panels in manufacturer's standard 48-inch widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.

B. Panel Skin Options:

1. Roll-formed 21-gage steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction:

a. 50 STC

C. Hinges for Closure Panels, Pass Doors, and Pocket Doors shall be:

1. Full leaf butt hinges, attached directly to panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.

2. Concealed laminated hinge with antifriction segments mounted between each heat-treated link. Hinge to be attached directly to panel frame. Welded internal hinge bracket shall support the hinge and allow for adjustment of hinge plates. Concealed hinges mounted into edge or vertical astragal are not acceptable (available on steel skin panel only).

D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.

E. Panel Weights:

1. 50 STC - 8 lbs./square foot

2.4 PANEL FINISHES

A. Panel face finish shall be:

1. Reinforced vinyl with woven backing weighing not less than 20 ounces per lineal yard.

2. Reinforced heavy-duty vinyl with woven backing weighing not less than 30 ounces per lineal yard.

3. Acoustical, non-woven needle punch carpet, with fused fibers to prevent unraveling or fray of material.

4. Wall covering and upholstery fabric with surface treatment to resist stains.

5. Customer's own material (subject to factory approval).

6. Full height steel markerboard work surface.

7. Uncovered for field finishing.

8. Primed for field finishing.

B. Panel trim: No exposed panel trim required or allowed; seals and hardware to be of one color.

1. To be selected from manufacturer's standard colors.

2.5 SOUND SEALS

A. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.

B. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.

C. Horizontal Bottom Seals:

1. SM2 - Manually activated seals providing nominal 2-inch operating clearance with an operating range of +1/2-inch to -1-1/2-inch. Seal shall be operable from panel edge or face. Extended seal shall exert nominal 120 pounds downward force to the floor throughout operating range.

2.6 SUSPENSION SYSTEM

A. Modernfold Truss System: Prefabricated, self-supporting header system for the support of operable partitions. (For complete specification see Modernfold Truss System brochure Form #2600)

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings, and approved Shop Drawings.

B. Install operable partitions and accessories after other finishing operations, including painting have been completed.

C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION

- A. Demonstrate proper operation and maintenance procedures to Owner's representative.
- B. Provide Operation and Maintenance Manual to Owner's representative.

END OF SECTION 10222

SECTION 10261
CORNER GUARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Corner Guards Polycarbonate - Surface Mount.

B. Related Requirements:

1. Drawings and general provisions of the Contract, AIA 201, and Division 01 Specification Sections, apply to this Section
2. Section 01350 - Submittal Procedures: For administrative and procedural requirements for processing of submittals during the construction phase.
3. Section 01780 – Project Closeout: For administrative and procedural requirements for completion of the Work.

1.02 ACTION SUBMITTALS

A. Submit in accordance with Section 01330.

1. Product Data:
 - a. Materials description for corner guards including details showing mounting type, relationships to surrounding construction, materials, and construction.
 - b. Installation instructions for each product specified.
2. Shop Drawing: Submit shop drawings showing components, dimensions, anchorage details.
3. Samples: Submit for approval 12 inch long sample for each model specified.

1.04 QUALITY ASSURANCE

- A. Provide corner guards produced by a single manufacturer.**

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle corner guards using means and methods that will prevent damage, deterioration, or loss.**
1. Deliver units in manufacturer's original packaging, properly labeled for identification.
 2. Store materials indoors in a clean, dry area protected from damage and in accordance with manufacturer's instructions.

3. Protect materials during handling and installation to prevent damage.

PART 2 – PRODUCTS

2.01 CORNER GUARD MANUFACTURERS

- A. Acceptable Manufacturers: Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new corner guards is based upon JL Industries a Division of Activar Construction Products Group, Inc., 9702 Newton Ave S., Bloomington, MN 55431, (800) 554-6077, www.activarcpg.com . Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 1. Cape Cod Systems.
 2. Or approved equal

2.02 SURFACE MOUNT CORNER GUARD

- A. STYLE CGL CORNERGUARD
 1. Model No.: CGL corner guard. LEXAN
 2. Material: .102-inch clear Lexan polycarbonate
 3. Dimensions:
 - a. Angle 90 degrees
 - a. Wing width: 2.5 inches
 - b. Height: 4 feet maximum.
 4. Fasteners: Standard screw included.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. Notify the Contractor in writing of conditions detrimental to proper and timely completion of the installation.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Comply with manufacturer's written instructions for installing corner guards to wall securely.

- B. Install corner guards accurately in location, alignment, and elevation.

3.03 CLEANING

A damp cloth removes most dirt and stains. For more stubborn stains, a good household solvent will suffice. Do not use an abrasive cleaner or steel wool.

END OF SECTION 10261

SECTION 10440
INTERIOR SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide interior signage at all Rooms and in locations as shown on the drawings.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- C. Schedule: Submit a schedule of all interior signage for review and approval.

1.03 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Manufacturers: Andco Industries Corp., ASI Sign Systems, The Supersine Co., Vomar Products, or approved equal.
- B. Interior Wall Mount Room Signage:
 - 1. Type: Unframed.
 - 2. Material: PVC and Vinyl
 - 3. Panel Depth: 0.25 inch thickness
 - 4. Attachable Backplate panel depth: 0.125 inch
 - 5. Panel Appearance: To be determined based on manufacturer's standard, high contract, semi-matte color chart
 - 6. Surface Texture: Matte Non-Glare
 - 7. Sign size: (Min.) 10 inches x (Min.) 8 inches
 - 8. Copy: Applied die-cut vinyl lettering.
 - 9. Lettering: To be determined from manufacturer's standard letter styles and color charts
 - 10. Braille: Provide Grade 2 Braille Dor Configuration, with rounded or domed shape, meeting local accessibility codes.
 - 11. Accessories: Provide required standoff wall supports (min. of one per corner). Finish to be selected by Owner/Architect from Manufacturers standard finishes. Basis of design is to be based on
 - a. Finish: satin nickel finish.
 - b. Diameter: 5/8 inch
 - c. Finish Depth: 1/8 inch
 - 12. Style/Design:
 - a. Shape: Rectangular with Square corners

Note: General Contractor to coordinate an initial design consultation with the Owner and Architect. Shop drawings are to be submitted for review and approval following that meeting.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION 10440

SECTION 10441
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, fire extinguishers and mounting brackets for fire extinguishers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Failure of hydrostatic test in accordance with NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
 - b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each and mounting bracket indicated.
 1. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified fire extinguishers is based upon Activar Construction Products Group, Inc. - JL Industries. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - a. Amerex Corporation.
 - b. Ansul by Johnson Controls Company.
 - c. Buckeye Fire Equipment Company.
 - d. Or approved equal
 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Regular Dry-Chemical Type in Steel Container: G0.3 UL-rated 10-B:C, 10-lb nominal capacity, with siliconized sodium bicarbonate-based dry chemical in enameled-steel container.
 1. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified fire extinguisher is based upon JL Industries; Galaxy 10 extinguisher Model FG10. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance.
- C. Multipurpose Dry-Chemical Type in Steel Container G0.3 UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
 1. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified fire extinguisher is based upon JL Industries; Galaxy 6 extinguisher Model FE6. Alternate manufacturers may be considered, but are subject to compliance with the requirements

specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance.

- D. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 - 1. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified fire extinguisher mounting bracket is based upon Activar Construction Products Group, Inc. - JL Industries. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - a. Amerex Corporation.
 - b. Ansul by Johnson Controls Company.
 - c. Buckeye Fire Equipment Company.
 - d. Or approved equal.
 - 2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- E. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Horizontal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: Top of fire extinguisher to be at 42 inches above finished floor.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10441

SECTION 10524
DATA AND STORAGE KEY CABINETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Surface Mount Key Storage Cabinet.
- B. Related Requirements:
 - 1. Drawings and general provisions of the Contract, AIA 201 and Division 01 Specification Sections, apply to this Section
 - 2. Section 01350 - Submittal Procedures: For administrative and procedural requirements for processing of submittals during the construction phase.
 - 3. Section 01780 – Project Closeout: For administrative and procedural requirements for completion of the Work.

1.02 ACTION SUBMITTALS

- A. Submit in accordance with Section 01330.
 - 1. Product Data:
 - a. Materials description for corner guards including details showing mounting type, relationships to surrounding construction, materials, and construction.
 - b. Installation instructions for each product specified.

1.04 QUALITY ASSURANCE

- A. Provide key storage cabinet constructed by a single manufacturer and all required components.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle corner guards using means and methods that will prevent damage, deterioration, or loss.
 - 1. Deliver units in manufacturer's original packaging, properly labeled for identification.
 - 2. Store materials indoors in a clean, dry area protected from damage and in accordance with manufacturer's instructions.
 - 3. Protect materials during handling and installation to prevent damage.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new key storage cabinet is based upon The Knox Company, 1601 W. Deer Valley Road, Phoenix, AZ 85027, 800-566-9269, info@knoxbox.com, model 3200. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
1. Or approved equal

2.02 KEY STORAGE CABINET

- A. KnoxBox 3200
1. Model No.: KnowBox 3200
 2. Material: .1/4" plate steel housing, 1/2" thick steel door with interior gasket seal and stainless steel door hinge. Box and lock UL Listed,
 3. Dimensions: 4" H x 5" W x 3-7/8" D
 4. Fasteners: Standard screw included.
 5. Color: Black
 6. Mounting: Surface

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Review substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.02 INSTALLATION

- A. General: Conform to manufacturer's written instructions for installing key storage cabinet to insulated metal wall panel securely.
- B. Provide all required accessories required to provide a complete and proper installation.

END OF SECTION 10524

SECTION 10570

WARDROBE AND CLOSET SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide labor, materials and equipment necessary to complete the work of this Section for the following areas and as indicated on the Drawings:
 - 1. Work Spaces: Office storage, craft room.
 - 2. Related Rooms: Small space storage, closets
- B. Related Work:
 - 1. Documents affecting work of this Section, but are not necessarily limited to the Contract, AIA 201, and Sections in Division 1 of these Specifications.
 - 2. Section 06100 - Rough Carpentry for furring, blocking, and other carpentry work not exposed to view.
 - 3. Section 09290 - Gypsum Board for gypsum board work including coordination of location of blocking and framing.

1.02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
- B. Contractor shall field verify all conditions and dimensions before ordering all accessories and components.

1.03 SUBMITTALS:

- A. Comply with pertinent portions of Section 01300.
- B. Samples for Verification: Representative samples of actual finishes and colors proposed for use.
- C. Shop Drawings: Submit project-specific shop drawings indicating plans, elevations, sections, attachment details, and relationship with adjacent construction, to include walls, floors and ceilings.
 - 1. Submit to Architect for review, within ten (10) days after Award of Contract.
- D. Product Data: Indicate product description, fabrication information and compliance with specified performance requirements.

1.05 QUALITY ASSURANCE:

- A. Manufacturer: Minimum ten years manufacturing closet and wardrobe specialties.
- B. Installer: Trained installers, journeymen, and masters as acceptable to manufacturer.

- C. Coordination: Coordinate with locations of items that may interfere with installation and operation such as lighting, HVAC, speakers, sprinklers, access panels, electrical switches, electrical outlets, flooring and floor obstacles.
- D. Field Measurements: Field verify dimensions of existing conditions to the greatest extent practical prior to fabrication.
- E. Field Conditions: Do not deliver the Work of this Section until spaces are enclosed and weathertight, wet work is complete and dry, and temporary heating system is operational.
- F. Pre-Installation Conference: Prior to the installation of any closet or wardrobe specialties, the Contractor shall conduct a pre-installation conference with the Owner's representative, Architect and Installer at the project site to examine all locations where the product is to be installed. Discrepancies or site deficiencies shall be noted during this conference and shall be addressed either during or shortly after the conference so as to not delay the project. Include the following topics:
 - 1. Schedule, including anticipated start and end dates.
 - 2. Responsibilities for correcting defects in existing construction.
 - 3. Provisions for handling materials on site and delivery to installation location.
 - 4. Allowable hours of work.
 - 5. Provisions for trash removal.
 - 6. Protection of work after installation.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Comply with pertinent portions of Section 01600.
- B. Deliver no components to the project site until areas are ready for installation. Store indoors.
- C. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.
- D. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- E. Storage and Handling: Comply with manufacturer's recommendations for storage and handling, including temperature recommendations.

1.07 WARRANTY

- A. Warranty: Provide manufacturer's standard limited lifetime warranty against defects in manufacturing or workmanship.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. To establish a level of quality and performance characteristics for the new shelving system, the desired is based upon California Closet Company, Inc., 1414 Harbour Way S., Richmond, CA 94804. Toll Free 855-336-9590. www.californiaclosets.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance, style, characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available

manufacturers offering products that may be incorporated into the Work include one of the following:

1. Organized Living
2. Or Approved Equal

2.02 CLOSET AND WARDROBE ACCESSORIES AND COMPONENTS

- A. Configuration: Provide the following accessories and components as applicable to the Project. Refer also to the Drawings.

2.03 MATERIALS

- A. Medium Density Fiberboard (MDF): ANSI A208.2, manufacturer's standard grade, complies with CARB Phase 2 formaldehyde emissions standards in CCR93120.0(a).
- B. Metals and Hardware: Corrosion-resistant steel structural elements, plated steel functional elements, aluminum accessory elements (aluminum finished in collection finishes).
- C. Fasteners and Anchors: Corrosion-resistant concealed screws, cam/dowel fasteners, pin nails and wall anchors as applicable.

2.04 FABRICATION

- A. Fabricate components at the manufacturing facility to the greatest extent practical, to minimize cutting and fitting at the site.
- B. Provide packaging which will fit through openings along the pathway to the final place of installation.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine existing conditions prior to installation for compliance with requirements for proper installation. Notify Architect in writing if unsatisfactory conditions are encountered. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install closet specialties in accordance with manufacturer's recommendations and approved submittals.
 1. Install level, plumb, square, rigid, and true.
 2. Install in proper relationship with adjacent construction.
 3. Scribe countertops to within 1/32 inch tolerance to adjacent materials.
 4. Install with proper support elements.
 5. Verify the following:
 - i. No core materials are exposed.
 - ii. Functional components operate smoothly as intended.
 - iii. Accessory components are secured in position as intended.
 - iv. Operable parts operate smoothly.

- B. After initial installation, prepare a punch-list of items not completed and items requiring touch-up.
 - 1. Complete punch-list items.
 - 2. Replace defective parts identified during installation that were not deliverable during the course of the installation.
 - 3. Replace any items that cannot be repaired to meet manufacturer's quality control criteria.

3.03 CLEANING AND TOUCH-UP

- A. Cleaning: Fully clean units after installation.
 - a. Wipe down surfaces using a general surface cleaner.
 - b. Remove glue residue from manufacturing using acceptable solvent and rinse solvent from surfaces.
 - c. Clean glass using glass cleaner.
 - d. Clean other surfaces using appropriate cleaners based on manufacturer's recommendation.
- B. Finishes: Touch up marred finishes or surface defects with manufacturer's recommended materials:
 - a. Use color-matched marker for small surface and edge chips less than 1mm size.
- C. Fasteners: Touch up fastener locations.
 - a. Use cover cap created from color-matched edge-banding material for screws.
 - b. Ensure that cover cap inset to sits flush in board material.
- D. Seamed Locations: Touch up seamed locations with color matched wax crayon or seam fill material.
- E. Excess Material: Remove excess materials from touch-up.

END OF SECTION 10570

SECTION 10800

TOILET ROOM ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide Toilet Room accessories where indicated on the drawings where specified herein, and as needed for a complete and proper installation.
- B. Related Work:
 - 1. Documents affecting work of this Section, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
- B. Contractor shall field verify all conditions and dimensions before ordering all bathroom accessories.

1.03 SUBMITTALS:

- A. Comply with pertinent portions of Section 01300.
- B. Shop Drawings: Indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.
 - 1. Submit to Architect for review, within ten (10) days after Award of Contract.
- C. Product Data: Indicate product description, fabrication information and compliance with specified performance requirements.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Comply with pertinent portions of Section 01600.
- B. Deliver no components to the project site until areas are ready for installation. Store indoors.
- C. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. To establish a level of quality and performance characteristics the desired specified toilet room accessories is based upon Bobrick Washroom Equipment, Inc. in the sizes and configurations indicated on the drawings. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to

performance, style, characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

1. Bradley Corporation
2. American Specialties
3. Or Approved Equal

2.02 TOILET ROOM ACCESSORIES

A. G.B. (satin finish concealed mounted grab bar)

1. Model No.: B-6806
2. Size: 1-1/2" diameter × 18", 36" and 42" long
3. Mount: 35" from floor to center of horizontal, or as shown on the drawings
4. Finish: Satin with peened gripping surface

B. T.P.H. (toilet paper holder)

1. Model: B-265
2. Size: 12-1/4" W, 2-3/4" H
3. Finish: Bright polished stainless steel

E. S.N.D. (Feminine sanitary napkin disposal with utility shelf):

1. Model No. B-270
2. Size: 7 1/2" W, 10" H, 3 13/16" D
3. Mount: 6" above top of water basin or flush valve (center on water closet).
4. Finish: Satin-Finish Stainless Steel

F. S.D. (surface-mounted soap dispenser):

1. Model No. B-2013
2. Size: 4 1/4" W, 9-9/16" H
3. Mount: See drawings
4. Finish: Satin

G. H.S.D. (surface mounted hand sanitizer dispenser):

1. Model No. B-2013
2. Size: 4-3/16" W, 9-9/16" H
3. Mount: See drawings
4. Finish: Satin

H. W.F.M. (welded frame mirror):

1. Model No. B-290
2. Size: 24" wide × 36" high
3. Mount: See drawings
4. Finish: Satin, No. 1 quality 1/4" float/plate glass mirror electrolytically copper plated

I. E.H.D. (surface mounted electric hand dryer):

1. Model No. Sloan EHD-701

2. Size: 9-39/250" wide x 13-93/100" height x 4" deep (from wall)
3. Mount: See drawings
4. Finish: Heavy-duty aluminum casting, satin finish

J. W.G. (surface mounted wall guard)

1. Model No. Sloan 3366138
2. Size: 31.75" wide x 15.75" height x 0.0625" depth
3. Mount: See drawings
4. Finish: Brushed nickel

K. Coat Hook

1. Model No. B-682
2. Size: 2" x 2" hook, 1" wide x 6-1/2" height
3. Mount: See drawings
4. Finish: type 304 stainless steel, satin finish.

L. Towel Hook (heavy duty)

1. Model No. B-2116
2. Size: 2-3/4" diameter
3. Mount: See drawings
4. Finish: satin nickel-plated finish.

M. Shower Curtain

1. Model No: B-204-2
2. Size: 42" (1065mm) W x 72" (1830mm) H
3. Finish: Opaque matte white vinyl (0.008" thick) containing antibacterial and flame-retardant agents and HDPE grommets along top at 6" o.c., hemmed bottom and sides
4. Quantity: two (2)

N. S.S.W.M. (horizontal stainless steel surface-mounted)

1. Model No. Koala Kare KB310
2. Size: 43-3/4" width x 28-5/8" height x 6-25/32" wide (closed)
3. Mount: See drawings
4. Finish: stainless steel

O. R.W.R (recessed waste receptacle)

1. Model No. B-3644
2. Size: 28-5/8" height x 15-3/16" wide x 4-1/8" deep
3. Mount: See drawings
4. Finish: stain finish

2.03 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor as subject to the approval of the Architect.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Coordinate as required with other trades to assure proper and adequate provision for the work of those trades which interface with the work of this Section.
- B. Install each item in its proper location, firmly anchored into position, level and plumb, and in accordance with the manufacturer's recommendations.

END OF SECTION 10800

SECTION 11650
ATHLETIC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Gymnasium Basketball Backstops and Components.
2. Indoor Volleyball.
3. Futsal.
4. Protective Wall Padding.
5. Indoor Scoreboards.
6. Shot Clocks.
7. Other athletic equipment as indicated on the Drawings.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03300 - Cast-In-Place Concrete.
3. Section 096456 - Resilient Athletic Flooring
4. Division 26 – Electrical.

1.02 DEFINITIONS

A. Sequencing, Scheduling:

1. Coordinate with related Work of other Sections.
2. Furnish items to be embedded in concrete or wood floors and templates for setting as required to respective trades in ample time for proper positioning as Work progresses.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01.**
- B. Shop Drawings: Submit Shop Drawings for Work.**

C. Product Data:

1. Copies of manufacturer's standard printed brochure and/or cutsheets illustrating standard components and features of each system specified.

D. Material Samples:

1. Manufacturer's standard color range.

1.05 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. Source Limitations: Provide secondary materials including adhesives, anchoring materials, filler, sealant material, and repair materials of type and from source recommended by manufacturer of primary playground surface system material.

B. Qualifications:

1. Installer: Minimum five years experience in successfully installing the same or similar playground equipment and shall be certified in writing by the playground materials manufacturer to install the playground equipment.

1.06 WARRANTY

- A. Manufacturer shall provide their standard warranty for components specified in this section.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Basketball Backstop System and Components:

1. Manufacturers:

- a. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new ceiling suspended motorized forward folding basketball backstop system is based upon Practice Sports. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

- 1) Porter Athletic Equipment Co.
- 2) Sports Specialties.
- 3) Schelde North America.
- 4) Or approved equal

- b. Type: Provide overhead supported backstop incorporating a fully welded vertical front frame assembly consisting of a main center mast of 6 5/8-inch outside diameter heavy wall structural steel tube with diagonal side sway braces of 2 1/2-inch rectangular steel tube. Ends of diagonal brace tubes and internal web bracing shall be precision machine cut to provide maximum weld surface contact to form a unitized, back-to-back triangular type structural design to provide superior lateral stability. Top horizontal mast hinge spreader shall be a heavy 4-inch structural channel. Backstop shall be supported from 3 1/2-inch outside diameter pipe anchored to overhead framing members by means of heavy formed steel support fittings which must be capable of supporting a load exceeding 10,000 pounds with sufficient attachment points and meeting a safety factor of 60 to 1. Certified test results shall be furnished with submittals.
- 1) Goals shall mount directly through backboard and into a heavy structural steel weldment "Center-Strut" which shall be clamped to the vertical 6 5/8-inch outside diameter center support to eliminate strain on backboard should a player hang on the front mounted goal. Design mount shall comply with NCAA and NFSHSA unit design recommendation on backboard stress minimization.
 - 2) NFSHSA requirements. fittings shall be attached to the 6 5/8-inch outside diameter vertical drop tube by heavy 1/4 inch thick precision saddle die-cut formed steel fittings secured in place by 5/8 inch diameter "U"-bolt type hardware. The upper backboard extension assembly shall provide the official NCAA and NFSHSA regulation 6-inch from the front of the Center-Strut to the face of the backboard.
 - 3) The main backstop frame assembly shall be suspended from overhead 3 1/2-inch outside diameter pipe by adjustable hangers (with 2-inch of vertical adjustment) to provide for precise plumbing of frame during installation. Each hanger shall be tested to 20,000 pounds maximum breaking point to achieve a safety factor of 50 to 1. Certified test results shall be furnished with submittals. Support hangers shall be offset 2-inch from centerline of main center mast to properly weight lock unit in playing position.
 - 4) Backstop to operate with 1 7/8-inch outside diameter front (rear brace for series 952) brace assemblies with folding knee joint. Knee joint shall lock backboard into playing position, by means of a torsion spring within the hinge assembly. Hoist cable shall disengage knee joint allowing front brace to fold easily.
 - 5) Backstop 6 5/8-inch outside diameter main stem shall be suspended diagonally from the super structure with a 15 degree angle with a 4-foot 6-inch long vertical member for attachment of basketball backboard.
 - 6) Provide hoist cable to each backstop of sufficient length and 1/4 inch diameter galvanized aircraft type (minimum of 7,000

pounds, ultimate). Swivel pulleys shall be furnished with a 4-inch diameter cast (ductile iron) pulley sheave with a maintenance free, oil-impregnated bearing for proper hoist cable routing to winch. Pulley assembly and attachment to 3 ½-inch outside diameter support structure shall be rated at a minimum 9,000 pound load rating. Certified test results shall be furnished with submittals.

- 7) Each backstop shall be provided with a heavy duty electric winch. Designed to hold units at any position when raising or lowering. Winch shall include a fully enclosed gear set. Gear set shall be set in an oil bath and sealed at factory to eliminate the need for lubrication. The cable drum shall be grooved to provide neat and consistent cable tracking. The gear shaft shall connect directly to the drum hoist without the use of a chain. Electric winch shall incorporate a special rotary up and down limit switches and a flush wall mounted dual key (separate up and down keys) switch to prevent improper operation of system. Key switches, which operate basketball backstops and gym dividers, must be furnished identical.

c. Forward-Fold Backstop: Provide Ceiling-Suspended Forward-Folding Motorized Backstop, including but not limited to straight post front-braced front-folding unit, side sway braces, adjustable hangers, weight lock, adjustable suspension hanger, conformance with NCAA and NFHS rules and regulations. Provide motorized winch for each backstop.

d. Backboard Padding: Provide for each rectangular glass backboard cushion edge pad along bottom of backboard and up 15-inch on each side meeting NCAA/NFHS rules. Provide standard colors. Provide standard warranty.

e. Goal Selection: Provide for each backboard a goal incorporating a positive lock, pressure release mechanism to automatically release and pivot downward when a static force of 230 pounds is placed on the top of the goal ring at the point most distant from the backboard to meet the latest NBA, NCAA, NFHS, and FIBA specifications for movable goals. Goal shall be spring loaded to automatically and instantaneously return to the playing position. The pressure release mechanism is preset at the factory with a capability for field adjustment to comply with the NCAA recommendation to test goals for rebound elasticity. Pressure release adjustment is accomplished without removing the mechanism cover. Breakaway goals with plastic pivot bearings are not permitted. Rim shall be rigidly braced by means of a 3/16 inch thick steel formed and die cut steel brace welded in position on the underside of the rim for maximum support. Rim shall be provided with a unique "tube-tie" net attachment system to eliminate the conventional wire-formed type net locks. Goal shall be easily mounted to the backboard with a special slotted direct mounting system without removing the housing cover. Goal shall be finished in a durable official orange powder coat. Provide, anti-whip type net.

B. Indoor Volleyball

1. Manufacturers:

- a. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new indoor volleyball netting system is based upon United Volleyball Supply, LLC, model Monson Slider Aluminum Indoor System. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

- 1) Porter Athletic Equipment Co.,
- 2) Jaypro Sports
- 3) Or Approved Equal.

2. Volleyball Game Standard:

- a. Twelve (12) foot anodized aluminum with an approximate 3-1/2" outside diameter with a 1/3" wall thickness. The poles shall have a stainless steel u-channel on the front of the pole to hold the net at tension. The slider bar shall be constructed from stainless steel. The winch shall be made from stainless steel. The slider bar shall have three (3) stainless steel eye bolt for net connection. The stainless steel bar shall be mounted on four (4) trollies with stainless steel ball bearings. This will allow the systems to move while the net is in full tension. The hitch pin to adjust net height shall be installed on the hardware from the manufacturer and shall be made from stainless steel. Poles shall be powder coat white. Limited lifetime warranty.

3. Floor Sleeves:

- a. Set of two (2) Anodized aluminum construction with powder coated 3" outside dimension aluminum floor sleeve cap. Coordinate installation with concrete floor slab installation. Floor sleeve to be set in concrete pier, measuring 24" x 24" with 4 No.05 rebar equally spaced. Set floor sleeve and bind to rebar with binding wire coil. Coordinate gymnasium floor finish with floor sleeve finish elevation, floor sleeve to be flush with finished gymnasium floor.

4. Volleyball Net: (SenComp Indoor Pro Net)

- a. 32 feet net width x 39 inches in height, #36 high break strength knotted nylon netting, 2" white vinyl border with removable wooden ash dowels on each end, stainless steel cable top and bottom lines and rope ratchets for side tensions.

5. Volleyball Pole Safety Pads: (VBSP Volleyball Standard Pad)

- a. 6 feet tall pad filled with 2 inch polyfoam and 18oz. UV / Mildew resistant vinyl Double stitched with UV / Mildew Resistant stitching. (6) Velcro Straps measuring 2 inches wide for pole attachment Our latest design currently offers six velcro straps. Color to be selected by Owner and Architects from manufacturer standard colors.

6. Volleyball Net Antenna:
 - a. Set of two (2) 6-foot solid fiberglass antenna with a set of two (2) Velcro sleeves. Color to be selected by Owner and Architect from manufacturer's standard colors.
7. Volleyball Referee Stand: (Jaypro Sports VRS-8000)
 - a. 1-5/8" steel stand four (4) non-marking wheels and four (4) legs tipped with rubber, padded and vinyl coated platform, no-slip foot treads, 300lbs maximum user weight, 30 in.W x 84 in.H x 10 in.D.

C. Fustal Goals

1. Manufacturers:
 - a. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new fustal goals is based Net World Sports, C/O Scarbrough International, 2551 S Liberty Parkway, Suite C, Liberty, MO 64068, phone 1-866-861-9095, www.forzagoal.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1) Jaypro Sports
 - 2) Kwik Goals
 - 3) Or Approved Equal
2. Fustal Goal: (Model ALU80 SKU: HB45002)
 - a. Set of two (2) regulation sized 10-foot wide x 6.5 foot height x 3.1 inch thick reinforced and powder coated aluminum futsal goals with a UV treated braided net, folding side frames and galvanized steel detachable back bars. Color to be selected by Owner and Architects from manufacturer's standard colors.

D. Protective Wall Padding:

1. Manufacturers:

- a. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new indoor gymnasium wall padding is based Practice Sports, Inc., 14706 Giles Road, 2nd Floor, Omaha, NE 68138, 402-592-2000, www.practiceports.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

- 1) Porter Athletic Equipment Co.,
- 2) Jaypro Sports
- 3) Or Approved Equal

2. Wall Padding: (Durasafe Wall Pads)

- a. 2-inch thick polyethylene foam, medium firm, wall padding bond to 7/16-inch wood board, 19 oz. vinyl with 100-psi tensile strength with leather-like finish and 1-inch nailing margins, mildew and rot resistant, attached with to wall with z-clips, meets ASTM F2440 impact protection. Color to be selected by Owner and Architect from manufacturer's standard colors. 5 year limited warranty.

2. Taper Column Padding: (3 Sided Tapered Durasafe Pads)

- a. 2-inch thick polyethylene foam, medium firm, 3 sided tapered rigid back wall padding bond to 7/16-inch wood board, 19 oz. vinyl with 100-psi tensile strength with leather-like finish, mildew and rot resistant, attached with to wall with z-clips, meets ASTM F2440 impact protection. Color to be selected by Owner and Architect from manufacturer's standard colors. 5 year limited warranty.

E. Indoor Scoreboard:

1. Manufacturer:

- a. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new indoor multi-sport scorebaord is Nevco Inc, 301 East Harris Avenue, Greenville, Illinois 62246; 800-851-4040; www.nevco.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to

performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

1. Everbrite, Inc., All American Scoreboards.
2. Sports Specialties.
3. Or Approved Equal.

2. Multi-Sport Scoreboard: (Model 271-NL Non-Lit caption, base model)

- a. Interior, multi-purpose basketball/volleyball/wrestling electronic scoreboard with two integral horns each, LED displays for time, scores, period, team and player fouls, bonus, double bonus, and next possession arrows. Warranty for scoreboard shall be for 5 years and the wireless component warranty shall be for 2 years. Quantity one (1)
- b. Shape: 8 feet long x 5 feet high
- c. Approximate Hanging Weight:, 115 lbs,
- d. Non-illuminated captions: 6-inches high "Home", "Guests" and "Period"
- e. Large Captions: 6 inches high: "Home", "Guests", "player", "fouls", "period".
- f. LED displays:
 - a. Timing: Super Bright Red or White 13 inches high digits.
 - b. Team scores: Super Bright Amber or White 13 inches high digits
 - c. Period and fouls: Super Bright Amber or White 9 inches high digits.
 - d. Player fouls, Super Bright Red or White 9 inches high digits.
 - e. Next possession: Super Bright Amber or White arrow for each team.
 - f. Include bonus and double bonus in the form of a 4 inch Super Bright Red or White LED "B".
- g. Suspension mounting attachments will be included.
- h. Power requirement: All options included: 126 Watts, MAX, 100-240 Volts AC w/Power Factor Correction.

- i. Control Center: ONE Mobile Controller App wireless, basic, all sports, control center with receiver unit mounted at scoreboard; Controller App will have operability with earlier scoreboards from Nevco.
 - a. Unit shall comply with Part 15 of FCC Rules and Regulations.
 - b. Control unit: Customer-provided mobile device (Apple iOS or Android, phone or tablet)
 - c. Features:
 - i. Secure Wifi wireless operation within 750 feet , line of sight.
 - ii. Operate multiple scoreboards simultaneously.
 - iii. System allows multiple controllers to link to individual scoreboards.
 - d. Receiver: Injection molded case, 10 by 6 by 2.5 inches mounted at scoreboard in accordance with instructions.
 - e. Maximum range: 750 feet from control center to receiver, line of sight.
 - f. Power adapters: Provide for each scoreboard receiver.
 - i. Input: 100-240 volts, 1.5 amps, 50/60 Hz.
 - ii. Output: 50 volts, 1.2 amps, 60 watts.
 - g. Provide suitable, RF transparent, NEMA 4 enclosure for receiver, to be located upon scoreboard supporting structure per installation diagrams.

F. Shot Clock Set:

- 1. Manufacturer:
 - a. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new indoor multi-sport scoreboard is Nevco Inc, 301 East Harris Avenue, Greenville, Illinois 62246; 800-851-4040; www.nevco.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. Everbrite, Inc., All American Scoreboards.

2. Sports Specialties.
 3. Or Approved Equal.
2. Shot Clock: (Model SSC-7)
- a. Pair of portable electronic units displaying shot clock time with external horn box that can be mounted above or below the clock; Model SSC-7 as manufactured by Nevco, Inc., quantity two (2)
 - i. Size: 20 inches x 20 inches x 2 inches deep.
 - ii. Approximate weight each: 40 lbs.
 - iii. LED displays:
 1. Shot clock time: High Intensity Red or White 13 inches high digits.
 - iv. Horn: Sounds automatically at 0 shot clock time.
 - v. Power requirement: 12vDC low voltage power input from included 120 VAC 1.2A Power Supply; powered from the Indoor Accessory Driver (IAD).
 - vi. Construction: Shot Clock face made of durable Lexan, encased in an aluminum cabinet.
 - b. Warranty: 5 years parts and factory labor guarantee for scoreboards, marquees, message centers, video displays, Stadium Pro loudspeaker enclosures and accessories from invoice date, 2 years part and factory labor guarantee for wireless components, portable scoreboards and solar power kits from invoice date, 1 year part and factory labor guarantee for scorer's tables, handheld controls and switches from invoice date.
 - c. Control Center: wireless, basic, AA battery operated, sport specific, control center with receiver unit mounted at scoreboard; Model MPCX2 as manufactured by Nevco, Inc.. Control will have operability with earlier scoreboards from Nevco, Inc.
 - i. Unit shall comply with Part 15 of FCC Rules and Regulations.
 - ii. Control unit: High impact, break-resistant black ABS plastic Size: 3-1/4" x 5-1/2" x 7/8
 - iii. Features:
 1. Wireless operation within 1000 feet
 2. Operate multiple scoreboards simultaneously.
 3. System allows multiple controllers to link to individual scoreboards.
 4. High visibility LCD display with a sealed keyboard.
 5. Long battery life with indicator; include two AA batteries.

6. Single hand operation with a no slip grip.
 7. Built-in belt clip.
 8. Wireless signal strength meter and internal antenna.
- iv. Receiver: Injection molded case, 5-1/2 by 3-3/4 by 2 inches mounted at scoreboard.
 - v. Maximum range: 1,000 feet from control center to receiver.
 - vi. Power adapters: Provide for each scoreboard receiver.
 1. Input: 120 volts, 0.4 amps, 50/60 H
 2. Output: 9 volts, 1.67 amps, 15 watts.
 - vii. Provide carrying case for up to two control centers, Model CC-4 as manufactured by Nevco, Inc..
 1. Size: 18-1/2 x 14-1/2 x 6 inches
 2. Construction: Double wall, high density black polyethylene with padded interior, mechanical latches, and hinges.

G. Team Bench:

1. Manufacturer:
 - a. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new player team bench is Belson Outdoors, 627 Amersale Drive, Naperville, IL 60563, (800) 323-5664, sales@belson.com. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 1. Bison Inc.
 2. Beacon Athletics
 3. Or Approved Equal
2. Team Bench: (AB12WB-S)
 - b. 2" x 10" extruded aluminum seats and backrests with aluminum frames, rubber foot pads, 12-foot length, quantity two (2)

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Equipment shall be installed by factory trained craftsmen skilled in their trade.
- B. Install and assemble equipment furnished in accordance with manufacturer's instructions and reviewed Shop Drawings. Adjust backstops, backboards and goals for plumb and level. Set and adjust electric winch upper and lower limit controls. Before Substantial Completion, demonstrate operation of units to designated Owner personnel. Transmit keys to the OAR before Substantial Completion.
- C. Install other athletic equipment as indicated on the Drawings.

3.02 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 11650

SECTION 11662
GYM DIVIDER CURTAINS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Gymnasium Divider Curtain

1.2 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Secondary structural members supporting gymnasium equipment.
- B. Electrical - Wiring Connections.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2018b.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and supplements.
- D. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2015.
- E. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Large Components: Ensure the large components can be moved into final position without damage to other construction.
- B. Electrically Operated Equipment: Coordinate location and electrical characteristics of service connection.

1.5 SUBMITTALS

- A. See Section 01300.
- B. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:
 - 1. Electrical characteristics and connection locations.
 - 2. Fire rating certifications.
 - 3. Structural steel welder certifications
 - 4. Manufacturer's installation instructions.
- C. Shop Drawings: For custom fabricated equipment indicate, in large scale detail, construction methods; method of attachment or installation; type and gage of

metal, hardware, and fittings; plan front elevation; elevations and dimensions; minimum one cross section; utility requirements as to types, sizes, and locations.

- D. Erection Drawings: Detailed dimensional requirements for proper location of equipment.
 - E. Samples: Submit samples of curtain materials in manufacturer's available range of colors.
 - F. Operating and maintenance data, for each operating equipment item.
 - G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- 1.6 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
 - B. Installer Qualifications: Company specializing in performing work of the type specified with minimum two years of experience.
- 1.7 WORK BY OTHERS
- A. Electric conduits, wiring, and disconnect. Boxes to connect to power supply and remote mount key switches at hand height within unobstructed line of site to curtain. Permanent connections from disconnect to control box and from control box to motor.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to the project site in manufacturer's original packaging with factory original labels attached.
 - B. Store products indoors and elevated above the floor; prevent warping, twisting, or sagging.
 - C. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.
- 1.9 WARRANTY
- A. Gymnasium Divider Curtain Fabric Panel shall be warranted free of defects in material and workmanship for a period of one (1) year.
 - B. Gymnasium Divider Curtain motor and hardware shall be warranted for a period of three (3) years against all defects of material and workmanship.

PART 2 - PRODUCTS

2.1 GYMNASIUM DIVIDER CURTAIN

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new one electrically operated gymnasium divider curtain is based upon NGE/Keeper Goals, model GDC-M-FS. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. Draper
 - 2. Or Approved Equal
- B. Other suppliers or manufacturers wishing bid products other than product specified herein shall submit to the Architect 7 days prior to the bidding a list of 3 past installations similar to the proposal, complete catalogue data along with deviations from the product specified. The manufacturer guarantees the proposed substitute product to comply with the product specified and as detailed on the drawings unless the deviations are so noted in the submittal for approval.

2.2 MATERIAL AND FABRICATION

- A. Curtain Material: Class A rated, self-extinguishing vinyl coated polyester meeting NFPA 701.
- B. Curtain shall be assembled from vertical and horizontal strips overlapping 2" triple sewn and or welded. Panel is to be of correct size to cover the entire opening except if designated otherwise.
- C. Curtain to have top and bottom pocket to accommodate 1 1/2" diameter pipe. There are to be d-rings on 10'-0" centers spaced not greater than 48" apart to allow
- D. routing of lifting cables. Manufacturer may decide to alter these dimensions to best suit opening dimensions.
- E. Curtain to have 8' high double wall vinyl or mesh lower portion to enclose and conceal lifting cables for superior aesthetics and safety for athletes.
- F. Curtain shall hang loose and free so that it may fold up to match desired roofline.

2.3 DESIGN CRITERIA

- A. The materials shall have the following characteristics:

Lower Portion		Upper Portion	
Vinyl		Flexmesh	
Weight	18 oz/sq.yd.	Weight	7 oz/sq.yd.
		Mesh	1/8" apertures
Finish	Color to be selected by Architect		

2.4 RAISING AND LOWERING MECHANISM

- A. The centrally located motor drive unit 120v-single phase shall be equipped with magnetic contactors and overload that can stop, start and reverse from any position and electric brake and travel limit switches.
- B. Drive shaft shall measure 1" equipped with individual pulleys for each take up line. The pulleys range from 25 times the cable diameter and increase according to accommodate the desired stacked profile.
- C. Operating control shall be spring loaded type key switch flush mounted.
- D. All exposed hardware is to be zinc plated, powder coated, or painted to color match as required by the Architect.

PART 3 - EXECUTION

3.3 EXAMINATION AND MEASUREMENT

- A. When the job is sufficiently advanced to permit the installation of the gymnasium divider curtain, visit the site and check the actual conditions where the partition is to be installed, to ascertain whether the preparation work by the preceding trades is acceptable.
- B. Check and record all dimensions that affect the manufacture and installation of the units. Incorporate these dimensions into the Shop Drawings.
- C. Delivery to the job site shall be co-coordinated by the Contractor. Proper storage of the curtain before installation and continued protection during and after installation shall be the responsibility of the Contractor.

3.4 INSTALLATION

- A. Install gymnasium divider curtain straight and level and adjust movable parts for smooth operation.
- B. Clean soiled surfaces with cleaners compatible with finished surfaces.

- C. A local NGE Inc. factory trained installer shall carry out this installation.
- D. Electrical Contractor will provide electrical connections and power.

3.3 OPERATION

- A. The gymnasium divider curtain shall be capable of being stacked at the top of the opening between joists or under joists as required.
- B. A single person shall easily operate the gymnasium divider curtain.

END OF SECTION 11662

SECTION 12 24 00 WINDOW SHADES

PART 1 GENERAL

1.01 SUMMARY - SECTION INCLUDES

- A. Furnish and install the following:
 - 1. Interior roller shades.
 - a. Chain driven, manually operated roller shades.
 - 2. Shade fabric.
 - a. Light filtering roller shades: RS-1

1.02 RELATED REQUIREMENTS

- A. Section 06100 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

- A. AERC 100 - Standard for Rating the Energy Performance of Fenestration Attachments; 2019.
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
- D. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2023.
- E. ASTM E2180 - Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) in Polymeric or Hydrophobic Materials; 2018.
- F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- G. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.
- H. HPDC (PR) - Health Product Declaration Collaborative HPD Public Repository; 2017.
- I. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
- J. ANSI/WCMA A100.1-2022 - Standard for Safety of Window Covering Products; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. General: Coordinate the work of this Section with the respective trades responsible for installing interfacing and adjoining work for proper sequence of installation, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work.
- B. Sequencing:
 - 1. Take field measurements for each opening are taken with field conditions in place before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of work.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.05 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. Note on submittals any deviations from specified requirements and the reasons thereof.
- 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 direction of operation.
- C. Samples:
 - 1. Fabric Samples:
 - a. For Initial Selection: Include fabric samples in full range of available colors and patterns.
 - b. For Verification: Minimum size 8-inch by 10-inch sample, representing actual materials, color, and pattern.
 - 2. Hardware Samples:
 - a. Include hardware samples in full range of available colors and patterns.
 - 1) Including but not limited to – Shade housing or valance, fascia, cassette, brackets, end caps, and external hem bars,
- D. Operation and Maintenance Data: Operation and maintenance instructions for shade systems and shade fabrics.
 - 1. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Declarations:
 - 1. Material Ingredients: Submittal documentation requirements for MR Credit 4 Building Product Disclosure and Optimization - Material Ingredients for Health Product Declaration (HPD), Environmental Product Declarations (EPD) Cradle to Cradle (C2C), Declare Label and similar certifications.
- F. Certifications:
 - 1. Authorization for deviations from specifications: If any deviations from specifications have been accepted, include written description and reasons for deviations. Include authorization for change signed by Owner, Architect, Engineer, and person submitting change. Authorization for change shall also clearly indicate party responsible for remedying defects.
 - 2. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least ten years of documented experience.
- G. Specimen warranty: Provide sample copies of manufacturers' actual warranties for all materials to be furnished under this Section, clearly defining all terms, conditions, and time periods for the coverage thereof.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated shades to site in labeled protective packages, uniquely identified for each intended location and store shades in accordance with manufacturer's recommendations.
- B. Store materials in manner recommended by shade manufacturer, inside, under cover, and in manner to keep them dry, protected from moisture, direct sunlight, excessive temperatures, surface contamination, corrosion and damage from construction traffic and other causes.
- C. Schedule delivery of shades to prevent delays of work and minimize on-site storage.

1.07 FIELD CONDITIONS

- A. Ambient Conditions: Install roller shades after finish work, including painting, is complete and ambient temperature and humidity conditions are maintained at levels indicated for Project when occupied for its intended use.

1.08 WARRANTY

- A. See Section 01780 - Closeout Submittals for additional warranty requirements.
- B. Special Warranty: Provide manufacturer's special 25-year warranty for Project Name, transferable to Owner, project-based, specified, and commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS – ROLLER SHADES

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new roller shades is based upon Rollease Acmeda Contract – Stamford, C, Manufacturer Representative is Apex Lighting+Building Solutions at: shadedivision@apexltg.com or (877) 886-2843. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. Mecho Shade Systems
 - 2. Hunter Dougals
 - 3. Or Approved Equal

2.02 ROLLER SHADES

- A. General: Provide shade system that operates smoothly when shades are raised or lowered with components that are easy to remove or adjust without removal of mounted shade brackets.
 - 1. Performance Requirements:
 - a. Design and size components to support shade system dead loads and to withstand live loads caused by positive and negative wind pressure acting normal to plane of window wall on exterior shade systems.
 - b. Operating Cord Safety: Comply with requirements of ANSI/WCMA A100.1-2022 regarding operating cord safety on window coverings.
- B. Manually Operated Clutch and Chain Interior Roller Shade System:
 - 1. Description: Single roller, manually operated fabric window shade system with mounting brackets, roller tubes, hem bars, hardware, and other components necessary for complete installation.
 - a. Fabric Drop Orientation: Regular roll. Unless otherwise indicated on drawings.
 - b. Mounting Positions: Provide universal hardware and brackets with ability to mount and affix to top, side, or face. As indicated on drawings.
 - 2. Manual Clutch Operator: Manufacturer's standard material and design; UV-stabilized fiberglass reinforced nylon construction and tempered high carbon steel internal springs, self-lubricating.
 - a. Clutch and Chain Operation: Right side. Unless otherwise indicated on drawings.
 - b. Drive Chain: Continuous loop stainless steel beaded ball chain, 120 lb (54 kg) minimum breaking strength. Provide upper and lower limit stops.
 - 1) Chain must be a continuous loop with no connectors or one way connectors that require a tool or secondary process to break the chain.
 - c. Shade Lift Assistance: Manufacturer's standard spring device contained in idler end of roller tube to reduce force required to lift shades; as required based on shade weight.
 - d. Chain Tensioning Safety Device: Must comply with ANSI/WCMA A100.1-2022: Standard for Safety of Window Covering Products

3. Mounting System and Hardware: Fascia with end caps.
 - a. Mounting Brackets: Zinc plated or powder-coated, cold-rolled steel universal brackets. Must have ability for linking brackets for multiple shade bands.
 - b. Type and Size: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - c. Fascia: Extruded aluminum, required to conceal shade mounting, attachable to mounting end caps, without exposed fasteners
 - 1) Color: Anodized.
4. Roller Tubes: As required for type of shade operation; designed for removal without removing mounting hardware.
 - a. Material: Extruded aluminum with engineered wall & ribs to lock the clutch and idle end plug into place, providing strength & durability.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Switch fabric changer spline attachment; fabric hook attached to top edge of shade fabric engages flexible tube hook that drops down from tube.
 - d. Roller tubes capable of being removed and reinstalled without affecting roller shade limit adjustments.
5. Hembars: Designed to maintain bottom of shade straight and flat; selected from manufacturer's standard options.
 - a. Style: Closed pocket; aluminum elliptical slat inside pocket with heat-sealed ends.

2.03 ROLLER SHADE FABRIC

- A. Light Filtering Fabric Basis of Design: 3000 Net by Rollease Acmeda.
 1. Shade cloth material shall hang flat without buckling or distortion. The edge when trimmed shall hang straight without raveling. The unguided shade band shall roll up true and straight, without shifting sideways more than 1/8 inch in either direction due to warp distortion or weave design.
 - a. Marked as RS-1 on drawings.
 - b. 2x2 Basket Weave
 - c. Fabric Drop Orientation: Regular roll, unless otherwise indicated on drawings.
 - d. Color and Openness: Chosen by architect from the manufacturers full range of standard selections.
 - e. Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 - f. Material: 25 percent polyester, and 75 percent pvc. Free of lead, phthalates, formaldehyde, and fragrances.
 - g. Roller shade fabric must have a valid:
 - 1) (HPD) Health Product Declaration
 - 2) (EPD) Environmental Product Declaration
 - 3) (GGGC) Green Guard Gold Certificate
 - h. Substitutions: See Section 016000 - Product Requirements.
 - 1) Submit proposed substitutions in writing for approval by Architect a minimum of 10 working days prior to bid date and make them available to bidders. Accompany proposed substitutions with certification of compliance with specifications, listing exceptions.

2.04 ROLLER SHADE FABRICATION

- A. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances. Based on mounting conditions as indicated in drawings.
 1. Vertical Dimensions:
 - a. Outside Mount: Cover window frames, trim, and casings completely.

2. Horizontal Dimensions:
 - a. Outside Mounting: Extend shades 1 inch beyond jambs on each side.
3. Banded Shades: Fabricate banded shades marked on plans and drawings.
4. Fabric shall hang straight and flat without buckling or distortion. Fabric edges shall be straight and without ravels.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Measurements: Verify actual measurements of openings by field measurements before fabrication; show recorded measurements on shop drawings.
- B. Examine finished openings for deficiencies that may preclude satisfactory installation.
- C. Start of installation is considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. Clean soiled shades and exposed components as recommended by manufacturer.
- C. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01780 - Closeout Submittals for closeout submittals.
- B. Care and Maintenance: Please provide care and maintenance documents for all systems and fabrics listed in this specification.
- C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.06 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

3.07 MAINTENANCE

- A. See Section 01780 - Closeout Requirements for additional requirements relating to maintenance service.

END OF SECTION 12224

SECTION 12353
KITCHEN CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drawings and general provisions of the Contract, AIA 201, and Division 01 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS

- A. Section 06100 –Rough Carpentry.
- B. Section 06200 - Finish Carpentry.

1.3 REFERENCES

- A. American National Standards Institute
 - 1. ANSI/BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association.
 - 2. ANSI/KCMA A161.1 - Performance and Construction Standard for Kitchen and Vanity Cabinets; Kitchen Cabinet Manufacturers Association; current edition (ANSI/KCMA A161.1).
- B. Builders Hardware Manufacturers Association (BHMA):
- C. Kitchen Cabinet Manufacturers Association (KCMA):

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Typical installation methods.
- C. Verification Samples: Two representative units of each type, size, pattern, and color.
- D. Shop Drawings: Include details of materials, construction, and finish. Include relationship with adjacent construction.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.
- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.
- D. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review

and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.

1. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
3. Retain mock-up during construction as a standard for comparison with completed work.
4. Do not alter or remove mock-up until work is completed or removal is authorized.

1.6 PRE-INSTALLATION CONFERENCE

- A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's material and workmanship warranty.
 1. Limited Warranty Duration: 1 year.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. To establish a level of quality and performance characteristics the desired specified new kitchen casework is based upon Wolf Home Products. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 1. Highland Cabinetry Inc.
 2. The RTA Store, Inc.
 3. Or Approved Equal

2.2 KITCHEN CASEWORK

- A. Basis of Design: Traditional Series as manufactured by Wolf Home Products.
 1. Cabinet Construction:
 - a. Industrial Grade Furniture plywood: 5/8 inch (16 mm). Glued and doweled construction.
- B. Cabinet finish shall match existing lower cabinets exactly. Submit manufacturer's full samples.
 1. Exterior: Color matched to door and drawer fronts.

2. Shelves:
 - a. Furniture Board: 3/4 inch . In white laminated melamine and edge banded with white thermoplastic edge banding
 - b. Adjustable shelving: I-shaped supports or approved shelf support clips/pins.
3. Front Edge:
 - a. Thermoplastic edge banding color matched to door/drawer front.
4. Toe Kick: Standard 4-inch height
5. Standard Drawers:
 - a. Formed metal sides.
 - b. Back and Bottom: 5/8 inch melamine.
 - c. Undermount Drawer Glides: Soft-close, full-extension
6. Bottom Edge: Sealed from moisture with thermoplastic edge banding.
7. Doors:
 - a. 5-Piece shaker style.
 - b. Hinges: Six-way Soft-close
 - c. Finish: SmartShield Technology.
 - d. Provide door bumpers
8. Color: To be selected by Architect from standard colors.
9. Finish: To be primed and painted in factory
10. Hardware: Bar pulls, 1.375 inch (H), 1.375 inch (D), 5.375 inch (L), 0.5 inch (W).
11. Hardware Finish: To be selected by Owner from manufacturer standard finishes.
12. Wall Cabinets:
 - a. Cabinets under 42" in width shall have adjustable shelves that are supported by shelf clips. Double door cabinet shelves shall be supported at the front center with shelf clips. Wall cabinets 42" and wider shall have fixed shelves that are jointed to the cabinet ends. Each fixed shelf shall be secured through the back of the cabinets.
 - b. Refer to drawings for sizes.
13. Base Cabinets:
 - a. Base Cabinet widths less than 30" wide shall have adjustable shelves supported by shelf clips. Base cabinets 30" and wider shall have fixed shelves that are jointed to the cabinet ends. Each fixed shelf shall be secured through the back of the cabinet. Double door base cabinets with center mullions shall have a center shelf support at the front center of each shelf.

2.3 COUNTERTOPS

- A. To establish a level of quality and performance characteristics the desired specified new solid surface countertop is based upon Corian. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 1. Swanstone
 2. Wilsonart
 3. Or approved equal
- B. Shop fabricate countertops and splashes to the types and dimensions shown on the Drawings.
- C. Provide 4" high covered splash and no-drip leading edge as locations shown on the drawings.
- D. Thickness: 1/2-inch

- E. Edge Profile: Straight edge
- F. Color: To be selected by Owner and Architect from manufacturer's standard colors.

2.4 ACCESSORIES

- A. Flush mounted counter brackets: Fabricate components from extruded aluminum sections complying with ASTM B221, 6063-T5 alloy and temper.
- B. Factory applied finishes: Exposed aluminum surfaces shall be free of scratches and other serious blemishes and be factory finished with clear anodized coating complying with AAMA 607.1 - MM10C22A31.
- C. Type: Support brackets fabricated by welding miter cut extruded aluminum sections, grinding and deburring sharp edges and welds, drilling holes for field attachment, and factory finishing.
- D. Manufacturers: To establish a level of quality and performance characteristics the desired specified new flush mounted counter brackets manufactured by Rangine Corporation. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
 - 1. Federal Brae
 - 2. Centerline Brackets
 - 3. Or Approved Equal
- E. Model Number: EH-1818FM
- F. Construction: Fabricated from horizontal aluminum T section and vertical aluminum L section. Vertical leg designed to attach to side of supporting stud and be concealed by gypsum board or other wall finish.
- G. Size: 18-inches (H) x 18-inches (D)
- H. Load capacity per bracket: 300 pounds

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed and prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Coordinate provision of support brackets with design and fabrication of counter tops to be supported to ensure compatibility of dimensions and load capacity.

- D. Coordinate requirements for stud spacing, blocking, and auxiliary structural supports to ensure adequate means for installation and anchorage of support brackets.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals and shop drawings, and in proper relationship with adjacent construction. Install support brackets in accordance with reviewed shop drawings and manufacturer's installation instructions.
- B. Install millwork at locations indicated on Drawings. Verify locations in field with Architect. Ensure installation of millwork is secure, plumb and aligned.
- C. Install brackets at locations and heights indicated on Drawings. Verify locations in field with Architect.
- D. Install brackets rigidly to wood studs and supporting substrate so that they are secure, plumb, and aligned.
- E. Install with fasteners of type, size, and quantity as supplied or recommended by bracket manufacturer for type of application and substrate.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.
- B. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

- A. Clean products in accordance with the manufacturer's recommendations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 12353

SECTION 12481

ENTRANCE MATS AND FRAMES

PART 1. GENERAL

1.1 SUMMARY

- A. Section Includes
- B. Entrance floor mats and frame assemblies.
- C. Related Requirements

1.2 REFERENCES

- A. ASTM B 221-93 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- B. ASTM A 276-92 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
- C. AAMA 606.1 Voluntary Guide Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum
- D. AAMA 607.1 Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
- E. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

1.3 COORDINATION

- A. If product is to be recessed, coordinate with concrete work so that products are available for placing integrally with floor slabs.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturers product specifications, installation and maintenance instructions.
- B. Shop Drawings: Show layout and types of grates and frames not less than half-scale sections of typical installations, details of patterns or designs, anchors, and accessories, and field measurements of slab recess to receive frames grates (if applicable).
- C. Samples for Selection Purposes: Actual sections of grate and frame material in a convenient but representative size showing full range of colors, textures, finishes and patterns available for each type of floor grate and frame specified.

- D. Samples for Verification Purposes: Not less than 6 inch square sections of grate material and 6 inch length of frame material in selected colors and finishes for each type of grate and frame specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Provide manufacturer's standard warranty
- B. Sustainable Design Submittals:
 - 1. Building Product Disclosure Requirements: To encourage the use of building products that are working to minimize their environmental and health impacts, provide the following information when available:
 - a. Material Ingredients Documentation demonstrating the chemical inventory of the product

1.6 CLOSEOUT SUBMITTALS

- A. Manufacturer's Installation Instructions and Operation & Maintenance: Indicate installation, operation and maintenance requirements and rough-in dimensions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2. PRODCUTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new recessed entrance mat and frame is based upon Mats, Inc., 6333 Sidney Street, Houston, TX 77021, Phone: 1-877-834-1085, Model Soft Grid. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:

- 1. Nystrom
- 2. Or Approved Equal

2.2 ROLL-UP RAIL MATS

- A. Aluminum Hinged Mats: Extruded-aluminum tread rails 2 inches (50 mm) by 3/8 inch (9.5 mm) thick, sitting on continuous vinyl cushions.
 - 1. Tread Inserts:

- a. Vinyl: Ribbed-design-surface, resilient vinyl.
- 1. Colors, Textures, and Patterns of Inserts: As selected by Architect from full range of industry colors.
- 2. Rail Color: Mill finish
- 3. Hinges: Aluminum.
- 4. Structural Performance: Wheel load of 350 lb per wheel.
- 5. Mat Size: As indicated
- 6. Frame:
 - a. Recessed Frames:
 - 1) LBM: Level-bed, mechanically fastened 6063-T5 aluminum frame.
 - 2) Color: Mill finish
 - b. Surface-Mounted Frames:
 - c. Tapered Ramp Frames: SAM; Mechanically fastened, tapered 6063-T5 aluminum frame with mitered corners.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Products must be placed on a flat and level substrate. Substrate shall meet tolerance of 1/8" over 10 feet in accordance with ACI 302.
- B. Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions, at locations shown and with top of products level with adjoining finished flooring where applicable.
- B. Coordinate top of product surfaces with swinging doors to provide under-door clearance.
 - 1. Provide necessary shims, spacers, and anchorages for proper location and secure attachment of frames to concrete.
 - 2. For installation in terrazzo flooring, contact manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Adjust top surface of assembly to be flush with adjacent finishes.
- B. Coordinate top of surfaces with doors that swing across surface to provide adequate under door clearance.
- C. Clean dirt and debris from frame recess before installing floor system.

3.4 PROTECTION

- A. Upon completion of frame installations, provide temporary filler of plywood or fiberboard in grate recesses, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near time of Substantial Completion
- B. Install product when no further wheeled construction traffic will occur and wet type operations including painting and decorating are complete.

END OF SECTION 12481

**SECTION 12760
TELESCOPING BLEACHERS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Telescoping Gym Seating, wall attached, electrically operated, of multiple-tiered seating rows comprising of seat, deck components, and understructure that permits closing into a nested configuration without requiring dismantling.
- B. Related Sections:
 - 1. Division 26 - Electrical Work.

1.2 REFERENCES

- A. American Society for Testing Materials (ASTM), latest edition, for Standard Specifications for:
 - 1. A36 Carbon Structural Steel.
 - 2. A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 3. A653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 4. A1011 Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 5. D1248 Polyethylene Plastics Extrusion Materials For Wire and Cable.
- B. American Institute of Steel Construction (AISC):
 - 1. Design of Hot Rolled Steel Structural Members.
- C. Aluminum Association (AA):
 - 1. Aluminum Structures, Construction Manual Series

1.3 QUALITY ASSURANCE

- A. Rhode Island State Building Code (RISBC).
- B. Americans with Disabilities Act and Accessibility Guidelines (ADA).
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 102 - Standard for Assembly Seating, Tents and Membrane Structures.
- D. American Welding society (AWS):
 - 1. D1.1 Structural Welding Code - Steel.
 - 2. D1.3 Structural Welding Code - Sheet Steel.
- E. Flooring system shall comply with the minimum slip-resistant coefficients of 0.5 for level floors and 0.8 for ramps.

1.4 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings for fabrication and erection of retractable bleachers.
 - a. Include plans, elevations, and details as required.
 - b. Show anchorage, accessory items, material types and finishes.
 - c. Drawings shall be suitable for use in actual construction of specified equipment.
 - d. Include Wiring Diagrams showing all electrical wiring and connections.
 - e. Provide Graphics Layout Drawings indicating any patterns of contrasting or matching seat colors.

B. Manufacturer's Literature: Submit specification and full selection of stock color chips for review by the A/E.

C. Project Data: Manufacturer's product data for each system. Include the following:

D. Samples: Seat materials and color finish as selected by Architect from manufacturers offered color finishes.

E. Manufacturer copy of a telescopic load test observed by a qualified independent testing laboratory, and certified by a registered professional structural engineer verifying the integrity of the manufacturer's geometry design and base structural assumptions.

F. Operating/Maintenance Manuals: Provide to Owner maintenance manuals. Demonstrate operating procedures, recommended maintenance and inspection program.

1.5 SYSTEM DESCRIPTION

A. Manual retractable bleacher system of multiple tiered seating rows of wood or polyethylene seats, plywood decks, and wood risers with metal supportive understructure.

1. Flake board, particle board, and oriented strand board are not allowed.

B. Design:

1. Design retractable bleachers to support, in addition to their own weight, the following forces:

- a. Live load of 120 lbs. per linear foot on seat and decking.
- b. Uniformly distributed live load of not less than 100 lbs. per sq. ft. of gross horizontal projection.
- c. Parallel horizontal "swaying" force of 24 lbs. per linear foot of row combined with (b) above.
- d. Perpendicular sway load of 10 lbs. per linear foot of row combined with (b) above.

2. Hand Railings, Posts and Supports: Engineered to withstand the following forces applied separately:

- a. Concentrated load of 200 lbs. applied at any point and in any direction.
- b. Uniform load of 50 lbs. per foot applied in any direction.

3. Guard Railings, Post and Supports: Engineered to withstand the following forces applied separately:

- a. Concentrated load of 200 lbs. applied at any point and in any direction along top rail.
- b. Uniform load of 50 lbs. per foot applied horizontally at top rail and a simultaneous uniform load of 100 lbs. per foot applied vertically downward.

4. Dimensions:

- a. Depth Per Row: 22 inches.
- b. Rise Per Row: 9-5/8 to 10-1/4".
- c. Seat Height: 16 to 17 inches.

1.6 QUALITY ASSURANCE

- A. Seating Layout: Comply with current NFPA 102 Standard for Assembly seating, Tents, and Membrane Structures, and specifically with Folding and Telescopic Seating, except where additional requirements are indicated or imposed by authorities having jurisdiction.
- B. Welding Standards & Qualification: Comply with AWS D1.1 Structural Welding Code-Steel and AWS D1.3 Structural Welding Code-Sheet Steel.
- C. Manufacturer Qualifications: Manufacturer who has a minimum of twenty years of experience manufacturing telescoping gym seats.
- D. Installer Qualifications: Engage experienced Installer who has specialized in installation of telescoping gym seat types similar to types required for this project and who is acceptable to, or certified by, telescoping gym seat manufacturer.
- E. Engineer Qualifications: Engage licensed professional engineer experienced in providing engineering services of the kind indicated that have resulted in the successful installation of telescoping bleachers similar in material, design, fabrication, and extent to those types indicated for this project.
- F. Flooring shall be level and rear wall plumb within 1/8 inch in 8'-0". Maximum bleacher force on the floor of a 25'-6" section shall be a static point load of less than 300 psi.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Coordinate actual dimensions of construction affecting telescoping bleachers installation by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid delay of Work.

1.8 WARRANTY

- A. Manufacturer's Product Warranty: Submit manufacturer's warranty form for telescoping bleachers. This warranty is in addition to, and not a limitation of other rights Owner may have under Contract Documents.
 - 1. Warranty Period: Non-prorated warranty to correct all defects in materials, installation and workmanship, for a period five (5) years from the date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the telescoping bleachers is based upon Hussey MAXXAM Courtside XC10 Gym Bleacher, by Hussey Seating Co., Inc., North Berwick, ME.. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
1. Folding Equipment Co., Toledo, Ohio.
 2. Irwin Seating Co., Grand Rapids, MI
 3. Or Approved Equal

2.2 MATERIALS AND EQUIPMENT

- A. Lumber: ANSI/Voluntary Product 20, B & B Southern Pine
- B. Plywood: ANSI/Voluntary Product PS1, APA A-C Exterior Grade.
- C. Structural Steel Shapes, Plates and Bars: ASTM A36.
- D. Uncoated Steel Strip (Non-Structural Components): Commercial Quality, Hot-Rolled Strip.
- E. Uncoated Steel Strip (Structural Components): ASTM A1011 Grade 33, 40, 45, or 50, Structural Quality, Hot-Rolled Strip.
- F. Uncoated Steel Strip Structural Components): High-Strength, Low Alloy, Hot-Rolled Strip.
- G. Galvanized Steel Strip: ASTM A653 Grade 40, zinc coated by the hot-dip process, structural quality.
- H. Structural Tubing: ASTM A500 Grade B, cold-formed.
- I. Polyethylene Plastic: ASTM D1248, Type III, Class B; molded, color-pigmented, textured, impact-resistant, structural formulation; in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.
- J. Fasteners: Vibration-proof, of size and material standard with manufacturer.

2.3 UNDERSTRUCTURE FABRICATION

- A. Frame System:
1. Wheels: Not less than 5 inches diameter by 1-1/4 inch with non-marring soft rubber face to protect wood and synthetic floor surfaces, with molded-in sintered iron oil impregnated bushings to fit 3/8 inch diameter axles secured with E-type snap rings. Wheels less than 4 inch in diameter are not acceptable
 2. Lower Track: Continuous Positive Interglide System interlocks each adjacent CPI unit using an integral, continuous, anti-drift feature and through-bolted guide at front to prevent separation and misalignment. Each CPI unit shall contain a Low Profile Posi-Lock LX to lock each row in open position and allow unlocking automatically. Provide adjustable stops to allow field adjustment of row spacings.

3. Slant Columns: High tensile steel, tubular shape.
4. Sway Bracing: High tensile steel members through-bolted to columns.
5. Deck Stabilizer: High tensile steel members through-bolted to nose and riser at three locations per section. Interlocks with adjacent stabilizer on upper tier using low-friction nylon roller to prevent separation and misalignment. Incorporates multiple stops to allow field adjustment of row spacing.
6. Deck Support: Securely captures front and rear edges of decking at rear edges of nose beam and lower edge of riser beam for entire length of section.

B. Deck System:

1. Nosing and Rear Riser: Continuous roll formed galvanized steel members.
2. Attachment: Through-Bolted fore/aft to deck guides, and frame cantilevers.
3. Decking: 5/8 inch, AC grade, tongue & groove, transversely oriented plywood, interior type with exterior glue, 5-ply, all plies Southern Pine with plugged crossbands, produced in accordance with National Bureau of Standards PS-1. Longest unsupported span: MXM 26, 21-1/2 inch. Plywood that runs side to side is not acceptable.

2.4 SEATING FABRICATION

A. Plastic Seat Modules:

1. Seat Modules: 18 inches long unitized, interlocking, engineered, high density polyethylene modules providing scuff resistant textured 10" wide anatomically contoured seat surface. One half inch minimum interlock on seat and face.
2. Profile: Designed with internal reinforcement ribs and cantilevered to the rear to provide not less than 3 inch smooth toe space beneath the seat. Back of seat shall be enclosed with a smooth closure panel. Exposed ribs or exposed seat support brackets are not acceptable.
3. Seat Support: Each seat support module shall be secured against fore/aft movement by not less than 2 longitudinally sited steel fasteners spaced no less than 2-1/4 inch on center, creating a steel to steel connection, tying the structure firmly to the steel nosing.
4. Number Plates: Seat module shall be designed to accept seat number plates.
5. End Caps: Each end of row shall be enclosed with matching end caps. End caps shall be designed with concealed attachment and provide indent for row letters. Color to match seat top.

2.5 SHOP FINISHES

- A. Understructure: For rust resistance, steel understructure shall be finished on all surfaces with black "Dura-Coat" enamel. Understructure finish shall contain a silicone additive to improve scratch resistance of finish.
- B. Wear Surfaces: Surface subject to normal wear by spectators shall have a finish that does not wear to show different color underneath:
 1. Steel nosing and rear risers shall be pre-galvanized with a minimum spangle of G-60 zinc plating.
 2. Decking shall have surfaces to receive a sealer coat with use surfaces to receive 4 coats of high solids high gloss clear polyurethane finish.
- C. Railings: Steel railings shall be finished with powder coated semi-gloss black.

2.6 FASTENINGS:

- A. Welds: Performed by welders certified by AWS standards for the process employed.

- 2.7 Structural Connections: Secured by structural bolts with prevailing torque lock nuts or Free-spinning nuts in combination with lock washers or Riv-nuts in combination with lock washers.
- A. Integral Power: Furnish and install an integral automatic electro-mechanical propulsion system, to open and close each telescopic seating area. Integral Power and Control System shall be Underwriters Laboratories, Inc. (UL) approved and listed.
1. Operation shall be with a removable pendant control unit which plugs into seating bank for operator management of stop, start, forward, and reverse control of the power operation.
 2. Each Powered Frame unit shall consist of output shaft gear reducer with 6 inch diameter x 4 inch wide wheels covered with non-marring 1/2 inch thick composite rubber. Reducers shall be fitted with induction motors. Bleacher systems with power units located in between the frames are not acceptable.
 3. Electrical: Seating Manufacturer shall provide all wiring within seating bank including pendant control.
 - a. Power supply shall be 120/208 volts three phase 4 wire plus ground service with 20 amps. Motors, housing, and wiring shall be installed and grounded in complete accord with the National Electric Code.
 - b. The electrical contractor shall provide required power source with no greater than 4 percent voltage drop at the junction box. The electrical contractor shall perform all wiring connections in junction box that are attached to or a part of the building.

2.8 ACCESSORIES

- A. Flex-Row: Provide first ROW modular units to be utilized by persons in wheelchairs and able bodied persons. Each Flex-Row unit shall have an unlock lever for easy deployment if wheelchair access is needed. Unlock lever shall lock the bleacher seats into position when fully opened.
1. Provide a black full surround skirting 3/4 inch off the floor for safety and improved aesthetics.
 2. Provide a black injection molded end cap for the nose beam for safety and improved aesthetics.
 3. Provide a mechanical positive lock when the Flex-Row system is in the open and used position.
 4. Flex-Row modular units are designed to achieve multi-use front row seating to accommodate team seating, ADA requirements and facility specific requirements. Flex-Row units are available in modular units from 2-7 seats wide as well as full section widths.
 5. If manufacturer does not provide flex row modules fully enclosed recoverable truncations shall be provided throughout the front row of bleachers on each bank.
- B. Front Aisle Steps: Provide at each vertical aisle location front aisle step. Front steps shall engage with front row to prevent accidental separation or movement. Steps shall be fitted with four non-skid rubber feet each 1/2 inch in diameter. Blow molded end caps shall have full radius on all four edges. Quantity and location shall be as indicated.
- C. Non-Slip Tread: Provide at front edge of each aisle locations an adhesive-backed abrasive non-slip tread surface.
- D. Foot Level Aisles: Provide deck level full width vertical aisles located as indicated.
- E. Intermediate Aisle Steps: Intermediate aisle steps shall be of boxed fully enclosed type construction. Blow molded end caps shall have full radius on all four edges. Step shall have non-skid on surface. Quantity and location as indicated.

- F. Intermediate Aisle Handrails: Provide single pedestal mount handrails 34 inches high with terminating mid rail. Handrails shall be attached to the socket and shall rotate 90 degrees for easy storage in socket. Aisle handrails that are detached from the socket for storage are unacceptable.
- G. Self-Storing End Rails: Provide steel self-storing 42 inches high above seat, end rail with tubular supports and intermediate members designed with 4 inch sphere passage requirements.
- H. Scorer's Table: Provide one 8 feet x 15 inch scorer's table. Table top shall be grey high pressure laminate on 5/8 inch balance veneer core with cushioned edge mounting. Perimeter steel frame with tubular steel legs permanently attached to top with screws. Mounting sockets provided shall be attached to first row.
- I. Top Seat Flush Filler: Provide at top seat level a flush filler board mounted between top seat and rear wall. Flush filler board shall be constructed of 4/4 inch nominal thickness Southern pine Grade "B & B" clear urethane finished.
- J. Provide 2 inch wide colored safety strips at front edge of aisles.
- K. Provide each exposed bank end with a full-height , continuous stack safety end-closure panel standard to bleacher manufacturer, to restrict entry under the bleachers in the opened condition.
- L. Color: Color of finish retractable bleacher assemblies will be selected by A/E from manufacturer's stock color selection.
- M. Wall Anchorage: Provide wall anchorage devices, including necessary plates, bolts, washers, and expansion shields to properly anchor retractable bleachers to existing substrates as recommended by bleacher manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verification of Conditions: Verify area to receive telescoping gym seats are free of impediments interfering with installation and condition of installation substrates are acceptable to receive telescoping gym seats in accordance with telescoping gym seats manufacturer's recommendations.
- B. Do not proceed with the work of this section until conditions detrimental to the proper and timely completion of the work have been corrected in an acceptable manner.

3.2 INSTALLATION

- A. Install retractable bleachers according to approved shop drawings, details shown in drawings and manufacturer's recommendations.
- B. Maximum bleacher force on the floor, of a 25'-6" section, shall be a static point load of less than 300 psi.
- C. Install telescoping gym seats in accordance with manufacturer's installation instructions and final shop drawings. Install each section plumb, true, and in alignment with each adjacent section. Provide accessories, anchors, fasteners, inserts and other items for installation of telescoping gym seats and for permanent attachment to adjoining construction

- D. Repair or replace adjacent floor or wall surface damaged because of the work of this contract as directed by A/E.
- E. Cleaning: Clean surfaces with materials and methods as recommended by bleacher manufacturer.

3.3 DEMONSTRATION

- A. Provide M-DCPS designated personnel, a minimum of two hour training and demonstrate in the proper operation of the retractable bleachers. Demonstration shall include simple written instructions covering the operation and maintenance of this equipment.

END OF SECTION 12760

SECTION 13120
METAL CANOPY SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pre-engineered extruded aluminum metal overhead hanger rod style canopies including structural steel framing, metal roof panels, metal soffit deck panels, aluminum composite fascia panels, accessories and trim, and concrete foundation design.

1.2 RELATED SECTIONS

- A. Section 05500 – Metal Fabrications.
- B. Section 07920 – Sealants and Caulking.

1.3 REFERENCES

- A. ASTM International (ASTM)
 - 1. ASTM E2950 – 14 – Standard Specification for Metal Canopy Systems
 - 2. ASTM A36/A36M – Specification for Carbon Structural Steel
 - 3. ASTM A325/A325M – Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- B. American Institute of Steel Construction, Inc. (AISC): AISC 303 – Code of Standard Practice for Steel Buildings and Bridges.
- C. American Society of Civil Engineers (ASCE): ASCE 7 – Minimum Design Loads for Buildings and Other Structures
- D. American Welding Society (AWS): AWS D1.1 – Structural Welding Code
- E. American Concrete Institute (ACI): ACI 318 – Building Code Requirements for Structural Concrete and Commentary.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide a complete metal overhead canopy system, manufacturer's standard mutually dependent components and assemblies that form a metal overhead canopy system. The metal overhead canopy system must be capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure. Include primary and secondary framing, roof and wall panels, and accessories complying with requirements indicated, including those in this Article.
- B. Metal Overhead Canopy System Design: Of size, spacing, slope, and spans indicated, and as follows:
 - 1. Frame Type: Fixed Base Cantilevered Steel Tube Columns
 - 2. Clear Height: as indicated by nominal height on Drawings.
 - 3. Support Locations: as indicated on drawings.
 - 4. Roof System: Manufacturer's standard lap-seam roof panels.

5. Secondary Frame Type: Manufacturer's standard.

C. Structural Performance: Provide metal canopy systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Design Loads: As indicated on the drawings.
2. Live Loads: As indicated on the drawings.
3. Wind Loads: Include horizontal loads induced by a basic wind speed as required for the location of the project and per building code in effect for the project.
4. Collateral Loads: Include additional dead loads other than the weight of overhead canopy system for permanent items.
5. Load Combinations: Design metal canopy systems to withstand the most critical effects of load factors and load combinations.
6. Deflection Limits: Based on Manufacturer standards

D. Seismic Performance: Design and engineer metal canopy systems capable of withstanding the effects of earthquake motions determined according to the building code in effect for this Project.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of the following metal canopy system components:

1. Structural-framing system.
2. Roof panels.
3. Fascia panels
4. Drainage System

B. Shop Drawings: For the following overhead canopy system components. Include plans, elevations, sections and details.

1. For installed components indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Anchor-Bolt Plans: Include location, diameter, and projection of anchor bolts required to attach metal canopy to foundation.
3. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
4. Roof Layout Drawings: Show layouts of panels on support framing, details of edge conditions, joints, panel profiles, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of the following products with factory-applied color finishes:

1. Deck panels.
 2. Fascia Panels
- D. Product Certificates: Signed by manufacturers of metal canopy systems certifying that products furnished comply with requirements.
1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - a. Name and location of Project.
 - b. Name of manufacturer.
 - c. Overhead Canopy dimensions, including width, length, and height.
 - d. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - e. Governing building code and year of edition.
 - f. Design Loads: Include dead load, roof live load, roof snow load, wind loads/speeds and exposure and seismic design category.
 - g. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, must have an annual audit and review of their quality assurance program, and other information specified.

1.6 QUALITY ASSURANCE

- A. Erector Qualifications: An erector with a minimum of five years of experienced who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal canopy systems that are similar to those indicated for this Project in material, design, and extent.
- C. Manufacturer Qualifications: A minimum of twenty-five years of experienced in manufacturing overhead canopy systems similar to those indicated for this Project and with a record of successful in-service performance.
1. Manufacturer to have an annual audit of its quality assurance program.
 2. Engineering Responsibility: Engineering analysis by a qualified professional engineer.

- D. Welding: Qualified procedures and certified welding personnel according to the following:
 - 1. Welding shall be in accordance to AWS D1.1, "Structural Welding Code Steel".
 - 2. Steel Shop connections shall be welded and field connections shall be bolted (Unless otherwise noted in the drawings). Shop welds may be changed to field welds with the approval of the project engineer.
 - 3. Slag shall be cleaned from welds and prime painted with rust-inhibitive primer.
- E. Source Limitations: Obtain pre-engineered metal canopy through one source from a single manufacturer who shall manufacture and install the canopy.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package roof and wall panels for protection during transportation and handling.
- B. Handling: Unload, store, and erect roof and wall panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight and ventilated covering. Store roof and wall panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit roof and fascia panel installation to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: The Contractor shall verify locations and elevations and other canopy components.
 - 1. Established Dimensions: The Contractor will, where field measurements cannot be made, establish dimensions and proceed with fabrications of metal canopy without field measurements. Contractor is responsible to coordinate locations and elevations with any interferences with or attachments to abutting structures.
- C. Site Conditions: Must meet manufacturer's Required Job Site Conditions for Installation.
 - 1. All work surfaces must be even with no exposed product lines.

1.9 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights. Owner may have under other provisions of the Contract Documents and shall be in

addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1. Warranty Period: One year from date of Substantial Completion.
- B. Special Warranty on Panels: Written warranty, executed by manufacturer agreeing to repair or replace roof and fascia panels that fail in materials or workmanship within specified warranty period.
1. Warranty Period: One year from date of Substantial Completion.
- C. Special Warranty on Panel Finishes: Written warranty, signed by manufacturer agreeing to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking peeling, and loss of film integrity.
1. Warranty Period for Roof Panels: 10 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: To establish a level of quality and performance characteristics the desired specified for the new pre-engineered canopy is based upon Mapes Canopies 7748 N 56th St, Lincoln, NE 68514 Phone: 1-888-273-1132; Fax: 1-877-455-6572; <https://mapescanopies.com>. Alternate manufacturers may be considered, but are subject to compliance with the requirements specified herein, including but not limited to performance characteristics, colors and warranty. Manufacturer's trade names are listed to establish a level for compliance. Available manufacturers offering products that may be incorporated into the Work include one of the following:
1. Mitchell Metals, LLC 1761 McCoba Drive Smyrna, GA 30080 Phone: 770.431.7300 www.mitchellmetals.net
 2. Dittmer Architectural Aluminum 1006 Shepard Road Winter Springs, FL 32708 Phone: 407.699.1755 www.dittdeck.com
 3. Or Approved Equal

2.2 DECK MATERIALS

- A. Metallic-Coated Steel Sheet Pre-painted with Coil Coating: Steel sheet metallic coated by the hot dip process and pre-painted with polyester paint and compatible primer on the face side and wash coat on the back side by the coil-coating process to comply with ASTM A 755/A 755M and the following requirements:
1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G60 (Z180) coating designation; Grade 50.

2. Surface: Smooth, flat, mill finish.

2.3 FABRICATION, GENERAL

- A. General: Design components and field connections required for erection to permit easy assembly and disassembly.
 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 2. Fabricate framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Cold-formed members shall be free of cracks, tears, and ruptures.
- B. Primary Framing: Shop-fabricate framing components to indicated size and section with base plates, 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. Brace compression flange of primary framing by angles connected between frame web and purlin or girt, so flange compressive strength is within allowable limits for any combination of loadings.
 3. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.
- C. Secondary Framing: Shop-fabricate framing components to indicated size and section by roll forming or break-forming, with base plates, 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 surfaces for shop priming according to SSPC-SP 2. Shop prime secondary structural members with specified primer after fabrication.

2.4 STRUCTURAL FRAMING

- A. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads, fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
- B. Bracing: Provide lateral bracing as follows:
 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G60 (Z180) coating designation; Grade 50.

2. Surface: Smooth, flat, mill finish.

2.5 ALL-EXTRUDED HANGER ROD CANOPIES WITH FLAT SOFFIT

A. Materials:

1. Decking shall consist of louvered blades (.110" extruded aluminum)
2. Intermediate framing members shall be extruded aluminum, alloy 6063-T6, in profile and thickness per manufacturer.
3. Hanger rods and attachment hardware shall be a standard finish.
4. Fascia shall be standard extruded 8-inches J-Style.
5. Finish: 2-Coat Kynar Finish
6. Color: Selected from Manufacturer's standard colors

2.6 SUN CONTROL CANOPIES

A. Materials:

1. Decking to be 3-inches extruded flat soffit .078 decking
2. Fascia shall be standard 8-inches extruded J-Style (minimum 0.125 aluminum)
3. Hanger rods and attachment hardware shall be powder coated to match canopy.
4. Decking and fascia shall be extruded aluminum, alloy 6063-T6, in profile and thickness shown per manufacturer.
5. Finish: 2-Coat Kynar Finish
6. Color: Selected from Manufacturer's standard colors

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances, including oil, grease, rolling compounds, incompatible primers, and loose mill scale that impair bond of erection materials.
- B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

3.2 ERECTION OF STRUCTURAL STEEL

- A. Erect metal canopy system according to manufacturer's written instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal canopy system manufacturer's professional engineer.
- C. Set structural framing in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base plates and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces before setting base plates and bearing plates. Clean bottom surface of base plates and bearing plates.
 1. Set base plates and bearing plates for structural members on leveling nuts.

2. Tighten anchor bolts after supported members have been positioned and plumbed.
- E. Align and adjust framing members before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Make adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
 2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- F. Primary Framing: Erect framing true to line, level, plumb, rigid, and secure. Level base plates 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.
 1. Make field connections using high-strength bolts. Tighten bolts by turn-of-the-nut method.
- G. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips, non-high-strength bolts, and or screws as indicated on manufacturers erection drawings.
- H. Bracing: Install bracing in roof where indicated on manufacturers erection drawings.

3.3 ACCESSORY INSTALLATION

- A. General: Install gutters, downspouts, and other accessories according to manufacturer's written instructions, with positive anchorage and weather tight mounting. Coordinate installation with flashings and other components.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions. Provide for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 1. Install exposed flashing and trim 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 resulting in waterproof and weather-resistant performance.
 2. Separations: Separate metal from incompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

3.4 COMPOSITE METAL FASCIA PANELS INSTALLATION

- A. General: Install aluminum composite panels, and other accessories according to manufacturer's written instructions.
 - 1. Install panels plumb, level and true, in compliance with fabricator's recommendations.
 - 2. Anchor panels securely in place, in accordance with fabricator's approved shop drawings.
 - 3. Comply with fabricator's instructions for installation of concealed fasteners and with provisions of Section 07900 for installation of joint sealants.
 - 4. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels: .025 inch in 20 feet (6.4mm in 6.1m), noncumulative.

3.5 ERECTION AND LOCATION TOLERANCES

- A. Structural-Steel Erection Tolerances: Comply with erection tolerance limits of AISC 303-05, "Code of Standard Practice for Steel Buildings and Bridges."

3.6 CLEANING AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean, prepare, and prime or re-prime welds, bolted connections, and abraded surfaces of prime-painted primary and secondary framing, accessories, and bearing plates.
 - 1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
 - 2. Apply compatible primer of same type as shop primer used on adjacent surfaces.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded surfaces of shop-painted primary and secondary framing, accessories, and bearing plates per manufacturer's requirements.

END OF SECTION 13120

SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes:

1. Sleeves without waterstop.
2. Sleeves with waterstop.
3. Stack-sleeve fittings.
4. Sleeve-seal systems.
5. Grout.
6. Silicone sealants.
7. Escutcheons.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the fire-suppression equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of components.
 - b. Include operating characteristics and furnished accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 COORDINATION

- ###### A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
1. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip

- galvanized, with plain ends.
- 3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
- 4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
- 5. Molded-PVC Sleeves: With nailing flange.
- 6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Grout:

- 1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- 2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- 3. Design Mix: 5000 psi, 28-day compressive strength.
- 4. Packaging: Premixed and factory packaged.

2.2 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1. BrassCraft Manufacturing Co.; a Masco company
- 2. Jones Stephens Corp.
- 3. Mid-America Fittings, LLC; A Midland Industries Company

B. Escutcheon Types:

- 1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- 2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
- 3. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- 4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- 5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- 6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; exposed-rivet hinge; and spring-clip fasteners.

C. Floor Plates:

- 1. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES, GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.

- C. Install sleeves in concrete floors, walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire-resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.3 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
 - 1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
 - 2. Prepare test and inspection reports.
- B. Escutcheons:
 - 1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.4 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Interior Walls and Partitions:
 - a. Sleeves without waterstops.

3.5 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping and Relocated Existing Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Chrome-Plated Piping: One piece, steel with polished, chrome-plated finish.
 - 3. Insulated Piping:
 - a. One piece, stamped steel or split plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
 - 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, stamped steel or split plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
 - 5. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, stamped steel or split plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
 - 6. Bare Piping in Unfinished Service Spaces:
 - a. One piece, stamped steel or split plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
 - 7. Bare Piping in Equipment Rooms:
 - a. One piece, stamped steel or split plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
- B. Install floor plates for piping penetrations of equipment room floors.

- C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: One piece, floor plate.
 - 2. Existing Piping: Split floor plate.

END OF SECTION 210500

SECTION 210523

GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Two-piece ball valves with indicators.
 - 2. Indicator Post
 - 3. Check valves.
 - 4. Iron OS&Y gate valves.

1.2 DEFINITIONS

- A. NRS: Nonrising stem.
- B. OS&Y: Outside screw and yoke.
- C. SBR: Styrene-butadiene rubber.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
 - 1. Fire Main Equipment: HAMV - Main Level.
 - a. Indicator Posts, Gate Valve: HCBZ - Level 1.
 - b. Ball Valves, System Control: HLUG - Level 3.
 - c. Butterfly Valves: HLXS - Level 3.
 - d. Check Valves: HMER - Level 3.
 - e. Gate Valves: HMRZ - Level 3.
 - 2. Sprinkler System and Water Spray System Devices: VDGT - Main Level.
 - a. Valves, Trim and Drain: VQGU - Level 1.
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
 - 1. Automated Sprinkler Systems:
 - a. Indicator posts.
 - b. Valves.
 - 1) Gate valves.
 - 2) Check valves.
 - 3) Miscellaneous valves.
- C. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B31.9 for building services piping valves.
- D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- E. NFPA Compliance for Valves:
 - 1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.
- F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.3 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ames Fire & Waterworks; A Watts Water Technologies Company
 2. NIBCO INC.
 3. Victaulic Company
- B. Description:
1. UL 1091, except with ball instead of disc and FM Global approved for indicating valves (butterfly or ball type), Class Number 1112.
 2. Minimum Pressure Rating: 175 psig.
 3. Body Design: Two piece.
 4. Body Material: Forged brass or bronze.
 5. Port Size: Full or standard.
 6. Seats: PTFE.
 7. Stem: Bronze or stainless steel.
 8. Ball: Chrome-plated brass.
 9. Actuator: Worm gear
 10. Supervisory Switch: Internal or external.
 11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
 12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.4 INDICATOR POSTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Kennedy Valve Company; a division of McWane, Inc.
 2. Mueller Co. LLC; Mueller Water Products, Inc.
 3. NIBCO INC.
- B. Description:
1. Standard: UL 789 and FM Global standard for indicator posts.
 2. Type: Upright.
 3. Base Barrel Material: Cast or ductile iron.
 4. Extension Barrel: Cast or ductile iron.
 5. Cap: Cast or ductile iron.
 6. Operation: Wrench.

2.5 CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering

products that may be incorporated into the Work include, but are not limited to, the following:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
3. Victaulic Company

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Victaulic Company
2. WATTS; A Watts Water Technologies Company
3. Zurn Industries, LLC

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Grooved.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION, GENERAL

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:
 - 1. Section 211000 "Water-Based Fire-Suppression Systems" for application of valves in fire-suppression standpipes; wet-pipe, fire-suppression sprinkler systems; and dry-pipe, fire-suppression sprinkler systems.
 - 2. Section 331415 "Site Water Distribution Piping" for application of valves in fire-suppression water-service piping.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.
- C. Install double-check valve assembly in each fire-protection water-supply connection.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 210523

SECTION 210529

HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports for fire-suppression piping - metal.
2. Pipe hangers for fire-suppression piping - metal, trapeze type.
3. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Delegated Design Submittals: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for fire-suppression piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
- C. NFPA Compliance: Comply with NFPA 13R.
- D. UL Compliance: Comply with UL 203.

2.2 PIPE HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING - METAL

- A. Pipe Hangers and Supports for Fire-Suppression Piping - Carbon Steel:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Cooper B-line; brand of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
 - 2. Description: Factory-fabricated components, NFPA approved, UL listed, or FM Global approved for fire-suppression piping support.
 - 3. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
 - 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 PIPE HANGERS FOR FIRE-SUPPRESSION PIPING - METAL, TRAPEZE TYPE

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM Global-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 EQUIPMENT SUPPORTS

- A. Description: NFPA-approved, UL-listed, or FM Global-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.5 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to comply with NFPA 13 requirements, minimum 5 times the water-filled weight of piping and supported components plus 250 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.
- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- E. Pipe Slopes: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- F. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

- G. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.
- H. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- I. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners in accordance with powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions. Install in accordance with approvals and listings.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation:
 - 1. Fabricate from welded-structural-steel shapes.
 - 2. Grouting: Place grout under supports for floor-mounted equipment and make bearing surface smooth.
 - 3. Provide lateral bracing, to prevent swaying.
- L. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. MSS SP-58, Type 39 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
 - a. MSS SP-58, Type 40 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on

rollers.

4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
 - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
 2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless steel pipe hangers and corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper, or, stainless steel attachments for copper piping and tubing.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and

- with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Comply with NFPA requirements.
- L. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. C-Clamps (MSS Type 23): For structural shapes.
 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- M. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

SECTION 210553

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Craftmark Pipe Markers
 - c. Marking Services Inc.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Brady Corporation
 2. Craftmark Pipe Markers
 3. Marking Services Inc.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
1. Pipe size.
 2. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.3 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Brady Corporation
 2. Craftmark Pipe Markers
 3. Marking Services Inc.
- B. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.04 inch thick, with predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire.

- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of fire-suppression equipment.
- B. Sign and Label Colors:
 - 1. White letters on an ANSI Z535.1 safety-red background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe-Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels,

complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit a view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.

E. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Fire-Suppression Pipe Label Color Schedule:

1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

3.5 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule in the operating and maintenance manual. Include the identification "FSV" on all fire-suppression system valve tags.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.

1. Valve-Tag Size and Shape:
 - a. Fire-Suppression Standpipe: 1-1/2 inches, round.
 - b. Wet-Pipe Sprinkler System: 1-1/2 inches, round.
2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

END OF SECTION 210553

SECTION 210700

FIRE-SUPPRESSION SYSTEMS INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following fire protection piping services:

1. Engine coolant piping for remote radiator of engine-driven fire pump.
2. Engine exhaust piping and silencer.
3. Indoor and outdoor equipment.
4. Outdoor piping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

- B. Sustainable Design Submittals:

- C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
3. Detail attachment and covering of heat tracing inside insulation.
4. Detail insulation application at pipe expansion joints for each type of insulation.
5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
6. Detail removable insulation at piping specialties and equipment connections.
7. Detail application of field-applied jackets.
8. Detail application at linkages of control devices.
9. Detail field application for fire-suppression water storage tanks.

- D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Sheet Form Insulation Materials: 12 inches square.
3. Jacket Materials for Pipe: 12 inches long by NPS 2.
4. Sheet Jacket Materials: 12 inches square.
5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program, certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

- a. One 10-foot section of NPS 2 straight pipe.
- b. One each of a 90-degree threaded, welded, and flanged elbow.
- c. One each of a threaded, welded, and flanged tee fitting.
- d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
- e. Four support hangers including hanger shield and insert.
- f. One threaded strainer and one flanged strainer with removable portion of insulation.
- g. One threaded reducer and one welded reducer.
- h. One pressure temperature tap.
- i. One mechanical coupling.
- j. One union.

2. Equipment Mockups:

- a. One tank or vessel.

- 3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
- 4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
- 5. Obtain Architect's approval of mockups before starting insulation application.
- 6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- 7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- 8. Demolish and remove mockups when directed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size, as well as ASTM standard designation, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 210529 "Hangers and Supports for Fire-Suppression Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and with equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Diesel Engine Exhaust Insulation Schedule"; "Equipment Insulation Schedule"; "Piping Insulation Schedule, General"; "Indoor Piping Insulation Schedule"; and "Outdoor, Aboveground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel have a leachable chloride content of less than

50 ppm when tested in accordance with ASTM C871.

- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I or Type II.
- G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature of up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Knauf Insulation
 - c. Manson Insulation Inc.
 - 2. Preformed Pipe Insulation: Type I, Grade A unfaced.
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

2.4 SEALANTS

- A. Materials are as recommended by insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 - 4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving, with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.

5. PSK Jacket: Aluminum-foil-fiberglass-reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.7 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.8 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC in accordance with ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum in accordance with ASTM B209; Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel in accordance with ASTM A240/A240M, Type 304.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with epoxy primer 5 mils thick and epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents, unless otherwise approved by engineer of record.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended in writing by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended in writing by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet

and dry film thicknesses.

- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.

- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.5 INSTALLATION OF EQUIPMENT AND TANK INSULATION

- A. Glass-Fiber and Mineral Wool Pipe and Tank Insulation Installation for Tanks: Secure insulation with adhesive, anchor pins, and speed washers.
 - 1. Apply adhesives in accordance with manufacturer's recommended coverage rates per unit area, for 100 percent coverage of surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. Maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 5. Secure each layer of insulation with stainless steel or aluminum bands. Select band material compatible with insulation materials.
 - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 - 7. Stagger joints between insulation layers at least 3 inches.
 - 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 - 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 - 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using prefabricated fitting insulation made from same material and density as adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with prefabricated fitting insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using prefabricated fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using prefabricated fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 - 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for pressure gauges, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless

- steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are unavailable, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as straight segments of pipe insulation when available.
2. When prefabricated sections are unavailable, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Contractor to engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- E. All insulation applications will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Indoor fire-suppression piping.
2. Underground piping.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Indoor Engine Coolant Piping for Remote Radiator of Engine-Driven Fire Pump:

1. All Pipe Sizes: Insulation is one of the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

END OF SECTION 210700

SECTION 210800

COMMISSIONING OF FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Cx process requirements for the following fire-suppression systems, assemblies, and equipment:
 - a. Water-based fire-suppression systems.

B. Related Requirements:

1. For construction checklists, comply with requirements in various Division 21 Sections specifying fire-suppression systems, system components, equipment, and products.

1.2 DEFINITIONS

A. IgCC: International Green Construction Code.

B. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fire-suppression testing technician.

B. Construction Checklists:

1. Cx plan, including material, installation, and performance construction checklists for systems, assemblies, subsystems, equipment, and components relating to fire-suppression system to be part of the Cx process and in accordance with requirements in Section 019113 "General Commissioning Requirements" and NFPA 3.

C. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:

1. Equipment/instrument identification number.
2. Planned Cx application or use.
3. Manufacturer, make, model, and serial number.
4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:

- a. Instrument or tool identification number.
- b. Equipment schedule designation of equipment for which the instrument or tool is required.
- c. Manufacturer, make, model, and serial number.
- d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

1.4 QUALITY ASSURANCE

- A. Fire-Suppression Testing Technician Qualifications: Technicians to perform fire-suppression Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
 - 1. Journey level or equivalent skill level with knowledge of fire-suppression system, electrical concepts, and building operations.
 - 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Clean-Agent Fire-Suppression Systems Testing Technician Qualifications: Technicians to perform clean-agent fire-suppression system Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
 - 1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in mechanical systems, fire-suppression systems, or similar field. Degree requirement may be offset by three years' experience in servicing fire-suppression systems in the clean-agent fire-suppression systems industry. Generally, required knowledge includes clean-agent fire-suppression systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of fire-suppression system equipment, assemblies, and systems.
 - 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- C. Testing Equipment and Instrumentation Quality and Calibration:
 - 1. Capable of testing and measuring performance within the specified acceptance criteria.
 - 2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 - 3. Be maintained in good repair and operating condition throughout duration of use on Project.
 - 4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- D. Proprietary Test Instrumentation and Tools:
 - 1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
 - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
 - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
 - c. Fire-suppression system proprietary test instrumentation and tools become

property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Cx PROCESS

A. Perform Cx process for fire-suppression system in accordance with the following:

- 1.
2. NFPA 3.
3. Cx standards acceptable to the authority having jurisdiction.

3.2 CONSTRUCTION CHECKLISTS

A. Preliminary detailed construction checklists are to be for each fire-suppression system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in NFPA 3 and IgCC. Contractor performs the following:

1. Review fire-suppression system preliminary construction checklists and provide written comments on Construction Checklist items where appropriate.
2. Return preliminary Construction Checklist with review comments within 10 days of receipt.
3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
4. Use only construction checklists marked "Approved for Use, (date)" when performing tests. Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.

B. Prepare preliminary detailed construction checklists for each fire-suppression system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in NFPA 3.

1. Submit preliminary construction checklists to CxA and Designer for review.
2. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
3. Use only construction checklists marked "Approved for Use, (date)" when performing tests. Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.

C. Additional Systems Required to Be Commissioned:

1. Facility fire-suppression water-distribution piping outside the building, including the following:
 - a. Fire-suppression water piping, fittings, and specialties outside the building.
 - b. Hydrants and fire-department connections.
 - c. Fire-alarm devices.
 - d. Meters and meter pits.
 - e. Outdoor water-storage tanks.
 - f. Sleeves and sleeve seals.
 - g. Meters and gauges.

- h. General-duty and specialty valves.
 - i. Hangers and supports.
 - j. Heat tracing.
 - k. Vibration isolation.
 - l. Identification.
 - m. Insulation.
2. Fire-suppression sprinkler systems, including the following:
- a. Wet-pipe sprinkler piping, fittings, sprinklers, and specialties.
 - b. Dry-pipe sprinkler piping, fittings, sprinklers, and specialties.
 - c. Pre-action, deluge sprinkler piping, fittings, sprinklers, and specialties.
 - d. Fire pumps, motors, accessories, and controls.
 - e. Pressure-maintenance pumps, motors, accessories, and controls.
 - f. Compressed-air piping, compressors, motors, accessories, and controls.
 - g. Sleeves and sleeve seals.
 - h. Meters and gauges.
 - i. General-duty and specialty valves.
 - j. Hangers and supports.
 - k. Heat tracing.
 - l. Vibration isolation.
 - m. Identification.
 - n. Insulation.
3. Documentation:
- a. Fire-suppression system operating manuals.
 - b. Documentation of required Cx.
 - c. Documentation of required operator training.

3.3 Cx TESTING PREPARATION

- A. Certify that fire-suppression systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that fire-suppression system instrumentation and control systems have been completed and calibrated, that they are operating in accordance with the Contract Documents and approved submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the fire-suppression system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.
- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation, and schedule seasonal tests.

3.5 Cx TESTS COMMON TO FIRE-SUPPRESSION SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response compared to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 21 Sections specifying fire-suppression systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
 1. Cx Construction Checklist verification tests.
 2. Cx Construction Checklist verification test demonstrations.

3.6 CONSTRUCTION CHECKLIST EXAMPLES

- A. Vibration Isolation in Fire-Suppression Systems:
 1. Prerequisites: Acceptance of results of construction checklists for vibration control devices.
 2. Components to Be Tested:
 - a. Vibration isolation control devices in water-based fire-suppression systems.
 - b. Support systems.
 3. Test Purpose: Evaluate effectiveness of vibration isolation control devices.
 4. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness while the isolated equipment operates.
 - a. Maximum speed.
 - b. Minimum speed.
 - c. Critical speed.

5. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.
- B. Supervision of Fire-Protection Valves in Water-Based Fire-Suppression Systems:
1. Prerequisites: Acceptance of results of construction checklists for valves specified in the following Sections:
 - a. Section 210523 "General-Duty Valves for Water-Based Fire Protection Piping."
 - b. Section 211000 "Water-Based Fire-Suppression Systems."
 2. Equipment and Systems to Be Tested:
 - a. Supervised valves in water-based fire-suppression systems.
 - b. Division 28 fire-detection and -alarm systems.
 3. Test Purpose: Verify generation of supervisory alarm at the fire-alarm control panel in response to activation of valve supervision device or tamper switch.
 4. Test Conditions:
 - a. Fire-alarm system operating in normal, automatic mode.
 - b. Activate valve supervision devices and tamper switches, one at a time.
 5. Acceptance Criteria: Activation of valve supervision device or tamper switch generates supervisory alarm at fire-alarm control panel.

END OF SECTION 210800

SECTION 211000

WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-suppression piping, fittings, and appurtenances.
2. Fire department connections.
3. System control valves.
4. Fire-suppression piping specialties.
5. Cover systems for sprinkler piping.
6. Sprinklers.
7. Alarm devices.
8. Pressure gauges.

1.2 DEFINITIONS

- A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of 175 psig maximum.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles.
 - b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Prepare in accordance with NFPA 13, and, NFPA 14 section "Working Plans."
 - a. Include plans, elevations, and sections of the system piping and details.
 - b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.
 - c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Prepare computer-generated hydraulic calculations in accordance with the following:

- a. Minimum operating pressure at hydraulically most remote fire hose valve is to be 100 psig.
 - b. Name of hydraulic program used.
 - c. Water supply information, including fire hydrant flow test data report.
- 3. Submit documents and calculations signed and sealed by qualified professional engineer responsible for their preparation, and prepared by NICET Level III-certified technician, "Water-Based Systems Layout."
- 4. Include diagrams for power, signal, and control wiring.
- D. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation, prepared by NICET Level III-certified technician, "Water-Based Systems Layout."

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Fire-suppression system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Seismic Qualification Certificates: For fire-suppression equipment, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Qualification Data: For qualified Installer and professional engineer, and NICET-certified technician.
- D. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, and NFPA 14, including documented approval by AHJs, and including hydraulic calculations if applicable.
- E. Welding certificates.
- F. Field Test Reports:
 - 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13, and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 - 2. Fire-hydrant flow test report.
- G. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
 - 2. System control valves.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by qualified professional engineer.,NICET Level III-certified technician, "Water-Based Systems Layout."
- B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Suppression System Components, Devices, and Accessories: Listed in ULSE's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."
- 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. Fire-suppression system equipment, specialties, accessories, installation, and testing to comply with NFPA 13R.
- D. Delegated Design: Engage a qualified professional engineer,NICET Level III-certified technician, "Water-Based Systems Layout" to design fire-suppression systems.
 - 1. Margin of Safety for Available Water Flow and Pressure: 5 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - b. Elevator Machine Room and Hoistway: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - e. Offices, including Data Processing: Light Hazard.
 - f. Residential: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500 sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over 1500 sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500 sq. ft. area.
 - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm/sq. ft. over 2500 sq. ft. area.
 - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm/sq. ft. over 2500 sq. ft. area.
 - f. Special Occupancy Hazard: As determined by AHJs.
 4. Maximum protection area per sprinkler in accordance with ULSE listing.
 5. Total Combined Hose-Stream Demand Requirement: In accordance with NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
 6. Minimum residual pressure at each hose-connection outlet is as follows:
 - a. NPS 1-1/2 (DN 40) Hose Connections: 65 psig.
 - b. NPS 2-1/2 (DN 65) Hose Connections: 100 psig.
- E. Obtain documented approval of fire-suppression system design from AHJs.

2.2 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

A. Steel Pipe, Fittings, and Appurtenances:

1. Schedule 40 Steel Pipe: Galvanized-,and,black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
 - a. Standards:
 - 1) UL 852.
 - 2) FM 1630.
 - b. Factory-applied exterior coating.
 - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
 - d. Pipe ends may be factory or field formed to match joining method.
2. Schedule 10 Steel Pipe: Galvanized-,and,black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
 - a. Standards:
 - 1) UL 852.
 - 2) FM 1630.
 - b. Factory-applied exterior coating.
 - c. Factory-applied bacterial resistant internal coating to reduce microbiologically influenced corrosion.
 - d. Pipe ends may be factory or field formed to match joining method.
3. Steel Pipe Nipples: Galvanized, and, black steel, ASTM A733, made of ASTM A53/A53M,

- standard-weight, seamless steel pipe with threaded ends.
4. Steel Couplings: Galvanized, and, uncoated steel, ASTM A865/A865M, threaded.
 5. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
 - 1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - 2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 - b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.
 6. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
 - a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
 7. Grooved-Joint, Steel-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Gruvlok; an ASC Engineered Solution
 - 2) Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
 - 3) Victaulic Company
 - b. Pressure Rating: 175 psig minimum.
 - c. Grooved-End Fittings for Steel Piping: Painted grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
 - d. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

B. CPVC Pipe, Fittings, and Appurtenances:

1. CPVC Pipe: ASTM F442/F442M and UL 1821, SDR 13.5, for 175 psig rated pressure at 150 deg F, with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
2. CPVC Fittings: UL listed, for 175 psig rated pressure at 150 deg F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
 - a. NPS 3/4 to NPS 1-1/2 (DN 20 to DN 40): ASTM F438 and UL 1821, Schedule 40, socket type.
 - b. NPS 2 to NPS 3 (DN 50 to DN 80): ASTM F439 and UL 1821, Schedule 80, socket type.
 - c. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
 - d. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
 - e. Flanges: CPVC, one or two pieces.
3. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493 solvent cement

- recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
4. Plastic Pipe-Flange Gasket and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connection, Exposed Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International
 - b. Guardian Fire Equipment, Inc
 - c. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Description: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Three.
11. Escutcheon Plate Marking: See Fire Protection Plans.
12. Finish: Polished chrome plated.
13. Outlet Size: NPS 4.

2.4 HOSE CONNECTIONS AND HOSE STATIONS

A. Hose Connections, Adjustable Valve:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brooks Equipment Co., Inc
 - b. Guardian Fire Equipment, Inc
 - c. Zurn Industries, LLC
2. Standards:
 - a. UL 668.
 - b. UL 1468.
3. Description: Fire hose valve, with integral reducing or restricting pressure-control device, for connecting fire hose.
4. Pressure Rating: 175 psig maximum inlet.

5. Material: Brass or bronze.
6. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
7. Inlet: Female pipe threads.
8. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads in accordance with NFPA 1963 and matching local fire department threads.
9. Pattern: gate.
10. Pressure-Control Device Type: Pressure reducing.
11. Finish: Polished chrome plated.

2.5 SYSTEM CONTROL VALVES

- A. Listed in ULSE's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
- B. Pressure Rating:
 1. Standard-Pressure Piping Valves: 175 psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. System Control Valve, Alarm Valve:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The)
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
 - c. Victaulic Company
 2. Standard: UL 193.
 3. Design: For horizontal or vertical installation.
 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
 5. Drip cup assembly pipe drain without valves and separate from main drain piping.

2.6 FIRE-SUPPRESSION PIPING SPECIALTIES

- A. Sprinkler Inspector's Test Fittings:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. Reliable Automatic Sprinkler Co., Inc. (The)
 - c. Viking Group Inc.
 2. Standard: ULSE's "Fire Protection Equipment Directory" or FM Approvals' "Approval

- Guide."
- 3. Pressure Rating: 175 psig minimum.
- 4. Body Material: Cast- or ductile-iron housing with sight glass.
- 5. Size: Same as connected piping.
- 6. Inlet and Outlet: Threaded.

B. Flexible Sprinkler Hose Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Flexhead; an ASC Engineered Solution
 - b. Reliable Automatic Sprinkler Co., Inc. (The)
 - c. Victaulic Company
- 2. Standards:
 - a. UL 2443.
 - b. FM 1637.
- 3. Description: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
- 4. Pressure Rating: 175 psig minimum.
- 5. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1. Reliable Automatic Sprinkler Co., Inc. (The)
- 2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
- 3. Victaulic Company
- 4. Viking Group Inc.

B. Standards:

- 1. UL 199.
- 2. UL 1626.
- 3. UL 1767.
- 4. FM 2000.
- 5. FM 2008.
- 6. FM 2030.

C. Listed in ULSE's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

D. Pressure Rating for Sprinklers:

- 1. Standard Automatic Sprinklers: 175 psig minimum.

E. Sprinklers, Automatic Wet with Heat-Responsive Element:

1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
2. Standard Spray, Standard Response:
 - a. Upright.
 - b. Pendent.
 - c. Recessed pendent.
 - d. Flat, concealed pendent.
 - e. Vertical sidewall.
 - f. Horizontal sidewall.
3. Standard Spray, Quick Response:
 - a. Upright.
 - b. Pendent.
 - c. Recessed pendent.
 - d. Flat, concealed pendent.
 - e. Vertical sidewall.
 - f. Horizontal sidewall.
 - g. Flat, concealed horizontal sidewall.
4. Extended Coverage:
 - a. Upright.
 - b. Pendent.
 - c. Flat, concealed pendent.
 - d. Horizontal sidewall.
 - e. Flat, concealed horizontal sidewall.
5. Residential:
 - a. Recessed pendent.
 - b. Flat, concealed pendent.
 - c. Flat, concealed horizontal sidewall.

F. Sprinkler Finishes: painted.

2.8 ALARM DEVICES

- A. Match alarm-device material and connection types to piping and equipment materials and connection types.
- B. Electrically Operated Notification Appliances:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Notifier; Honeywell International, Inc.
 - b. Potter Electric Signal Company, LLC
 2. Electric Bell:

- a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.
 - c. Size: 8-inch minimum- diameter.
 - d. Voltage: 24 V dc.
 - e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.
3. Strobe/Horn:
 - a. Standard: UL 464.
 - b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
 - c. Voltage: 120 V ac, 60 Hz.
 - d. Effective Intensity: 110 cd.
 - e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
 - f. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police or fire department.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Potter Electric Signal Company, LLC
 - b. System Sensor; Honeywell International, Inc.
 - c. Viking Group Inc.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125 V ac and 0.25 A, 24 V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Kennedy Valve Company; a division of McWane, Inc.
 - b. Potter Electric Signal Company, LLC
 - c. System Sensor; Honeywell International, Inc.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Design: Signals that controlled valve is in other than fully open position.

5. Wire Terminal Designations: Indicates normal switch position when switch is properly installed on valve and valve is fully open.
6. 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.
7. OS&Y Valve Supervisory Switches:
 - a. One or two single-pole, double-throw switches.
 - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
 - c. Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.
 - d. Mounting Hardware: Mounting bracket to grip valve yoke and prevent movement of switch assembly on OS&Y valve.
 - e. Trip Rod Length: Adjustable
8. Butterfly Valve Supervisory Switches:
 - a. Two single-pole, double-throw switches.
 - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
 - c. Mounting Hardware: Removable nipple.
 - d. Trip Rod Length: Adjustable
9. Ball Valve Supervisory Switches:
 - a. One single-pole, double-throw switch.
 - b. NEMA Rating: NEMA 4 enclosure suitable for mounting in any position indoors or outdoors.
 - c. Mounting Hardware: Suitable for mounting directly to pipe, ball valves, or backflow preventers sized from up to NPS 2.

2.9 PRESSURE GAUGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. AGF Manufacturing, Inc.
 2. Ametek U.S. Gauge
 3. Brecco Corporation
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gauge Range: 0 to 250 psig minimum.
- E. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.
 - 1. Flow test is to be performed to meet the criteria established by NFPA 13, and, NFPA 14.
 - 2. Flow test is to be conducted in accordance with NFPA 291.
 - 3. Test is to be performed during a period of ordinary demand for the water system.
 - a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.
 - 4. Pitot readings are to be taken at the 2-1/2-inch orifice connection.
 - 5. The pitot reading is to range from 10 to 35 psig.
 - 6. Open additional hydrant outlets as needed to control pitot readings.
 - 7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.
- B. Flow Test Data Written Report:
 - 1. Flow data report is to be written in accordance with NFPA 291.
 - 2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.
- C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.
- D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.
- E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF DOMESTIC WATER-SUPPLY CONNECTIONS

- A. Connect fire-suppression water piping to building's interior domestic water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 331415 "Site Water Distribution Piping."

3.3 INSTALLATION OF FIRE-SUPPRESSION PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general

location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from AHJs. File written approval with Architect before deviating from approved working plans.
 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13, and, NFPA 14 requirements for installation of fire-suppression piping.
- C. Install seismic restraints on piping. Comply with NFPA standards requirements for seismic-restraint device materials and installation.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located in accordance with NFPA 13.
- H. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.
- I. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and spill over floor drain or to exterior of building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- L. Fill wet-type fire-suppression system piping with water.
- M. Drain dry-type fire-suppression system piping.
1. Install electric heating cables and pipe insulation on fire-suppression piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500 "Common Work Results for Fire-

Suppression Piping."

3.4 INSTALLATION OF PIPING JOINTS

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.
- M. Brazed Joints: Join copper tube and fittings in accordance with Copper Development Association's "Copper Tube Handbook," "Brazed Joints" chapter.
- N. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube

and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.

- O. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- P. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- Q. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- R. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join in accordance with ASTM D2846/D2846M Appendix.

3.5 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

- A. Install wall-type fire department connections.
- B. Install yard-type fire department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
- C. Install automatic (ball-drip) drain valve at each check valve for fire department connection.

3.6 INSTALLATION OF HOSE CONNECTIONS AND HOSE STATIONS

- A. Examine roughing-in for hose connections and hose stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and hose stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Install freestanding hose connections and hose stations for access and minimum passage restriction.
- E. Install NPS 1-1/2 hose-connection and hose-station valves with flow-restricting device unless otherwise indicated.
- F. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device unless otherwise indicated.
- G. Install wall-mounted-type hose connections and wall-mounted, rack hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 104413 "Fire Protection Cabinets."

- H. Install hose-reel hose stations on wall with bracket.

3.7 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.
- B. Install listed fire-suppression system shutoff valves in supervised open position, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. System Control Valves:
 - 1. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
 - 2. Install deluge valves with trim sets for drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
- D. Air Vent:
 - 1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
 - 2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
 - 3. Pipe from outlet of air vent to drain.

3.8 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings symmetrically in center of narrow dimension of acoustical ceiling panels within tolerance of 1/2 inch. Coordinate entire pattern of sprinkler locations with approved reflected ceiling plan.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping in accordance with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Perform the following tests and inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect fire-suppression systems in accordance with NFPA standards.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Coordinate with fire-pump tests. Operate as required.
 - 8. Verify that equipment hose threads are same as local fire department equipment.
 - 9. Verify that sprinklers' original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.
- C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.
- D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.
- E. Prepare test and inspection reports.

3.11 CLEANING

- A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.12 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain system control valves.

3.13 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. CPVC pipe, Schedule 40 CPVC fittings, and solvent-cemented joints may be used for light-hazard and residential occupancies.
- E. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the

Following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Schedule 40, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
4. Schedule 40, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
5. Schedule 40, black-steel pipe with cut-,or,roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
6. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
8. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
9. Schedule 10, steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
10. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.
11. Schedule 40 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.

F. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), to Be One of the Following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Schedule 40, black-steel pipe with cut-,or,roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.

G. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Schedule 40, black-steel pipe with cut-,or,roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.

3.14 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Pendent, recessed, flat concealed, vertical sidewall sprinklers as indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces and locations not generally exposed to view; and wax coated where exposed to acids, chemicals, or other corrosive fumes.
2. Recessed Sprinklers: Bright chrome, with factory-painted white escutcheon.
3. Flat Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
4. Residential Sprinklers: Dull chrome.

END OF SECTION 211000

SECTION 220500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves without waterstop.
2. Silicone sealants.
3. Escutcheons.

B. Related Requirements:

1. Section 221119 "Domestic Water Piping Specialties" for water meters.

1.2 DEFINITIONS

- ###### A. Existing Piping to Remain:
- Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
 - b. Include operating characteristics and furnished accessories.

B. Delegated Design Submittals:

For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of expansion joint to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.7 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water expansion fittings for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
- C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 SLEEVES AND SLEEVE SEALS

- A. Sleeves without Waterstop:
 - 1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
 - 2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
 - 3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
 - 4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
 - 5. Molded-PVC Sleeves: With nailing flange.
 - 6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.
- B. Grout:
 - 1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or

- floors.
- 2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- 3. Design Mix: 5000 psi, 28-day compressive strength.
- 4. Packaging: Premixed and factory packaged.

2.3 ESCUTCHEONS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company
 - 2. Mid-America Fittings, LLC; A Midland Industries Company
 - 3. ProFlo; a Ferguson Enterprises, Inc. brand
- B. Escutcheon Types:
 - 1. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; exposed-rivet hinge; and spring-clip fasteners.
- C. Floor Plates:
 - 1. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location

of joint.

- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.3 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.4 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

3.5 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
 - 1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
 - 2. Prepare test and inspection reports.
- B. Escutcheons:
 - 1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.6 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Interior Wall and Partitions:
 - a. Sleeves without waterstops.

3.7 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Chrome-Plated Piping: One piece, steel with polished, chrome-plated finish.
 3. Insulated Piping:
 - a. One piece, stamped steel split plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, stamped steel split plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
 5. Bare Piping in Unfinished Service Spaces:
 - a. One piece, stamped steel or split plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
- B. Install floor plates for piping penetrations of equipment-room floors.
- C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 1. New Piping and Relocated Existing Piping: One piece, floor plate.
 2. Existing Piping: Split floor plate.

END OF SECTION 220500

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Sections Includes:

1. Ball valves.
2. Check valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. FKM: Fluoroelastomer.
- D. NBR: Nitrile butadiene rubber (also known as Buna-N).
- E. NRS: Nonrising stem.
- F. OS&Y: Outside screw and yoke.
- G. PTFE: Polytetrafluoroethylene.
- H. RPTFE: Reinforced polytetrafluoroethylene.
- I. RS: Rising stem.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include material descriptions and dimensions of individual components.
 - b. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, press ends, solder ends, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.

5. Block check valves in either closed or open position.
 6. Set gate valves closed to prevent rattling.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:
1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
 2. ASME B16.1 for flanges on iron valves.
 3. ASME B16.5 for flanges on steel valves.
 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 5. ASME B16.18 for cast-copper solder-joint connections.
 6. ASME B16.22 for wrought-copper solder-joint connections.
 7. ASME B16.34 for flanged- and threaded-end connections.
 8. ASME B16.51 for press joint connections.
 9. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.3 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Press Ends - Brass, Two Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Viega LLC
 - c. WATTS; A Watts Water Technologies Company
2. Standards: MSS SP-110, MSS SP-145, IAPMO/ANSI Z1157.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Two piece.
5. Body Material: Forged brass.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Seats: PTFE or RPTFE.
9. Stem: Brass.
10. Ball: Chrome-plated brass.
11. Port: Full.
12. O-Ring Seal: NBR or EPDM.

2.4 CHECK VALVES, LEAD FREE

A. Check Valves, Lead Free, Swing Type, Press Ends - Bronze:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Milwaukee Valve Company
 - c. NIBCO INC.
2. Standards: MSS SP-80 and MSS SP-139.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B584, bronze.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Disc: Brass or bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Examine press fittings to verify they have been properly pressed.
- F. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and actuator or manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Install check valves for proper direction of flow and as follows:
 - 1. Check Valves: Center-guided type, in horizontal or vertical position, between flanges.
 - 2. Check Valves, Swing Type: In horizontal position with hinge pin level.
 - 3. Check Valves, Lift Type: With stem upright and plumb.
- I. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- J. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
 - 5. For Stainless Steel Piping, NPS 2 (DN 50) and Smaller: Press ends.
 - 6. For Stainless Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends.
 - 7. For Grooved-End Copper Tubing: Valve ends may be grooved.
 - 8. For Grooved-End Steel Piping: Valve ends may be grooved.
 - 9. Wafer-Type Valves: Flanged connections.

3.5 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Ball valves, lead free, press ends - brass, two piece with full port and brass trim.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Ball valves, lead free, flanged or threaded ends - iron, Class 125; threaded ends.

3.6 DOMESTIC HOT- AND COLD-WATER CHECK VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125; soldered ends.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Check valves, lead free, swing type, flanged or threaded ends - iron, with metal seats, Class 125; threaded ends.

END OF SECTION 220523

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports - metal.
2. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220500 "Common Work Results for Plumbing" for pipe guides and anchors.
3. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal strut support systems.
3. Rooftop-mounted strut support systems.
4. FRP strut support systems.
5. Pipe stands.
6. Equipment supports.

C. Delegated Design Submittals: For strut support systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication/assembly and design calculations for strut support systems.
2. Detail fabrication/assembly and design calculations for each type of strut support system, by the manufacturer's technical representative.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design , strut support systems, equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 PIPE HANGERS AND SUPPORTS - METAL

- A. Pipe Hangers and Supports - Carbon Steel:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Cooper B-line; brand of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
 - 2. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 3. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
 - 4. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
 - 5. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.4 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.
- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- F. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through

- insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
- 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Thermal hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
 - a. Thermal hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
 - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- H. Strut System Installation: Metal, rod type; arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems. Install in accordance with manufacturer's written installation instructions.
- I. Thermal Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- J. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions.
 - 3. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
 - 4. Install fasteners in accordance with manufacturer's written instructions.
- K. Pipe Stand Installation:
 - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- L. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

- M. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- N. Equipment Support Installation:
 - 1. Fabricate from welded-structural-steel shapes.
 - 2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
 - 3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
 - 4. Provide lateral bracing, to prevent swaying.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
 - 2. Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
 - 3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless steel pipe hangers and corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-

- beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548.13

VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Post-installed concrete anchors.

B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

1.2 DEFINITIONS

A. IBC: International Building Code.

B. RISBC: Rhode Island State Building Code

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Include load rating for each wind-load-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device component.
4. Annotate to indicate application of each product submitted and compliance with requirements.
5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:

1. For each wind-load protection device that is required by this Section or is indicated on

Drawings, submit the following:

- a. Vibration Isolator and Wind-Load-Restraint Selection: Select vibration isolators and wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
 - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
 - c. Concrete Anchors and Inserts: Include calculations showing anticipated wind loads.
 - d. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
 - 1) Qualified Professional Engineer: All designated-design submittals for wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.
 - e. Wind-Restraint Detail Drawings:
 - 1) Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
 - 2) Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during wind events. Indicate association with vibration isolation devices.
 - 3) Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
 - f. All delegated-design submittals for wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
 - g. Product Listing, Preapproval, and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and basis for approval (tests or calculations).
2. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
 3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.

- C. Welding certificates.
- D. Field quality-control reports.
- E. Wind-Load Performance Certification: Provide special certification for plumbing components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-load performance certification.
 - 1. Provide equipment manufacturer's written certification for each designated plumbing device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
 - 2. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-spring mounts to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01400 "Quality Requirements," to design system.
 - 1. Wind-Load Performance: Equipment and systems shall withstand the effects of high wind events determined in accordance with ASCE/SEI 7-16.
- B. Consequential Damage: Provide additional restraints for suspended fire-suppression system components or anchorage of floor-, roof-, or wall-mounted fire-suppression system components as indicated in ASCE/SEI 7-16 so that failure of a non-essential or essential fire-suppression system component will not cause failure of any other essential architectural, mechanical, or electrical building component.
- C. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a

maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.

D. Component Supports:

1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7-16 Section 13.6.

2.2 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hilti, Inc.
 - b. Mason Industries, Inc.
 - c. Powers Fasteners
2. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

B. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-05, Ch. 13.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

C. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp that is not vibration isolated.

1. Undercut expansion anchors are permitted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to wind load forces.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static forces within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL AND WIND-LOAD CONTROL DEVICES

- A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules, where indicated on Drawings, or where the Specifications indicate they are to be installed on specific equipment and systems.
- B. Provide wind-load control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- D. Installation of vibration isolators must not cause any stresses, misalignment or change of position of equipment or piping.
- E. Equipment Restraints:
 - 1. Install snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install wind-load-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- F. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify Project structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL MOTION

- A. Provide flexible connections in piping systems where they cross structural joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 221116 "Domestic Water Piping" and Section 221119 "Domestic Water Piping Specialties" for piping flexible connections.

3.5 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
1. Perform tests and inspections
 2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary

- load-spreading members.
 - 5. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect/Engineer.
 - 6. Test to 90 percent of rated proof load of device.
 - 7. Measure isolator restraint clearance.
 - 8. Measure isolator deflection.
 - 9. Verify snubber minimum clearances.
 - 10. Test and adjust restrained-air-spring isolator controls and safeties.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Units will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 220548.13

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Craftmark Pipe Markers
 - c. Pipemarker.com; Brimar Industries, Inc.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches,

1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Champion America
3. Marking Services Inc.

- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

- C. Letter and Background Color: As indicated for specific application under Part 3.

- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.3 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Craftmark Pipe Markers
3. Marking Services Inc.

- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire.

- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels,

complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Within 3 ft. of each valve and control device.
 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 3. Within 3 ft. of equipment items and other points of origination and termination.
 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- F. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- G. Pipe-Label Color Schedule:
1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
 3. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background.
 4. Sanitary Waste and Storm Drainage Piping: White letters on a black background.

3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 2 inches, round.
 - b. Domestic Hot Water: 2 inches, round.
 - c. Domestic Hot-Water Return: 2 inches, round.
 2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

END OF SECTION 220553

SECTION 220593

TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. TAB of domestic water system.
2. TAB of plumbing equipment:
 - a. Domestic hot-water in-line circulation pumps.
 - b. Drainage pumps.
3. Pipe-leakage test verification.
4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.3 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
 1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that

the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Sample report forms.
- G. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- B. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- C. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- D. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
 - 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on plumbing equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Perform system-readiness checks of plumbing systems and equipment to verify system

readiness for TAB work. Include, at a minimum, the following:

1. Domestic Water System:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
 - b. Water heaters are installed and functioning.
 - c. Piping is complete and all points of outlet are installed.
 - d. Water treatment is complete.
 - e. Systems are flushed, filled, and air purged.
 - f. Strainers are clean.
 - g. Control valves are functioning in accordance with the sequence of operation.
 - h. Shutoff and balance valves are 100 percent open.
 - i. Suitable access to balancing devices and equipment is provided.
2. Sanitary Sewage/Drainage System:
 - a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
 - b. Piping is complete.
 - c. Sanitary sewage pumps/drainage pumps are operational.
 - d. Control valves are functioning in accordance with the sequence of operation.
 - e. Shutoff valves are 100 percent open.
 - f. Suitable access to equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in ASHRAE 111 and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
 2. ."
- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
 1. Domestic water in-line pumps.
 2. Domestic water heaters.

3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
 - 1. Check expansion tank for proper setting.
 - 2. Check water heater for proper discharge temperature setting.
 - 3. Check remotest point of outlet for adequate pressure.
 - 4. Check flow-control valves for proper position.
 - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 - 6. Verify that motor controllers are equipped with properly sized thermal protection.
 - 7. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

3.6 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

- A. Balance system with manual or automatic balancing valves by setting at design flow.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- B. Adjust pump to deliver total design flow.
 - 1. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - 2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
 - 3. Mark final settings and verify that all memory stops have been set.
 - 4. Verify final system conditions as follows:

- a. Re-measure and confirm that total flow is within design.
- b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
- c. Mark final settings.

3.7 PROCEDURES FOR WATER HEATERS

A. Electric Water Heaters:

1. Measure and record entering- and leaving-water temperatures.

END OF SECTION 220593

SECTION 220719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less

than 50 ppm when tested in accordance with ASTM C871.

- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Knauf Insulation
 - c. Manson Insulation Inc.
 - 2. Preformed Pipe Insulation: Type I, Grade A, unfaced.
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

2.4 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 - 4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
 - 5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.7 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses

required for each item of pipe system, as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents, unless otherwise approved by the engineer-of-record.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation conforms to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. All insulation applications will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 1. NPS 1 and Smaller: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 2. NPS 1-1/4 and Larger: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 1. NPS 1-1/4 and Smaller: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 220719

SECTION 220800

COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Cx process requirements for the following plumbing systems, assemblies, and equipment:
 - 1. Domestic hot- and cold-water piping.
 - 2. Sanitary waste and vent piping.
 - 3. Plumbing equipment.
- B. Related Requirements:
 - 1. For construction checklists, comply with requirements in various Division 22 Sections specifying plumbing systems, system components, equipment, and products.

1.2 DEFINITIONS

- A. IAPMO: International Association of Plumbing and Mechanical Officials.
- B. IgCC: International Green Construction Code.
- C. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For plumbing testing technician.
- B. Construction Checklists:
 - 1. Cx plan, including material, installation, and performance construction checklists for systems, assemblies, subsystems, equipment, and components relating to plumbing to be part of the Cx process and in accordance with requirements in ASHRAE 202.
- C. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:
 - 1. Equipment/instrument identification number.
 - 2. Planned Cx application or use.
 - 3. Manufacturer, make, model, and serial number.
 - 4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 - 5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:

- a. Instrument or tool identification number.
- b. Equipment schedule designation of equipment for which the instrument or tool is required.
- c. Manufacturer, make, model, and serial number.
- d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

1.4 QUALITY ASSURANCE

- A. Plumbing Testing Technician Qualifications: Technicians to perform plumbing Construction Checklist verification tests. Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:

- 1. Journey level or equivalent skill level with knowledge of plumbing system, electrical concepts, and building operations.
- 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.

- B. Testing Equipment and Instrumentation Quality and Calibration:

- 1. Capable of testing and measuring performance within the specified acceptance criteria.
- 2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
- 3. Be maintained in good repair and operating condition throughout duration of use on Project.
- 4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.

- C. Proprietary Test Instrumentation and Tools:

- 1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
 - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
 - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
 - c. Plumbing system proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Cx PROCESS

- A. Perform Cx process for plumbing systems in accordance with:
 - 1. Commissioning standards acceptable to the authority having jurisdiction.

3.2 CONSTRUCTION CHECKLISTS

- A. Preliminary detailed construction checklists are to be prepared under Section 019113 "General Commissioning Requirements" for each plumbing system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in ASHRAE 202. Contractor performs the following:
1. Review plumbing preliminary construction checklists and provide written comments on Construction Checklist items where appropriate.
 2. Return preliminary Construction Checklist with review comments within 10 days of receipt.
 3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
 4. Use only construction checklists marked "Approved for Use, (date)." Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.
- B. Prepare preliminary detailed construction checklists for each plumbing system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in ASHRAE 202.
1. Submit preliminary construction checklists to CxA and Designer for review.
 2. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
 3. Use only construction checklists marked "Approved for Use, (date)." Mark construction checklists in the appropriate place as indicated Project events are completed, and provide pertinent details and other information.
 4. Domestic hot-water systems and controls.
- C. Additional Systems Required to Be Commissioned:
1. Facility water-distribution piping, including the following:
 - a. Domestic water piping, fittings, and specialties outside the building.
 - b. Pumps, motors, accessories, and controls.
 - c. Outdoor water-storage tanks.
 - d. Sleeves and sleeve seals.
 - e. Meters and gauges.
 - f. General-duty and specialty valves.
 - g. Hangers and supports.
 - h. Heat tracing.
 - i. Vibration isolation.
 2. Domestic water piping, including the following:
 - a. Domestic cold- and hot-water piping, fittings, and specialties inside the building.
 - b. Sleeves and sleeve seals.
 - c. Indoor water-storage tanks.
 - d. Meters and gauges.
 - e. General-duty and specialty valves.
 - f. Hangers and supports.
 - g. Vibration isolation.
 3. Sanitary waste and vent piping, including the following:

- a. Gravity and forced-main sewerage piping, fittings, and specialties.
 - b. Sanitary waste interceptors.
 - c. Pumps, motors, accessories, and controls.
 - d. Drains.
 - e. Sleeves and sleeve seals.
 - f. General-duty and specialty valves.
 - g. Hangers and supports.
 - h. Vibration isolation.
4. Plumbing fixtures, including the following:
- a. Water closets, supports and connections, supplies, and flush valves.
 - b. Urinals, supports and connections, supplies, and flush valves.
 - c. Lavatories, supports, supplies, drain connections, and faucets.
 - d. Sinks, supports, supplies, drain connections, and faucets.
 - e. Tubs, drain connections, and faucets.
 - f. Showers, supplies, drain connections, and faucets.
 - g. Drinking fountains, supplies, and drainage connections.

3.3 Cx TESTING PREPARATION

- A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that plumbing system instrumentation and control systems have been completed and calibrated, point-to-point checkout has been successfully completed, and systems are operating in accordance with their design sequence of operation, Contract Documents, and approved submittals. Certify that all sensors are operating within specified accuracy and that all systems are set to and maintaining set points as required by the design documents.
- C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect/Engineer, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
 - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
 - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.

- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.5 Cx TESTS COMMON TO PLUMBING SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response compared to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 22 Sections specifying plumbing systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
 - 1. Cx Construction Checklist verification tests.
 - 2. Cx Construction Checklist verification test demonstrations.

3.6 CONSTRUCTION CHECKLIST EXAMPLES

- A. Vibration Isolation in Plumbing Systems:
 - 1. Prerequisites: Acceptance of results of construction checklists for vibration control devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
 - 2. Components to Be Tested:
 - a. Vibration isolation control devices in plumbing systems.
 - b. Support systems.
 - 3. Test Purpose: Evaluate effectiveness of vibration isolation control devices.
 - 4. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness at the following operating conditions:
 - a. Maximum speed.
 - b. Minimum speed.
 - c. Critical speed.
 - 5. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.
- B. Supervision of Alarms in Plumbing Systems:
 - 1. Prerequisites: Acceptance of results of construction checklists for plumbing systems specified in the following Sections:

END OF SECTION 220800

SECTION 221116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. PEX tube and fittings - domestic water.
3. Piping joining materials - domestic water.
4. Encasement for piping.
5. Transition fittings - domestic water.
6. Dielectric fittings - domestic water.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper tube and fittings - domestic water.
2. PEX tube and fittings - domestic water.
3. PEX-AL-PEX tube and fittings - domestic water.
4. PEX-AL-HDPE tube and fittings - domestic water.
5. PVC pipe and fittings - domestic water.
6. Piping joining materials - domestic water.
7. Encasement for piping.
8. Transition fittings - domestic water.
9. Dielectric fittings - domestic water.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service in accordance with requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Architect's written permission.

1.6 WARRANTY

- A. Polypropylene (PP-R and PP-RCT) Pipe and Fittings Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R and PP-RCT pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.
 - 1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of piping system due to defects in materials or manufacturing.
 - 2. Warranty is to be in effect only upon submission by Contractor to manufacturer of valid pressure/leak documentation indicating that the system was tested and passed manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

- A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cambridge-Lee Industries, LLC
 - b. Cerro Flow Products, LLC
 - c. Mueller Streamline Co.; a company of Mueller Industries

- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.
- D. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.
- E. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.
- F. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. NIBCO INC.
 - c. Viega LLC
 - 2. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
 - 3. Housing: Copper.
 - 4. O-Rings and Pipe Stops: EPDM.
 - 5. Tools: Manufacturer's special tools.
 - 6. Minimum 200 psig working-pressure rating at 250 deg F.

2.4 PEX TUBE AND FITTINGS - DOMESTIC WATER

- A. PEX Tube - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. IPEX USA LLC
 - b. NIBCO INC.
 - c. Uponor Inc.
 - 2. Source Limitations: Obtain PEX tube from single manufacturer.
 - 3. Tube Material: PEX plastic in accordance with ASTM F876.
- B. PEX Tube Fittings - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. NIBCO INC.
 - b. Oatey Co.
 - c. Uponor Inc.

2. Source Limitations: Obtain PEX tube fittings from single manufacturer.
 3. Fittings: ASTM F1807, metal insert and copper crimp rings.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

2.5 PIPING JOINING MATERIALS - DOMESTIC WATER

- A. Pipe-Flange Gasket Materials:
1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
- G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.
- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.6 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: tube.
- C. Color: natural.

2.7 TRANSITION FITTINGS - DOMESTIC WATER

- A. General Requirements:
1. Same size as pipes to be joined.
 2. Pressure rating at least equal to pipes to be joined.
 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Plastic-to-Metal Transition Fittings - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Charlotte Pipe and Foundry Company
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Uponor Inc.
2. Source Limitations: Obtain plastic-to-metal transition fittings from single source.
3. Description:
 - a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Company
2. Source Limitations: Obtain plastic-to-metal transition unions from single manufacturer.
3. Description:
 - a. PVC four-part union.
 - b. Brass threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.8 DIELECTRIC FITTINGS - DOMESTIC WATER

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions - Domestic Water:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Jomar Valve
 - c. WATTS; A Watts Water Technologies Company
 2. Source Limitations: Obtain dielectric unions from single manufacturer.
 3. Standard: ASSE 1079.
 4. Pressure Rating: 125 psig minimum at 180 deg F.
 5. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric-Flange Insulating Kits - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, LLC
 - b. CALPICO, Inc.
 - c. GPT; a division of EnPRO Industries
2. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
3. Nonconducting materials for field assembly of companion flanges.
4. Pressure Rating: 150 psig.
5. Gasket: Phenolic, Temperature Rating: 225 deg F.
6. Bolt Sleeves: Phenolic or polyethylene.
7. Washers: Phenolic with steel backing washers.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller is to be the following:
 1. Annealed-temper copper tube, ASTM B88, Type L; copper pressure-seal fittings; and pressure-sealed joints.
 2. PVC, Schedule 40; socket fittings; and solvent-cemented joints.
 3. Polypropylene (PP-R and PP-RCT), SDR 7.4 pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger is to be the following:
 1. Annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
 2. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
 3. Push-on joint, ductile-iron pipe; standard-pattern, push-on joint fittings; and gasketed joints.
 4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 5. PVC, Schedule 40; socket fittings; and solvent-cemented joints.
 6. Polypropylene (PP-R and PP-RCT), SDR 7.4 pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.

- F. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
1. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 2. PEX tube, NPS 1 and smaller.
 - a. Fittings for PEX tube:
 - 1) ASTM F1807, metal insert and copper crimp rings.
 - 2) ASTM F1960, cold expansion fittings and reinforcing rings.
 - 3) ASSE 1061, push-fit fittings.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) is to be the following:
1. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.2 EARTHWORK

- A. Comply with requirements in Section 310000 "Earth Work" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.
- D. Install underground copper tube in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.
- E. Install valves in accordance with Section 220523 "General-Duty Valves for Plumbing Piping."
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants

unless otherwise indicated and except in equipment rooms and service areas.

- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install PEX tube with loop at each change of direction of more than 90 degrees.
- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Results for Plumbing."
- T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic Water Pumps."
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or

damaged.

- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints in accordance with AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Joint Construction for Grooved-End Steel Piping: Make joints in accordance with AWWA C606. Square cut groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
- M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join in accordance with ASTM D2846/D2846M.
 - 3. PVC Piping: Join in accordance with ASTM D2855.
- N. Joints for PEX Tubing, ASTM: Join in accordance with ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.
- O. Joints for PEX Tubing, ASSE: Join in accordance with ASSE 1061 for push-fit fittings.
- P. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition unions.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install hangers for copper and tube and pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install vinyl-coated hangers for PEX tube, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.
- F. Support vertical runs of copper to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of PEX tube to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system in accordance with either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

- b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
 - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - g. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 221116

SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Temperature-actuated, water mixing valves.
4. Strainers for domestic water piping.
5. Outlet boxes.
6. Wall hydrants.
7. Drain valves.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 331415 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

1.2 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pressure Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. WATTS; A Watts Water Technologies Company
 - c. Zurn Industries, LLC
 - 2. Standard: ASSE 1020.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 5 psig maximum, through middle third of flow range.
 - 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. WATTS; A Watts Water Technologies Company
 - c. Zurn Industries, LLC

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Body: Bronze for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for vertical flow.
7. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acorn Controls; a Division of Morris Group International
 - b. POWERS; A Watts Water Technologies Company
 - c. Zurn Industries, LLC
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.
7. Finish: Chrome plated.
8. Tempered-Water Setting: **110 deg F**.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Titan Flow Control, Inc.
 - b. WATTS; A Watts Water Technologies Company
 - c. Zurn Industries, LLC
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Drain: Pipe plug.

2.7 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Oatey Co.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Symmons Industries, Inc
2. Mounting: Recessed.
3. Material and Finish: Plastic box and faceplate.
4. Drain Outlet Connection: NPS 2.
5. Accessory: Water hammer arresters.
6. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
7. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
8. Inlet Hoses: Two 60-inch- long, rubber, household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
9. Drain Hose: One 48-inch- long, rubber, household clothes washer drain hose with hooked end.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. WATTS; A Watts Water Technologies Company
 - b. Woodford Manufacturing Company
 - c. Zurn Industries, LLC
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Rough bronze.
10. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Rough bronze.
12. Operating Keys(s): Two with each wall hydrant.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- C. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- D. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.
- E. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- F. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Y-Pattern Strainers: For water, install on supply side of each water pressure-reducing valve.
- H. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

- I. Nonfreeze, Draining-Type Roof Hydrants: Install with drain connection piped to nearest floor drain or to the exterior.
- J. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- K. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Automatic water shutoff valve systems.
 - 5. Balancing valves.
 - 6. Temperature-actuated, water mixing valves.
 - 7. Outlet boxes.
 - 8. Wall hydrants.
 - 9. Roof hydrants.
 - 10. Water meters.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.

- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each reduced-pressure-principle backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections.
 - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221123
FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Manual gas shutoff valves.
 2. Pressure regulators.
 3. Dielectric fittings.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.3 ACTION SUBMITTALS

- A. Product Data:
1. Piping specialties.
 2. Corrugated, stainless steel tubing with associated components.
 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 4. Pressure regulators. Indicate pressure ratings and capacities.
 5. Dielectric fittings.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

- B. Welding certificates.
- C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- D. Field quality-control reports.
- E. Qualification Statements: For professional engineer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with the ASME Boiler and Pressure Vessel Code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide purging and startup of natural-gas supply in accordance with requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of natural-gas service.
 - 2. Do not proceed with interruption of natural-gas service without Architect's written permission.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed and concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."
- C. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 220553 "Identification of Plumbing Piping and Equipment."

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each product type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Comply with the International Fuel Gas Code.
- B. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
- C. Natural-Gas System Pressure within Buildings:
 - 1. Single Pressure: 0.5 psig or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
6. Mechanical Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Baker Hughes Company
 - 2) Smith-Blair, a Xylem brand.
 - b. Steel flanges and tube with epoxy finish.
 - c. NBR seals.
 - d. Steel bolts, washers, and nuts.
 - e. Coupling is to be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - f. Steel body couplings installed underground on plastic pipe are to be factory equipped with anode.

2.4 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated, stainless steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Seals: Nitrile.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Basket Strainers:

1. Body: ASTM A126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

F. Weatherproof Vent Cap:

1. Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.5 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Press Fittings
- C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.6 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 1. CWP Rating: 125 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Service Mark: Valves NPS 1-1/4 to NPS 2 having initials "WOG" permanently marked on valve body.
- B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
4. Service Mark: Initials "WOG" permanently marked on valve body.

C. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Lee Brass Company
2. Body: Bronze, complying with ASTM B584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.7 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dormont; A Watts Water Technologies Company
 - b. Maxitrol Company
 - c. Schneider Electric USA, Inc.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: NBR; resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: UV-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.

9. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Jomar Valve
 - b. WATTS; A Watts Water Technologies Company
 - c. Wilkins
 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.9 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description and rated pressure of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.
- B. Label and identify gas piping and pressure outside a multitenant building by tenant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

- B. Inspect natural-gas piping in accordance with the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for preventing accidental ignition.

3.3 INSTALLATION OF INDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Do not install piping in concealed locations unless sleeved with the sleeve open at both ends.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Where installing piping above accessible ceilings, allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access. Do not locate valves within return air plenums.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
 - 2. Install sediment trap on both sides of regulators for gas reduction to 2 psig with valve and cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or

floors, and in floor channels unless indicated to be exposed to view.

- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gauge upstream and downstream from each line regulator. Pressure gauges are specified in Section 230500 "Common Work Results for HVAC."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230500 "Common Work Results for HVAC."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Common Work Results for HVAC."

3.4 INSTALLATION OF VALVES

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.
- F. Do not install valves in return-air plenums.

3.5 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints in accordance with AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, and then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join in accordance with ASTM D2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for corrugated stainless steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.
- F. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of corrugated stainless steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 PIPING CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas-appliance equipment grounding conductor of the circuit powering the appliance in accordance with NFPA 70.
- C. Where installing piping adjacent to appliances, allow space for service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

3.8 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.9 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test, inspect, and purge natural gas in accordance with the International Fuel Gas Code and authorities having jurisdiction.
2. Natural-gas piping will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground, branch piping NPS 1 and smaller is to be the following:

1. Steel pipe

B. Aboveground, distribution piping is to be the following:

1. Steel pipe .

3.12 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter are to be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter are to be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller are to be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger are to be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, lubricated plug valve.

E. Valves in branch piping for single appliance are to be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 231123

SECTION 221123.21

INLINE, DOMESTIC-WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. In-line, sealless centrifugal pumps.

1.2 ACTION SUBMITTALS

- A. Product Data Submittals: For each product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which pumps will be attached.
2. Size and location of initial access modules for acoustical tile.

- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: UL 778 for motor-operated water pumps.
- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. GRUNDFOS CBS Inc.
 - 2. Taco Comfort Solutions
 - 3. WILO USA LLC - WILO Canada Inc.
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Minimum Working Pressure: 125 psig.
 - 3. Maximum Continuous Operating Temperature: 220 deg F.
 - 4. Casing: Cast iron, with threaded or companion-flange connections.
 - 5. Impeller: composite.
 - 6. Motor: Single speed.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Type: Water-immersion temperature sensor, for installation in piping.
 - 2. Range: 50 to 125 deg F.
 - 3. Operation of Pump: On or off.

4. Transformer: Provide if required.
5. Power Requirement: 120 V ac.
6. Settings: Start pump at 110 deg F and stop pump at 120 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 INSTALLATION OF PUMPS

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Pump Mounting:
 1. Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using vibration isolation type and deflection as specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
 1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
 2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- E. Install pressure switches in water-supply piping.
- F. Install thermostats in hot-water return piping.
- G. Install timers .
- H. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping."

Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
 - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
 - d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 - 1. Install pressure gauge at suction of each pump and pressure gauge at discharge of each pump. Install at integral pressure-gauge tapings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220500 "Common Work Results for Plumbing."

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between temperature controllers and devices.

3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- C. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set thermostats, for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 7. Start motor.
 - 8. Open discharge valve slowly.
 - 9. Adjust temperature settings on thermostats.

3.8 ADJUSTING

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123.21

SECTION 221316
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. PVC pipe and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.4 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

1.5 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10 ft. head of water.
 - 2. Waste, Force-Main Piping: 50 psig.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Charlotte Pipe and Foundry Company
 - 2. National Pipe and Plastic, Inc. (Oldcastle)
 - 3. North America Pipe Corporation
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.
- E. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- F. Adhesive Primer: ASTM F656.
 - 1. Product Data: Verify adhesive primer has a VOC content of 550 g/L or less.
 - 2. Product Data: Verify adhesive primer complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 3. Product Data: Verify adhesive primer complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or

- 7 ppb, whichever is less.
4. Product Data: Verify adhesive primer complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde does not exceed 9 mcg/cu. m.

G. Solvent Cement: ASTM D2564.

1. Product Data: Verify PVC welding solvent cement has a VOC content of 510 g/L or less.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.
- C. Form: tube.
- D. Color: natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 310000 "Earth Work."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 3. Do not change direction of flow more than 90 degrees.
 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.

- M. Install aboveground PVC piping in accordance with ASTM D2665.
- N. Install underground PVC piping in accordance with ASTM D2321.
- O. Install engineered soil and waste and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- P. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.

2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- C. Joint Restraints and Sway Bracing:
 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 1. Install transition couplings at joints of piping with small differences in ODs.
 2. In Waste Drainage Piping: Unshielded, nonpressure transition couplings.
 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
 - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
 3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
 4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- E. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

- a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed Plastic Piping: Protect PVC plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller are to be the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Aboveground, vent piping NPS 4 (DN 100) is to be the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- F. Underground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Air-admittance valves.
3. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 077200 "Roof Accessories" for preformed flashings.
3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
4. Section 221323 "Sanitary Waste Interceptors" for metal and concrete interceptors outside the building, grease interceptors, grease-removal devices, oil interceptors, and solids interceptors.
5. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.2 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

- A. Plastic Floor Cleanouts (Insert drawing designation, if any):
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. IPS Corporation
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Zurn Industries, LLC
 - 2. Size: Same as connected branch.
 - 3. Body: PVC.
 - 4. Closure Plug: PVC.
 - 5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.3 AIR-ADMITTANCE VALVES

- A. Fixture Air-Admittance Valves (Insert drawing designation, if any):
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Oatey Co.
 - b. ProVent Systems
 - c. Studor, Inc
 - 2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
 - 3. Housing: Plastic.
 - 4. Operation: Mechanical sealing diaphragm.
 - 5. Size: Same as connected fixture or branch vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install fixture air-admittance valves on fixture drain piping.
- E. Install stack air-admittance valves at top of stack vent and vent stack piping.
- F. Install air-admittance-valve wall boxes recessed in wall.
- G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- H. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- I. Install vent caps on each vent pipe passing through roof.
- J. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- L. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- M. Install wood-blocking reinforcement for wall-mounting-type specialties.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to

identifying unit.

1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13

SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Floor drains.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains are to bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

- A. Plastic Floor Drains (Insert drawing designation if any):
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Josam Company
 - c. Sioux Chief Manufacturing Company, Inc.
- 2. Source Limitations: Obtain plastic floor drains from single manufacturer.
 - 3. Standard: ASME A112.6.3.
 - 4. Material: PVC.
 - 5. Outlet: Bottom.
 - 6. Top or Strainer Material: Bronze.
 - 7. Top of Body and Strainer Finish: Nickel bronze.
 - 8. Top Shape: Round.
 - 9. Trap Material: Plastic drainage piping.
 - 10. Trap Pattern: Standard P-trap.

PART 3 - EXECUTION

3.1 INSTALLATION OF SANITARY DRAINS

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 - 3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 - 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- B. Install trench drains at low points of surface areas to be drained.
 - 1. Set grates of drains flush with finished surface, unless otherwise indicated.
- C. Comply with ASME A112.3.1 for installation of stainless steel channel drainage systems.
 - 1. Install on support devices, so that top will be flush with adjacent surface.
- D. Install FRP channel drainage system components on support devices, so that top will be flush with adjacent surface.
- E. Install plastic channel drainage system components on support devices, so that top will be flush with adjacent surface.

- F. Install open drain fittings with top of hub 1 inch above floor.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.
- D. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

SECTION 223400

FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial, power-vent, gas-fired, storage, domestic-water heaters.
2. Commercial, direct-vent, gas-fired, storage, domestic-water heater.
3. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of commercial, gas-fired, domestic-water heater.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Two year(s).
 - b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Component Importance Factor: 1.5.
- C. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.
 1. Comply with efficiency requirements in ASHRAE 189.1, which supersede requirements in ASHRAE/IESNA 90.1.
- D. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Power-Vent, Gas-Fired, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A. O. Smith Corporation
 - b. Rheem Manufacturing Company
 - c. State Industries
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: ANSI Z21.10.3/CSA 4.3.
4. Storage-Tank Construction: Non-ASME-code steel with 150-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Lining: Glass complying with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
5. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - d. Insulation: Comply with ASHRAE/IES 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner: For use with power-vent, gas-fired, domestic-water heaters and natural-gas fuel.
 - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 60730-2-5, electric, automatic,

- gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.
- 6. Special Requirements: NSF 5 construction.
 - 7. Power-Vent System: Exhaust fan, interlocked with burner.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Expansion Tanks:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMTROL, Inc.
 - b. State Industries
 - c. Taco Comfort Solutions
 - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
 - 3. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 - 4. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.
- F. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section

220523 "General-Duty Valves for Plumbing Piping."

1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."
- G. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.
- H. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig pressure rating as required to match gas supply.
- I. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.
- J. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
 2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.
- K. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.
 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
 2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.
- L. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- M. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater minimum of 18 inches above the floor.
- N. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF DOMESTIC-WATER HEATER

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on

concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 2. Maintain manufacturer's recommended clearances.
 3. Arrange units so controls and devices that require servicing are accessible.
 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 floor.
 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 8. Anchor domestic-water heaters to substrate.
- B. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
 4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."
- D. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" and Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- G. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

- H. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."
- I. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."
- J. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- K. Fill domestic-water heaters with water.
- L. Charge domestic-water expansion tanks with air to required system pressure.
- M. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
- B. Comply with requirements for gas piping specified in Section 221123 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency:
 - 1. Owner will engage a qualified testing agency to perform tests and inspections.
 - 2. Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION 223400

SECTION 224200

COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial lavatories.
2. Commercial showers.
3. Commercial sinks.
4. Commercial urinals.
5. Commercial water closets.
6. Flushometer valves.
7. Toilet seats.
8. Fixture carriers.

1.2 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. High-Efficiency Flush Volume: 1.28 gal. or less per flush.
- C. PMMA: Polymethyl methacrylate; also known as "acrylic."
- D. Standard-Efficiency Flush Volume: 1.6 gal. per flush.
- E. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions and thicknesses, dimensions of individual components and profiles, and finishes for plumbing fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Plans, elevations, sections, and mounting details.
2. Details of equipment assemblies, including accessories. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, location and size of each field connection, location and size of each cutout, and anchorage provisions and attachment methods. Indicate coordination requirements for adjacent and interfacing Work.
3. Diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1. Plumbing Fixtures: Provide the following:
 - a. Manufacturer cut sheet indicating water consumption.
 - b. WaterSense certification for residential fixtures, commercial water closets, commercial urinals, and commercial showers.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories and/or counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For lavatories and faucets.
 - a. In addition to items specified in Section 017800 "Project Closeout," include the following:
 - 1) Servicing and adjustments of automatic faucets.
2. For shower valves to include in maintenance manuals.
3. For sinks and faucets to include in operation and maintenance manuals.
 - a. In addition to items specified in Section 017800 "Project Closeout," include the following:
 - 1) Servicing and adjustments of automatic faucets.
4. For flushometer valves and electronic sensors to include in operation and maintenance manuals.
5. For wash fountains and components to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
 3. Shower Valve Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 4. Shower Valve Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
 5. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- 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.

2.2 COMMERCIAL LAVATORIES

- A. Lavatories, Counter Mounted:

- B. Lavatories, Wall Mounted:

- 1. Lavatories, Wall Mounted - Vitreous China, Rectangular, Wheelchair:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) American Standard
 - 2) Kohler Co
 - 3) Zurn Industries, LLC

- b. Fixture:

- 1) Standard: ASME A112.19.2/CSA B45.1.
 - 2) Type: Wheelchair.
 - 3) Nominal Size: Rectangular, 27 by 20 inches.
 - 4) Faucet-Hole Punching: One hole.
 - 5) Faucet-Hole Location: Top.
 - 6) Color: White.
 - 7) Mounting: For concealed-arm carrier.

- c. Support: concealed-arm.

- d. Lavatory Mounting Height: Accessible in accordance with ICC A117.1.

- C. Lavatory Faucets, Automatically Operated:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American Standard
 - b. Kohler Co
 - c. Sloan Valve Company

2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. Operation Type: Battery powered electronic sensor operated, mixing.
4. 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.
5. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
6. Body Type: Single hole.
7. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
8. Finish: Polished chrome plate.
9. Maximum Flow Rate: 0.5 gpm.
10. Mounting Type: Deck, concealed.
11. Spout: Rigid type.
12. Spout Outlet: Aerator.
13. Drain: Not part of faucet.

D. Lavatory Supply Fittings:

1. NSF Standards: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
2. Standard: ASME A112.18.1/CSA B125.1.
3. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
4. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
5. Operation: Wheel handle.
 - a. Risers Size: NPS 3/8.
 - b. Risers Material: ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel, flexible hose.

E. Lavatory Waste Fittings:

1. Standard: ASME A112.18.2/CSA B125.2.
2. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
3. Trap:
 - a. Size: NPS 1-1/2 by NPS 1-1/4.
 - b. Material:
 - 1) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.
 - 2) Stainless steel, two-piece trap and swivel elbow with 0.012-inch thick stainless steel tube to wall, and stainless steel wall flange.

2.3 COMMERCIAL SHOWERS

A. Showers ADA, Individual:

1. Showers, Individual - FRP, One Piece without Top:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Oasis
- 2) Florestone Products Co., Inc.
- 3) American Standard
- 4) Kohler

- b. Source Limitations: Obtain FRP showers without top from single source from single manufacturer.
- c. Description: FRP shower enclosure with valve and receptor and appurtenances.
- d. Standard: CSA B45.5/IAPMO Z124.
- e. Style: Accessible in accordance with ICC A117.
- f. Color: White.
- g. Outlet: Drain with NPS 2 outlet.

B. Shower Valve Assemblies:

1. Shower Valve Assemblies - Single-Handle, Thermostatic/Pressure-Balancing Mixing Valve with Head:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Chicago Faucets; Geberit Group
 - 2) POWERS; A Watts Water Technologies Company
 - 3) American Standard
 - b. Source Limitations: Obtain shower heads and shower valves from single source from single manufacturer.
 - c. Description: Single-handle, accessible,thermostatic/pressure-balancing mixing valve with hot- and cold-water indicators; diverting valvecheck stops; and hose with handheld shower head on sliding rodshower head.
 - d. Shower Valve:
 - 1) Standards:
 - a) ASME A112.18.1/CSA B125.1.
 - b) ASSE 1016/ASME A112.1016/CSA B125.16.
 - 2) Body Material: Solid brass.
 - 3) Mounting: Concealed.
 - 4) Operation: Single-handle, twist or rotate control.
 - 5) Antiscald Device: Integral with mixing valve.
 - 6) Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
 - e. Supply Connections: NPS 1/2.
 - f. Shower Head:
 - 1) Standard: ASME A112.18.1/CSA B125.1.
 - 2) Type: Ball joint with arm and flange.
 - 3) Shower Head Material: Metallic with chrome-plated finish.
 - 4) Spray Pattern: Fixed.
 - 5) Integral Volume Control: Required.
 - 6) Temperature Indicator: Not required.

C. Grout:

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink; recommended for interior and exterior applications.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

2.4 COMMERCIAL SINKS

A. Service Sinks, Floor Mounted:

1. Service Sinks, Floor Mounted - Molded Stone:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Fiat Products
 - 2) Florestone Products Co., Inc.
 - 3) Mustee
- b. Source Limitations: Obtain sinks from single source from single manufacturer.
- c. Fixture:
 - 1) Standard: ASME A112.18.2/CSA B125.2.
 - 2) Shape: Square.
 - 3) Nominal Size: 24 by 24 inches.
 - 4) Height: 10 inches.
 - 5) Rim Guard: On all top surfaces.
 - 6) Drain: Grid with NPS 3 outlet.
- d. Mounting: On floor and flush to wall.

B. Kitchen/Utility Sinks:

1. Kitchen/Utility Sinks, Counter Mounted - Stainless Steel:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkay
 - 2) Just Manufacturing
 - 3) American Standard
- b. Source Limitations: Obtain sinks from single source from single manufacturer.
- c. Fixture:
 - 1) Standard: ASME A112.19.3/CSA B45.4.
 - 2) Type: Stainless steel, self-rimming, sound-deadened unit with ledge back.
 - 3) Number of Compartments: One.
 - 4) Material: 18 gauge, Type 304 stainless steel.
 - 5) Compartment:

- a) Drain: Grid with NPS 1-1/2 tailpiece and twist drain.
 - b) Drain Location: Centered in compartment.
 - c) Depth: Accessible in accordance with ICC A117.1.
 - d. Faucet(s): .
 - 1) Number Required: One.
 - 2) Mounting: On ledge.
 - e. Supply Fittings:
 - 1) Standard: ASME A112.18.1/CSA B125.1.
 - 2) Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - a) Operation: Wheel handle.
 - b) Risers: NPS 1/2, .
 - f. Waste Fittings:
 - 1) Standard: ASME A112.18.2/CSA B125.2.
 - 2) Trap(s) Size: NPS 1-1/2.
 - 3) Trap(s) Material:
 - a) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
 - b) Stainless steel, two-piece trap and swivel elbow with 0.012-inch- thick stainless steel tube to wall; and stainless steel wall flange.
 - 4) Continuous Waste:
 - a) Size: NPS 1-1/2.
 - b) Material: Chrome-plated, 17-gauge brass tube.
 - g. Mounting: On counter with sealant.
- C. Sink Faucets, Manually Operated:
 - 1. Sink Faucets, Manually Operated: Single control, mixing.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) American Standard
 - 2) Chicago Faucets; Geberit Group
 - 3) Kohler Co
 - b. Source Limitations: Obtain sink faucets from single source from single manufacturer.
 - c. Standards:
 - 1) ASME A112.18.1/CSA B125.1.
 - 2) NSF 61.

3) NSF 372.

- d. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
- e. Body Type: Centerset.
- f. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
- g. Finish: Chrome plated.
- h. Maximum Flow Rate: 1.5 gpm.
- i. Mounting Type: Deck, concealed.

2. Sink Faucets, Manually Operated - Service Sink:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Acorn Engineering Company; a Division of Morris Group International
 - 2) Chicago Faucets; Geberit Group
 - 3) Fiat Products
 - 4) Just Manufacturing
- b. Source Limitations: Obtain sink faucets from single source from single manufacturer.
- c. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
- d. Faucet:
 - 1) Standards:
 - a) ASME A112.18.1/CSA B125.1.
 - b) NSF 61 and NSF 372.
 - c) ICC A117.1.
 - d) ASSE 1001 (VB).
- e. Vacuum Breaker: Required for hose outlet.

D. Sink Supply Fittings:

- 1. NSF Standards: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- 2. Standard: ASME A112.18.1/CSA B125.1.
- 3. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
- 4. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- 5. Operation: Wheel handle.
 - a. Risers Sizes: NPS 3/8.
 - b. Risers Material: ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

E. Sink Waste Fittings:

1. Standard: ASME A112.18.2/CSA B125.2.
2. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
3. Trap:
 - a. Size: NPS 1-1/2.
 - b. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.

F. Grout:

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink; recommended for interior and exterior applications.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

2.5 COMMERCIAL URINALS

A. Urinals, Wall Hung:

1. Urinals, Wall Hung - Back Outlet, Blowout:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) American Standard
 - 2) Kohler Co
 - 3) Zurn
 - b. Fixture:
 - 1) Standards:
 - a) ASME A112.19.2/CSA B45.1.
 - b) ASME A112.19.5/CSA B45.15.
 - 2) Material: Vitreous china.
 - 3) Strainer or Trapway: Manufacturer's standard strainer with integral trap.
 - 4) Water Consumption: 0.5 gpf
 - 5) Spud Size and Location: NPS 1-1/4; top.
 - 6) Outlet Size and Location: NPS 2; back.
 - c. Waste Fitting:
 - 1) Standard: ASME A112.18.2/CSA B125.2 for coupling.
 - 2) Size: NPS 2.

2.6 COMMERCIAL WATER CLOSETS

A. Water Closets, Wall Mounted:

1. Water Closets, Wall Mounted - Top Spud:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) American Standard
 - 2) Kohler Co
 - 3) TOTO USA, INC
- b. Source Limitations: Obtain water closets from single source from single manufacturer.
- c. Standard: ASME A112.19.2/CSA B45.1.
- d. Bowl:
 - 1) Material: Vitreous china.
 - 2) Type: Siphon jet.
 - 3) Style: Flushometer valve.
 - 4) Rim Contour: Elongated.
 - 5) Water Consumption: 1.28 gal.
 - 6) Spud Size and Location: NPS 1-1/2; top.

2.7 FLUSHOMETER VALVES

- A. Flushometer Valves, Manually Operated:
- B. Flushometer Valves, Sensor Operated:
- C. Flushometer Valves, Sensor Operated - Piston, Battery Powered:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard
 - b. Kohler Co
 - c. Sloan Valve Company
 - d. TOTO USA, INC
 - 2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
 - 3. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
 - 4. Minimum Pressure Rating: 125 psig.
 - 5. Features: Include integral check stop and backflow-prevention device.
 - 6. Material: Brass body with corrosion-resistant components.
 - 7. Style: Exposed
 - 8. Exposed Flushometer-Valve Finish: Chrome plated.
 - 9. Panel Finish: Chrome-plated or stainless steel.
 - 10. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
 - 11. Consumption: 1.28 gal.
 - 12. Minimum Inlet: NPS 1.
 - 13. Minimum Outlet: NPS 1-1/4.

2.8 TOILET SEATS

A. Toilet Seats - Commercial:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard
 - b. Bemis Manufacturing Company
 - c. Kohler Co
2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
3. Standard: IAPMO/ANSI Z124.5.
4. Material: Plastic.
5. Type: Commercial (heavy duty).
6. Shape: Elongated rim, open front

2.9 FIXTURE CARRIERS

A. Fixture Carriers - Lavatory:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Josam Company
 - c. Zurn Industries, LLC
2. Source Limitations: Obtain lavatory carriers from single source from single manufacturer.
3. Standards:
 - a. ASME A112.6.1M.
 - b. ASME A112.6.2.

B. Fixture Carriers - Urinal:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. Josam Company
 - c. Zurn Industries, LLC
2. Source Limitations: Obtain urinal carriers from single source from single manufacturer.
3. Standard: ASME A112.6.1M.
4. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture

C. Fixture Carriers - Water Closet:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International
 - b. WATTS; A Watts Water Technologies Company
 - c. Zurn Industries, LLC
2. Source Limitations: Obtain water closet carriers from single source from single manufacturer.
3. Standard: ASME A112.6.1M.
4. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.
- C. Examine counters for suitable conditions where lavatories and sinks will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

- A. Lavatory Installation:
 1. Install lavatories level and plumb in accordance with roughing-in drawings.
 2. Install supports, affixed to building substrate, for wall-mounted lavatories.
 3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.
 4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.
 5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.
 6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
 7. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
 8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- B. Shower Installation:

1. Assemble shower components in accordance with manufacturers' written instructions.
2. Install showers level and plumb in accordance with roughing-in drawings.
3. Install ball valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with ball valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping." Install valves in locations that are accessible for ease of operation.
4. Install shower flow-control fittings with specified maximum flow rates in shower arms.
5. Set shower basins in leveling bed of cement grout.
6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
7. Showers, except Cast-Polymer Showers: Seal joints between showers, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
8. Cast-Polymer Showers: Adhere panels to drywall using shower manufacturer's recommended adhesive. Seal joints, between panels and between panels and adjacent drywall, using shower manufacturer's recommended caulking specific for each application. Match sealant to fixture color.

C. Sink Installation:

1. Install sinks level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted sinks.
3. Install accessible, wall-mounted sinks at mounting height in accordance with ICC A117.1.
4. Set floor-mounted sinks in leveling bed of cement grout.
5. Install water-supply piping with stop on each supply to each sink faucet.
 - a. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."
 - b. Install stops/valves in locations that are accessible for ease of operation.
6. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
8. Seal joints between sinks, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

D. Urinal Installation:

1. Install urinals level and plumb in accordance with roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste-fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height in accordance with ICC A117.1.
5. Install trap-seal liquid in waterless urinals.
6. Install supports, affixed to building substrate, for wall-hung urinals.

7. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
8. Use carriers without waste fitting for urinals with tubular waste piping.
9. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
10. Measure support height installation from finished floor, not structural floor.
11. Install flushometer-valve, water-supply fitting on each supply to each urinal.
12. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
13. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
14. Install actuators in locations easily reachable for people with disabilities.
15. Install new batteries in battery-powered, electronic-sensor mechanisms.
16. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
17. Seal joints between urinals, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to urinal color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

E. Water Closet Installation:

1. Install water closets level and plumb in accordance with roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.
4. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
5. Use carrier supports with waste-fitting assembly and seal.
6. Install floor-mounted, back-outlet water closets, attached to building floor substrate, onto waste-fitting seals; and attach to support.
7. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.
8. Measure support height installation from finished floor, not structural floor.
9. Install flushometer-valve, water-supply fitting on each supply to each water closet.
10. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
11. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
12. Install actuators in locations easily reachable for people with disabilities.
13. Install new batteries in battery-powered, electronic-sensor mechanisms.
14. Install toilet seats on water closets.
15. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
16. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Wash Fountain Installation:

1. Install wash fountains level and plumb in accordance with roughing-in drawings.
2. Set freestanding wash fountains on floor.
3. Install off-floor carrier supports, affixed to building substrate, for wall-mounted wash fountains.
4. Install accessible, wall-mounted wash fountains at mounting height in accordance with ICC A117.1.
5. Install water-supply piping with shutoff valve on each supply to each wash fountain

faucet. Use ball or gate valves if supply stops are not specified with wash fountain. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping." Install stops/valves in locations that are accessible for ease of operation.

6. Install trap and waste piping on each drain outlet of each wash fountain to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
8. Seal joints between wash fountains, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 INSTALLATION OF PIPING CONNECTIONS

- A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil, waste, and vent piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- E. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Adjust water pressure at shower valves to produce proper flow.
- D. Adjust water pressure at flushometer valves to produce proper flow.
- E. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damage to finishes. Replace any fixtures unable to be repaired to the satisfaction of the Architect.

- B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224200

SECTION 224700

DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bottle filling stations.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - b. Include operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of fixture assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power wiring.

C. Delegated Design Submittals: For vibration isolation and supports, indicated to comply with performance requirements and design criteria, including analysis data .

D. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For remote water coolers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For bottle filling stations, to include in maintenance manuals.
 - 1. In addition to items specified in Section 017800 "Project Closeout," include servicing and adjustment of electronic-sensor fixtures.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for delivery, storage, and handling.

1.7 WARRANTY

- A. Manufacturer Warranty: Manufacturer and Installer agree to repair or replace bottle filling stations that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Drinking fountains, water coolers, bottle filling stations, and remote water coolers intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the authority having jurisdiction, and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 BOTTLE FILLING STATIONS

- A. Bottle Filling Station - Surface Wall Mounted, Powder-Coated Metal:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Most Dependable Fountains, Inc.
 - b. Elkay

- c. Halsey Taylor
- 2. Source Limitations: Obtain surface wall-mounted, powder-coated-metal, bottle filling stations from single source from single manufacturer.
- 3. Standards:
 - a. NSF 61.
 - b. NSF 372.
- 4. Type: Vandal resistant.
- 5. Cabinet: Powder-coated metal.
- 6. Bottle Filler: Push-button activation.
- 7. Drain: Grid type with NPS 1-1/4 tailpiece.
- 8. Supply: NPS 3/8 with shutoff valve.
- 9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
- 10. Filter: One or more water filters with capacity sized for unit peak flow rate.
 - a. Standards:
 - 1) NSF 42.
 - 2) NSF 53.
- 11. Support: Provide manufacturer's mounting plate.
- 12. Bottle Filling Station Mounting Height: Accessible in accordance with ICC A117.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb in accordance with roughing-in drawings. For fixtures indicated for juveniles, install at height required by authorities having jurisdiction.
- B. Set pedestal drinking fountains and bottle filling stations on flat surface in accordance with manufacturer's written installation instructions.
- C. Set freestanding water coolers on floor.
- D. Install recessed drinking fountains and bottle filling stations secured to wood blocking in wall construction.
- E. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- F. Install mounting frames, affixed to building construction, and attach recessed water coolers and

bottle filling stations to mounting frames.

- G. Set remote water coolers on floor unless otherwise indicated.
 - 1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
 - 2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- H. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- I. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- J. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
- K. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball shutoff valve on water supply to each fixture. . Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section

260553 "Identification for Electrical Systems."

2. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.
- C. Adjust electronic-sensor settings.

3.6 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, in accordance with manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224700

SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Drawings and General Provisions of Contract, including General and Modifications to General Conditions and Division 1 Specification Sections, apply to work specified in this Section.
- B. Equality of materials, articles, assembly or systems, other than those named or described in this Section, will be determined in accordance with the provisions given to Substitutions.
- C. All work in this Section is subject to the codes and standards of this Section unless otherwise listed in Section 230548 "Vibration and Seismic Controls", which will take precedence.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Inserts.
 - 7. HVAC demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Concrete bases.
 - 10. Supports and anchorages.
 - 11. Flashing of curbs.
 - 12. Openings in walls.
 - 13. Cutting and patching
 - 14. Painting.
 - 15. Electrical wiring.
 - 16. Vibration Isolation and seismic controls.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and within chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. "Contractor" means specifically sub-contractor working under his respective Section of the Specifications.
- G. "Furnish" and "Provide" mean to supply, erect, install and connect up complete in readiness for regular operation, particular work referred to, unless otherwise specified.
- H. "Piping" includes, in addition to pipe, all fittings, valves, hangers and other accessories relating to such piping.
- I. "Ductwork" includes, in addition to ducts, all fittings, hangers, dampers, elbows, transitions, access panels, breaker strips, flexible connections and other accessories relating to ductwork.
- J. "Supply" means purchase and delivery of material to the site.
- K. "Install" means to erect in place the supplied item.

1.4 SUBMITTALS

- A. Submit color samples for pipe coding system.
- B. Submit copies for approval and record of:
 - 1. All Tests.
 - 2. Balancing Report.
 - 3. Valve Chart.
 - 4. Pipe Color Code Chart.
 - 5. Maintenance Manuals.
 - 6. All products and materials supplied under Division 23.
- C. Any additional cost or loss, or damage arising from the substitution of any material or method for those originally specified shall be borne by the Contractor, notwithstanding review or acceptance of such substitution by the Owner or the Architect, unless the substitution was made at the written request of the Owner. Any cost for re-design of any components of the contract documents shall be borne by the Contractor, unless the substitution was made at the written request of the Owner.
- D. Submittals shall be used by the contractor to coordinate location and size of access requirements, and location of piping, duct, drain, and electrical connections. Where the submittal is lacking proper information, the contractor shall obtain certified drawings or manufacturers installation brochures and instructions for the equipment before proceeding with the work.

1.5 SUBSTITUTIONS

- A. Requests for substitutions shall be submitted in writing two (2) weeks prior to bid opening. Otherwise, substitutions will only be considered when a product becomes unavailable through no fault of the Contractor.
- B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- C. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality and operating efficiency level of the specified product.
 - 2. Has investigated proposed product and determined that it meets or exceeds the performance and has lower sound power ratings than the specified product.
 - 3. Has investigated proposed product and determined that it physically fits in the space designed, and does not require extensive revision of structural framing.
 - 4. Will provide the same warranty for the Substitution as for the specified product.
 - 5. Will coordinate installation and make changes to other Work which may be required for the Work to be complete in all respects with no additional cost to Owner.
 - 6. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 7. Will reimburse Owner for review or re-design services associated with re-approval by authorities.
- D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require revision to the Contract Documents.
- E. Engineer will determine acceptability of proposed substitution and will notify Contractor of acceptance or rejection in writing within a reasonable time.
- F. The Mechanical Contractor shall be responsible for the cost of and coordination of electrical revisions required as a result of the use of substituted equipment including modification to wire size, breaker size, wire routing, or starter/disconnect accessory differences.
- G. Only one request for substitution will be considered for each product. When substitution is not accepted, provide the specified product. If a substitution is submitted and rejected more than one time, the Engineer reserves the right to bill the Mechanical Contractor for additional review hours at the hourly rate established in the AIA Contract.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to the owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

- D. Piping shall be fabricated by a qualified licensed plumber/pipefitter and/or steamfitters.
- E. Drainage piping shall be installed by a qualified drain layer.

1.7 SCOPE OF WORK

- A. Provide all labor, materials, equipment, controls and accessories necessary to complete the work shown on the Drawings or herein specified to provide complete and operable systems.
- B. The work to be done under this Division includes all related work shown on the Drawings and or included in these Specifications.
- C. Provide commissioning of all mechanical systems; the general contractor as well as all sub-contractors shall cooperate with the commissioning agent and provide all required information to aid in system commissioning. Commissioning does not replace any specified start-up and testing of major pieces of equipment owned by the Mechanical Contractor.
- D. Drawings are diagrammatic and all duct and pipe fittings, transitions, or offsets required for installation in the actual space are not necessarily shown. Changes in duct size, shape, and route must be coordinated and approved prior to fabrication or installation.

1.8 MATERIALS

- A. Any device, material or construction required to complete the job that is not specifically covered by description herein shall be of commercial-grade material normally used for the purpose and installed in a manner consistent with the conditions of use. Items exposed to the elements shall be weatherproofed or protected. All such items shall be submitted for review before being purchased or installed.

1.9 CODES AND STANDARDS

- A. Materials and equipment shall be designed, constructed, installed and tested in accordance with this Specification and the latest editions of the following applicable standards in addition to state and local codes applying. All products shall bear the label of approval from the appropriate agency.

Agencies:

National Environmental System Contractors Assoc.	NESCA
Air Moving and Conditioning Association	AMCA
American Society of Heating, Refrigerating and Air Conditioning Engineers	ASHRAE
American Society of Mechanical Engineers	ASME
Federal Construction Safety Standards (U.S. Dept. of Labor)	FCSS
American Society of Testing Materials	ASTM
National Electric Code	NEC
National Electrical Manufacturers Association	NEMA
National Fire Code	NFC
Occupational Safety and Health Act of '70	OSHA
International Building Code (Latest Edition)	IBC
National Sanitation Foundation	NSF
Air Conditioning and Refrigeration Inst.	ARI
Underwriters Laboratories, Inc.	UL
Building Officials & Code Administrators International, Inc.	BOCA
International Code Council	ICC

National Fire Protection Association
Sheet Metal and Air Conditioning Contractors National Association
American National Standards Institute
American Welding Society
Cast Iron Soil Pipe Institute
Clean Air Act Amendment of 1990 (Title VI. Section 608)
Cooling Tower Institute
International Mechanical Code

NFPA
SMACNA
ANSI
AWS
CISPI
CAA
CTI
IMC

- B. Any materials or workmanship called for in the requirements of the above-mentioned standards which are not specified or shown on the Drawings, shall be furnished and installed by the Contractors as though same had been specifically mentioned or indicated.
- C. If these Contractors fail to notify the A/E at this time, and install work in variance with the above-mentioned codes and regulations, they shall assume responsibility and expense to rectify the installation to the satisfaction of the A/E and Owner.
- D. Secure all local, state and federal permits necessary in connection with the installation of the equipment, including licenses and approvals and pay fees required for same.
- E. All work shall be performed in strict accordance with the above-mentioned standards, local and state codes.
- F. File all necessary Plans and Documents with Local Authorities and obtain the necessary Certificates of Inspection for work. Deliver same to A/E prior to request for acceptance and final payment.
- G. Notify A/E of any deviation from codes of work indicated or herein specified before installation of work is affected.

1.10 WORK PROCEDURE

- A. The Contractor shall, in good workmanlike manner, perform all work and furnish all supplies and materials, machinery, equipment, refrigerant charges, water treatment, equipment support structures including those for VFD/Starter, hoisting, rigging, and means, herein and otherwise specified, necessary or proper to perform and complete all work required by the Plans and Specifications in order to have a complete and satisfactory installation acceptable to the A/E.

1.11 DELIVERY, STORAGE, HANDLING AND PROTECTION

- A. Prior to installation, and after installation, follow Sections in Division 1.
- B. During construction, close open ends of work subject to weather or adverse conditions with temporary covers or plugs to prevent entry of water, dirt and obstructing materials.

1.12 COOPERATION WITH OTHER TRADES / COORDINATION DRAWINGS

- A. Cooperate to fullest extent with all other trades to best expedite the entire work.
- B. Furnish all information pertaining to materials, sizes, locations, means of support, etc., to all other trades requiring such information.

- C. Where work of Contractor will be installed in close proximity to work of other trades, or where there is evidence that work of Contractor will interfere with work of other trades, he shall assist in working out space conditions to make satisfactory adjustment.
- D. Contractor shall prepare composite working "COORDINATION" drawings and sections at suitable scale not less than $\frac{1}{4}" = 1'-0"$ clearly showing how his work is to be installed in relation to work of other trades. The contractor shall identify any conflicts, investigate and suggest possible resolutions, and request assistance from the Architect / Engineer for assistance in resolving a field condition in order to complete the work required. No additional compensation will be granted or awarded for resolving coordination issues since this is considered part of this contractor's duties. Coordination drawings for suggested resolution of coordination issues shall be produced by this contractor and submitted for review by the Engineer.

1.12 ELECTRICAL ROOM REQUIREMENTS

- A. Do not install any piping, ductwork or equipment in or through electrical rooms, transformer rooms, electrical closets, data/telephone rooms or elevator machine rooms, unless piping or ductwork of equipment is intended to serve these rooms. Additionally, no ductwork or piping will be installed above electric panels. If the Contractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.
- B. Division 26 will furnish and install power wiring to the mechanical equipment and make electrical connections unless otherwise noted on the drawings.
- C. The mechanical contractor shall, regardless of voltage, furnish and install all temperature control wiring, all interlock wiring, and equipment control wiring for the equipment that the contractor furnishes unless otherwise noted. This contractor shall include in his bid, provisions to secure the services of the project's electrical contractor for incidental line voltage and transformers required for Automatic Temperature Controls.
- D. All electrical wiring furnished under the mechanical contract shall conform to the requirements of Division 26.
- E. The Mechanical Contractor shall be responsible for the cost of and coordination of electrical revisions required as a result of the use of substituted equipment including modification to wire size, breaker size, wire routing, or starter/disconnect accessory differences.
- F. Provide all starters and disconnects unless specifically furnished by Division 26.
- G. Duct smoke detectors are required at all air handling equipment 2000 CFM and larger. Detectors shall be supplied by Division 26, installed by this contractor, and wired by Division 26.

1.13 GUARANTEE

- A. The system specified herein and shown on the drawings shall be guaranteed to be free from original defects in both material and workmanship and shall perform to manufacturer specification for a period of two (2) years of normal use and service, excepting damages from other causes. Systems which are manufactured ISO-9001 certification are preferred. This guarantee shall become effective starting the date the Contract work is accepted as complete by the Architect on behalf of the Owner and in accordance with the General Provisions/Conditions.

- B. Upon completion of the installation, this contractor shall submit to the owner a proposal for a standard maintenance agreement to support the system operation for one year beyond the warrantee period. This service should include an option for manufacturer's recommended service maintenance for equipment as well as 24-hour emergency response
- C. Upon completion of the installation, the ATC Subcontractor shall submit to the Owner an agreement to provide the necessary programmed maintenance, to keep the various control systems in proper working condition for one year beyond the guarantee period. Additionally, this contractor shall submit to the owner its standard agreement to support the system operation. This service must include operators support, application support, remote diagnostic support as well as database management support. This service shall be available 365 days/year, 24 hours a day.
- D. This programmed maintenance agreement shall fully describe the maintenance work to be performed and shall advise as to the cost of this work prior to awarding of Contract.

1.14 RECORD DRAWINGS

- A. The contractor shall keep daily updated accurate records of all deviations in work as actually installed from work indicated on the contract drawings. Each Contractor shall record clearly, neatly, accurately, and promptly as work progresses the following data:
 - 1. Changes made resulting from change orders or instructions or sketches issued by the A/E.
 - 2. Changes in routing made to avoid conflict with other trades or structural conditions.
 - 3. Final location of equipment and panels if different than contract documents.
- B. The record drawings shall be kept at the job site, available to the Owner at all times and labeled as "Project Record Information – Job Set". When work is completed, one complete set of marked-up original prints, updated Cad drawings with all changes listed above and a CD with Cad files shall be delivered to the A/E for approval.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All products shall be new and without defects.
- B. Products required by construction but not specifically described herein shall be as selected by the Contractor subject to the approval of the A/E.
- C. All products of Section 230548 Vibration and Seismic Controls shall take preference over the products of this Section.
- D. All products shall be of an approved type and shall be designed for the pressures and temperatures at which they are to be operated, for the materials they are to handle and for their intended use.

2.2 DUCTWORK

- A. Refer to individual Division 23 Ductwork Sections for duct materials, accessories, and installation methods.

- B. Where ductwork penetrates any smoke and/or fire rated partitions provide UL listed dynamic fire and/or smoke dampers per NFPA Guidelines. Install dampers per manufacturer's instructions and install a duct and architectural access panels for every damper as required to test, inspect, and reset.
- C. Provide duct access doors for all motorized dampers, air flow stations, fire & smoke dampers, duct smoke detectors, the entering side of every coil, and at all other locations where components are installed within ductwork regardless of whether or not an access is indicated on the floor plans.
- D. All changes in duct direction shall be made in solid ductwork, not flexible duct.
- E. Square-throat/round-heel elbows are not allowed.
- F. Seal and pressure test ductwork as required in Section 233113 Metal Ducts.

2.3 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.4 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- D. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.5 SLEEVES

- A. Through outside masonry walls and below grade masonry walls, use schedule 40 ductile iron, caulked watertight.
- B. Through masonry floors or interior masonry walls and fire rated assemblies, use Schedule 40 galvanized steel pipe.
- C. Through interior non-fire rated stud partitions, use 22-gauge galvanized sheet metal.
- D. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- E. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

- F. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- H. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- I. PVC Pipe: ASTM D 1785, Schedule 40.
- J. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Escutcheons for pipes passing through outside walls shall be solid cast brass, flat type, secured to pipe with a set screw, Ritter Pattern & Casting Co., #1.
- B. Escutcheons for pipes passing through floors shall be split hinged, cast brass type designed to fit pipe on one end and cover sleeve projection through floor on other end, Ritter Pattern & Casting Company, #36A.
- C. Escutcheons for pipes passing through interior walls, partitions and ceilings shall be split-hinged, cast brass, chromium plated type, Ritter Pattern & Casting Co., #3A.
- D. Beaton & Corbin and/or Caldwell products will be acceptable.

2.7 INSERTS

- A. Inserts shall be individual or strip type, of pressed steel construction galvanized only with accommodation for removable nuts and threaded rods up to $\frac{3}{4}$ " diameter, permitting lateral adjustment. Individual inserts shall have an opening at top to allow reinforcing rods up to $\frac{1}{2}$ " diameter to be passed through insert body and shall be Fee & Mason Manufacturing Company, Figure 178. Strip inserts shall have attached rods with hooked ends to allow fastening to reinforcing rods and shall be Fee & Mason Manufacturing Company, Figure 190. Grinnell or Carpenter Patterson materials will be acceptable.
- B. At Contractor's option, inserts may be galvanized, malleable iron, Universal type, Grinnell, Figure 279, for pipe sized up to $3\frac{1}{2}$ ", Figure 282, for all sizes up to 8".
- C. Where subject to corrosive atmospheres use stainless steel products.

2.8 ACCESS DOORS

- A. The contractor shall furnish access panels not smaller than 12 x 16" for access to concealed valves, traps, dampers, sensors, etc. where no other means of access is provided. Access panels shall be all steel construction with no. 16 gauge wall or ceiling and no. 14 gauge panel door with not less than $\frac{1}{8}$ " insulation secured to inside of the door. Doors shall be supported with concealed hinges and secured with suitable clips and countersunk flush screws. Outside of access panels shall be flush with finished wall or ceilings, except that where panels are located in acoustic tile or paneling, the door shall be recessed to receive adjacent finish material. The final

position for each access door and the size to be used shall be determined by the contractor. Access panels shall be as manufactured by MILCOR. Fire ratings of access door shall not be less than the surface on which the door is installed.

PART 3- EXECUTION

3.1 GENERAL

- A. All installation methods of Section 230548 "Vibration and Seismic Controls" shall take precedence over the methods of this Section.

3.2 INTERPRETATION OF DRAWINGS

- A. Mechanical equipment and such other apparatus as may require maintenance and operation from time to time shall be made easily accessible. Although the equipment may be shown on the Drawings in certain locations, the construction may disclose that such locations do not make its position readily accessible. In such cases, the Owner or his Representative shall be notified before advancing the construction to a stage where a change will reflect additional expense.
- B. Compare actual site conditions with the Drawings and Specifications and include additional work which careful examination would disclose. Before the bidding period, advise the A/E of any omission, error or conflict in the Plans and Specifications.
- C. Equipment, ductwork and piping locations, as shown, are diagrammatic and approximate only unless fixed by dimensions. As the drawings are diagrammatic, every fitting, transition, and offset required for the installation is not shown on the drawings, but shall be anticipated to be necessary for the installation by the contractor. Actual field conditions and physical characteristics of the product govern exact locations. Where possible, adhere to locations on Drawing consistent with building construction and equipment installed by others.
- D. Contractor shall not scale measurements from the Drawings but check with General Contractor's latest Drawings, shop drawings, and equipment manufacturer's installation guides before proceeding with any work.
- E. Work layouts shall be the responsibility of the Contractor, following minimum requirements as set forth in these Specifications and accompanying Drawings.
- F. Where head room or space conditions appear inadequate, A/E shall be notified before proceeding with installation. If directed by A/E, Contractor shall, without extra charge, make reasonable modifications in layout as needed to prevent conflicts with work of other trades or for proper execution of work.
- G. If, in Contractor's opinion, work is shown or specified in manner or amount as to make it impossible to install a top quality piece of work or fulfilling intent of a perfectly efficient job when complete, refer same to A/E in writing before submitting proposals. The contractor shall suggest options for solutions to conflicts for review by the engineer.
- H. Should Contractor fail to refer such instances to A/E as required above, no excuse for poor, defective or incomplete work will be accepted.

3.3 SHOP DRAWINGS

- A. All equipment shall be submitted for approval under these Sections to the A/E.
- B. Do not place orders for any equipment until final approval is received. Allow at least two weeks for submittal review.
- C. If material or equipment is installed before it is approved, Contractor shall be liable for removal and replacement at no extra charge to the Owner.
- D. Contractor shall consult manufacturer's installation brochures and instructions to determine exact location of connection points. Take special care to allow for proper space for maintenance, operation of valves, removal of coils, filters and equipment. Provide offset pipe and union/flange arrangements for ease of removal of coils and equipment. Provide accessories required or recommended by the manufacturer. Locate drains for proper pitch and trapping for coils, space for control valves, and other components. Coordinate with electrical contractor by advising of proper location of attachment of electrical devices to be clear of areas of maintenance or access.
- E. Shop drawings shall be submitted on all major pieces of equipment and material. Each item of equipment proposed shall be a standard catalog product of an established manufacturer. The shop drawing shall give complete information on the proposed equipment such as: capacity, size, construction, material, dimensions, arrangement, operating clearances, performance characteristics, weight and rating authority. Each item of the shop drawing shall be properly labeled, indicating the intended service of the material.
- F. The contractor shall, before submitting the shop drawings of the equipment to the A/E, check each item of the shop drawings to verify the proper equipment is included. Items to check shall include but not be limited to confirmation that the equipment will physically fit into space; proper equipment for the job; electrical characteristics including operating efficiencies and voltage matches that of electric service; proper arrangements for connections; that the equipment meets code requirements, and that all required BMS/DDC components are included.
- G. The shop drawings shall be submitted electronically to the A/E with a letter of transmittal, which shall list each item, submitted with the manufacturer's name.
- H. Review of the shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings have been reviewed, said review does not mean that drawings have been checked in detail; said review does not in any way relieve the contractor from his responsibility or the necessity of furnishing material or performing work as required by the contract drawings.

3.4 WARRANTY

- A. Refer to General Conditions. The warranty period for the work under this Section is for TWO years from date of acceptance. These contractors shall provide free day-and-night service, parts and labor for the complete installation of the entire system for this period.

3.5 CONTRACTOR'S RESPONSIBILITY

- A. Contractor shall be held responsible for any injuries to people, employees or damage done to building premises or adjoining areas or to other work resulting from execution on his part of work, in any manner whatsoever.

- B. Contractor shall be responsible for proper protection of his work, materials, people or employees from injury or loss done by others and shall make good such injury at his own expense.
- C. The Engineer shall not be responsible for the safety of Contractor's employees.
- D. The contractor shall be responsible for coordination with the electrical contractor with regard to final diffuser & smoke detector installation. Smoke detectors should not be located in a direct airflow or closer than 1 m (3 ft) from an air supply diffuser or return air opening. Supply or return sources larger than those commonly found in residential and small commercial establishments can require greater clearance to smoke detectors. Similarly, smoke detectors should be located farther away from high velocity air supplies.

3.6 CUTTING AND PATCHING

- A. All rough cutting and patching required for installation of the mechanical system shall be the responsibility of this contractor. All finish patching relative to this contractor's work shall be the responsibility of other trades in accordance with other sections of this specification. Coordinate all work for a complete and finished installation.
- B. Contractor shall furnish sketches showing the locations and sizes of all openings and chases, and furnish and locate all sleeves and inserts required for the installation of the mechanical work before the walls, floors and roof are built. The contractor shall be responsible for the cost of cutting and patching where any mechanical items were not installed or where incorrectly sized or located. The contractor shall do all drilling required for the installation of his hangers.

3.7 TESTING

- A. Refer to sections 230800 "Commissioning of HVAC" and 230593 "Testing, Adjusting and Balancing for HVAC" for the requirements of coordination, verification, and reporting of tests.
- B. Contractor shall submit to the A/E for record and approval a written report for each test conducted including manufacturer's equipment start-up testing. Report shall indicate date of test, system tested, method of testing, name of person or agency witnessing test, and results of tests. If test records are not kept and submitted, it will be assumed that the test was not completed and Contractor will be required to perform the test at A/E 's direction.
- C. All piping, ducts and equipment shall be tested. Contractor shall furnish Labor, materials, instruments and power required for testing unless otherwise indicated under particular section of Specifications.
- D. Tests shall be scheduled in advance, and shall be performed in presence of and to satisfaction of A/E, Commissioning Agent, Owner's Representative and/or such other parties as may have jurisdiction.
- E. Pressure test shall be applied to piping and ductwork only before connection of equipment. In no case shall piping, equipment or accessories be subjected to pressures exceeding their ratings.
- F. Provisions for capping and sealing ductwork and piping in preparation of testing, and restoring for final connection to equipment is the responsibility of this contractor.
- G. Ductwork shall be tested in accordance with SMACNA HVAC Duct Leakage Test Manual, with a minimum test of 25% of all ducts operating in excess of 3" w.c. total static pressure on fans, all ducts installed outdoors, all ducts that will be concealed within shafts, solid ceiling, crawl spaces,

or solid soffits in the finished condition. In no case shall the maximum leakage allowed be equal to or greater than the SMACNA permitted leakage rates. Ductwork shall be resealed, sealant allowed to cure, and retested until all mains and all sections outdoors and within concealed ceilings, soffits, shafts and chases meets the leakage requirements.

- H. Defective work shall be promptly repaired or replaced and tests shall be repeated until particular system and/or component parts receive approval of the A/E.
- I. Any damages resulting from tests shall be repaired and damaged materials replaced.
- J. Duration and style of tests shall be as determined by authorities having jurisdiction or Commissioning Agent directive, but in no case less than time prescribed in each Section of Specifications. In general, pressure for tests shall be 1.5 times working pressure unless prescribed otherwise by code, specific specification section or ASTM Guidelines.
- K. Equipment and systems which normally operate during certain seasons of year shall be tested during appropriate season. Test shall be performed on individual equipment, systems and their controls for proper operation, functioning and performance. Controls shall be operated simultaneously with equipment of system being tested.
- L. During testing procedure, remove accessories liable to damage during tests.
- M. Notice shall be furnished to A/E at least two days prior to any testing. Contractor shall be solely responsible for any delays, damages, etc., resulting from failure to notify.
- N. Instruments required under this Contract for permanent installation may be used for testing if re-adjusted and recalibrated for the service for which intended.

3.8 CLEANING OF SYSTEM

- A. All piping, ducts and equipment shall be thoroughly cleaned of foreign matter after being placed in operation. System shall be disconnected, cleaned and reconnected wherever necessary to locate and remove obstructions. Any work damaged in course of removing obstructions shall be repaired or replaced when system is reconnected at no additional cost to the Owner.
- B. Replace all air filters with new prior to balancing of air systems.

3.9 SLEEVES, INSERTS, ANCHOR BOLTS

- A. Sleeves shall be located by this Contractor and set by the General Contractor, subject to A/E approval. Provide General Contractor with such information in ample time to prevent unnecessary cutting and patching. Mechanical Contractor shall be responsible for and subsequent cutting and patching of openings if sleeves have been omitted due to failure of setting them properly or in time. Fasten sleeves securely to avoid dislocation during concrete pouring.
- B. In placing sleeves, inserts, anchor bolts or any other material to be embedded in masonry and concrete or built into structure, Contractor shall cooperate with all other trades and shall consult with A/E in regard to their exact locations wherever there is any interference with structural members.
- C. Contractor will be held responsible for location of and maintaining in proper positions, sleeves, inserts and anchor bolts supplied and/or set in place by him. In event that failure to do so requires cutting and patching of finished work, it shall be done at Contractor's expense.

- D. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves having an internal diameter two inches larger than outside diameter of pipe.
- E. Sleeves through outside walls shall be painted with one coat of bitumastic paint inside and outside. Sleeves shall extend ½" beyond each side of wall. Space between sleeve and pipe shall be packed with oakum to within two inches of each face of wall. Remaining space shall be packed and made watertight with a waterproof compound.
- F. Sleeves through masonry floors or interior masonry walls shall be set flush with finished wall or ceiling surfaces.
- G. Sleeves through interior stud partitions shall be set flush with finished surfaces of partitions.

3.10 ESCUTCHEONS

- A. Escutcheons shall be installed on pipes wherever they pass through floors, ceilings, wall partitions and outside walls where exposed to view.

3.11 OPERATING INSTRUCTIONS

A. Operation of system - Instruction:

- 1. Contractor is responsible for construction and installation of all mechanical systems and shall supply the services of competent personnel for a period of one day per system (heating, cooling, controls) plus one day per major piece of equipment (VRF heat pumps, ERVs, air cooled condensers) to instruct owner's personal. As such, Contractor may be required during the first year to review every phase of all mechanical systems with Owner's personnel and also to instruct and supervise Owner's personnel in the proper operation and maintenance of said system. Time shall be recorded by Contractor and signed by Owner or Representative. At the owner's request, the training instruction shall be video recorded and shall be included in the Operating Manual package.

B. Operation of system - Manuals:

- 1. Contractor shall provide complete operating instructions of all systems installed, provided as electronic documents in MS Word or Adobe PDF format. Manuals shall be labeled with job name, address and date. Information on each piece of equipment of system shall be in a separate tab labeled section. Provide a complete index of the contents. After approval by the Engineer the zip files shall be forwarded to the Owner.
- 2. Manual shall contain one approved copy of each shop drawing and submitted data, printed instructions as to care and maintenance of system arranged in the following sequence:
 - a. Table of Contents
 - b. Description of Installation with Contractor contact information and letter of Warranty including start date and terms.
 - c. Care and Maintenance: Including a check and follow-up chart for greasing and oiling of all mechanical equipment and a copy of instructions as to upkeep of motors.
 - d. Manufacturer's Listing: In alphabetical order, of all equipment installed on job, together with a listing of material supplied, manufacturer's address, name and address of local manufacturer's agent.
 - e. Copy of Service Valve Charts
 - f. Copy of Pipe System complete with color samples.

- g. Testing & Balancing Report
- h. Duct Pressure Test Report
- i. Equipment start-up report and records including incident reports and refrigerant charges
- j. List of filter sizes for all mechanical equipment including “clean filter” pressure drop gauge reading and “change filter” pressure drop gauge reading
- k. Updated Automatic Temperature Control submittal & sequence of operations
- l. Operating & Maintenance manuals for the automatic temperature control system
- m. Manufacturer’s Equipment Warranties
- n. Project documents and certificates
- o. The manual shall also include a schedule for all equipment maintenance. Schedule shall provide a general outline for equipment requirement. Example; filters shall be changed every 3 months, test dampers once a year

3.12 PROJECT CLOSEOUT AND TROUBLE SHOOTING

- A. Each trade shall designate one person to methodically test, adjust, trouble shoot and effect repairs to all equipment, devices and systems. The person shall be available on one hour’s notice to answer trouble calls and to fully investigate and repair the cause of the problem. Each trade shall submit the name and phone number of the designated person to the Owner, Engineer and Architect. After final acceptance, this same person shall be available on eight hour’s notice for free day-and-night service during the guarantee period.
- B. Contractor shall demonstrate all sequences of control to the Commissioning Agent and Engineer. The temperature control and balancing sub-contractors shall accompany the Commissioning Agent and Engineer during check-out procedure and shall demonstrate proper balancing positions of minimum fresh-air settings. Personnel shall be equipped with tools and spare parts to make minor repairs and adjustments.
- C. Balanced positions shall be indicated with permanent marker on valves; label filter gauges with “clean filter pressure drop” and “change filter pressure drop”.
- D. Contractor shall demonstrate compliance with balancing of systems in the presence of the Engineer by actual measurement of water and air flows at a minimum of three locations randomly selected by the Engineer. If requested by the Engineer, re-balancing shall be done at no additional charge.

3.13 FIRE STOPPING

- A. Each trade is responsible for fire stopping of its own work.
- B. Fire stopping material shall be typical of HILTI Fire Barrier.
- C. Each trade must submit intended fire stopping material and methods for each application with UL listed approved designs.

3.14 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping with provisions to permit expansion.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation. Arrange operable accessories so that the final insulation thickness will not restrict the operation of valve handles or connection of hose fittings on drains.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install escutcheons for penetrations of walls, ceilings, and floors.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- Q. Fire/Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.15 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems and approved joining methods for this project.
- B. Ream ends of pipes and tubes and remove burrs. Bevel or groove plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid or flexible, where required, grooved-end-pipe couplings. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. A Victaulic factory trained field representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review the product installation. Only a direct employee of the grooved system manufacturer shall be considered suitable for field service. A distributor's representative is not to be considered qualified for field service. Contractor shall remove and replace any improperly installed products.
- H. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

4. PVC Non-pressure Piping: Join according to ASTM D 2855.

I. Press type fittings shall only be allowed with written permission of the A/E or Owner.

3.16 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.17 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 230500

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

- A. Common work result for HVAC section 23 shall apply to all work performed under this Section of the Specifications and shall be considered as included herein.

1.2 DESCRIPTION OF WORK

- A. Provide all HVAC Equipment motors and accessories required for a proper installation in accordance with the Drawings and Specifications.

1.3 QUALITY CONTROL

- A. All motors shall be manufactured by firms regularly engaged in the manufacture of similar equipment and whose products have been in satisfactory service for not less than five (5) years.

1.4 SUBMITTALS

- A. Submittals shall be provided in accordance with Division 1 and section 230500. In addition to submittals specified elsewhere, the following information shall be submitted for all motors:
 - 1. Product data indicating voltage, horsepower, full load current, locked rotor current, frequency, service factor, motor speed, efficiency, power factor, frame size, insulation class and NEMA design code.
 - 2. Wiring diagrams with electrical characteristics and connection requirements.
 - 3. Manufacturer's operation and installation manuals.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All motors shall be open Drip-proof type except where specifically noted otherwise.
- B. All motors shall be designed for continuous operation in 40° C (104° F) environment.
- C. Motors shall have minimum efficiencies and power factors as indicated in Performance Schedules at the end of this section.
- D. Explosion-Proof Motors, when required, shall be UL approved and labeled for hazard classification, with over temperature protection.
- E. A visible nameplate shall be provided for each motor which indicates, as a minimum, all information required by article 430-7 of the National Electric Code (NEC).
- F. Wiring Terminations
 - 1. Suitable terminal lugs shall be provided and enclosed in a terminal box which conforms to the requirements of article 430-12 of the NEC.

2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
 - G. All motors, 1 HP and larger, shall be premium efficiency according to the definition of the local utility company, and having minimum efficiency listed in item 3.06 of this section. All motors shall conform to the local utility company energy savings program, and shall qualify for respective rebates under this program.
 - H. All VFDs, control panels, and disconnect switches are to be factory assembled and prewired, but shipped loose in order to locate in compliance with NEC & local codes and to maintain required clearances.
- 2.2 THREE PHASE POWER – SQUIRREL CAGE MOTORS
- A. Starting Torque shall be between 1 and 1½ times full load torque.
 - B. Starting Current shall not be greater than six times full load current.
 - C. Power Output, Locked Rotor Torque, Breakdown or Pull out Torque shall have NEMA Design B characteristics.
 - D. Insulation System shall be NEMA Class F or better.
 - E. Motors shall be tested to determine that they are free from electrical or mechanical defects in compliance with performance data.
 - F. Motor Frames shall be NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - G. Bearings shall be grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication.
- 2.3 MOTORS
- A. All motors shall be rated at 85% power factor at full rated load. Motors less than 85% power factor shall be corrected to 90% power factor at the factory. All motors shall be rated premium efficiency. Motors used with variable frequency drives shall be rated for inverter duty.
 - B. Motors to be used with variable frequency controllers shall meet the following requirements in addition to requirements stated previously in this section.
 - C. Motors shall be designed and evaluated for use on AC adjustable frequency controller waveforms.
 - D. Motor insulation, for units operating at 600 VAC RMS or less, shall utilize a system that has increased mechanical and dielectric capabilities. This system shall be defined to mean a system that includes additional features which clearly indicate an attempt to improve the withstand capabilities of the motor winding to the increased mechanical and electrical stresses caused by inverter waveforms. The motor manufacturer's standard insulation system is considered to represent the base level of withstand capabilities by which the motor supplier shall use in his evaluation of whether the system supplied qualifies for use on inverter waveforms.
 - E. Windings shall have a minimum of one normally closed thermostat provided as standard. This device shall be sized for the maximum recommended safe operating temperature of the motor winding.

- F. Stator Cores shall utilize low loss type electrical steel, reinforced end coil treatment and increased varnish coverage.
- G. Rotor Cores shall be designed for reduced electrical losses and low slip RPM levels.
- H. Motor Assemblies shall be of a low vibration design with minimum balance specifications equal to ½ of NEMA Standard Levels.
- I. Motors shall meet NEMA Design “B” performance limits.
- J. The following additional information shall be included on the motor nameplate:
 - 1. Application Type: Constant torque, constant horsepower or variable torque.
 - 2. Maximum approved continuous torque or horsepower level(s).
 - 3. Approved operating range defined in RPM’s and frequency.
 - 4. Maximum motor amps approved, when used on non-sine wave power, for each voltage connection available.

2.4 STARTERS

- A. Starters shall be Cutler Hammer or equal, with pushbuttons, HOA switches auxiliary contacts, etc. Furnish starters for motors ½ HP and over and as required by sequence of operations. Starters for motors 200 V/3 phase and over, use products with built-in, 120-volt control circuit transformer.
- B. This Contractor shall supply all starters unless specifically shown or specified elsewhere. Division 26 will install starters.
- C. Disconnects provided by this contractor will be installed by Division 26, with the exception of factory mounted disconnects.

2.5 VARIABLE SPEED / VARIABLE FREQUENCY DRIVES

- A. Provide one combination VFD for each piece of equipment shown with a VFD on the plans and/or described with a VFD in these specifications. Unit shall be manufactured by ABB, Cerus or Emerson Industrial Automation/Control Techniques.
- B. Unit shall have the following options:
 - 1. NEMA 1 type enclosure for indoor use.
 - 2. Operating temperature range 32 deg F – 104 deg F.
 - 3. The VFD shall have a built-in AC or DC reactor equivalent to 3% of line impedance or else must include an equivalent external line reactor in order to protect from AC line transients & to reduce harmonics.
 - 4. HOA (Hand / off / Auto) Switch and manual/automatic lead pump selector.
 - 5. Potentiometer (0-100%)
 - 6. Three Contactor Electronic Bypass shall be provided when indicated on the plans. VFD and bypass components shall be mounted, fully pre-wired, tested and made available for installation as one UL listed assembly by the drive manufacturer.
- C. The VFD is to be mounted in the same room as the equipment it serves.
- D. The VFD is intended to be mounted indoors only.

PART 3 – EXECUTION

3.1 GENERAL

- A. All motors shall be installed in accordance with article 430 of the NEC and the manufacturer's instructions.
- B. Motors shall be installed securely on a firm foundation and positioned so as to obtain the alignment that meets or exceeds all drive component specifications.
- C. After making corrective adjustments for alignment, tighten foot bolts and recheck alignment. When making shim adjustments, change only one foot at a time.
- D. Verify that all connections are in agreement with the connection diagram.
- E. All connections shall be properly taped or otherwise insulated to prevent shorting against each other or to ground.
- F. Performance schedule: three phase – energy efficient, open, drip-proof:

Premium Efficiency Motor Requirements							
Open Drip-Proof (ODP) Motors				Totally Enclosed Fan-Cooled (TEFC)			
Size HP	Speed			Size HP	Speed		
	1200	1800	3600		1200	1800	3600
	NEMA Nominal Efficiency				NEMA Nominal Efficiency		
1	82.50%	85.50%	77.00%	1	82.50%	85.50%	77.00%
1.50	86.50%	86.50%	84.00%	1.50	87.50%	86.50%	84.00%
2	87.50%	86.50%	85.50%	2	88.50%	86.50%	85.50%
3	88.50%	89.50%	85.50%	3	89.50%	89.50%	86.50%
5	89.50%	89.50%	86.50%	5	89.50%	89.50%	88.50%
7.50	90.20%	91.00%	88.50%	7.50	91.00%	91.70%	89.50%
10	91.70%	91.70%	89.50%	10	91.00%	91.70%	90.20%
15	91.70%	93.00%	90.20%	15	91.70%	92.40%	91.00%
20	92.40%	93.00%	91.00%	20	91.70%	93.00%	91.00%
25	93.00%	93.60%	91.70%	25	93.00%	93.60%	91.70%
30	93.60%	94.10%	91.70%	30	93.00%	93.60%	91.70%
40	94.10%	94.10%	92.40%	40	94.10%	94.10%	92.40%

END OF SECTION 230513

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Pipe Hangers.
 - 2. Trapeze pipe hangers.
 - 3. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation for use in lightweight concrete or concrete slabs less than 4 inches thick:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.

- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.

- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.

7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Hangers for horizontal lines, except as noted below and in Section 230500 -
1. Vibration Isolation and Seismic Restraint, shall be spaced no greater than as follows:

Pipe Size	Rod Diameter	Maximum Spacing	
		Copper	Steel
1/2"	3/8"	5' - 0"	7' - 0"
3/4"	3/8"	5' - 0"	7' - 0"
1"	3/8"	6' - 0"	7' - 0"
1 1/4"	3/8"	7' - 0"	7' - 0"
1 1/2"	3/8"	8' - 0"	9' - 0"
2"	3/8"	8' - 0"	10' - 0"
2 1/2"	1/2"	9' - 0"	11' - 0"
3"	1/2"	10' - 0"	12' - 0"
4" - 5"	5/8"	12' - 0"	14' - 0"
6" - 8"	3/4"	14' - 0"	17' - 0"

2. Copper tubing shall be supported with split ring hangers, copperized with supporting rod.
3. Cast iron soil pipe shall be hung one hanger for each pipe length, close to hub.
4. PVC pipe shall be supported no more than 4'-0" on center.
5. Use insulation protection saddles or shields for all insulated cold piping and where hanger is outside the insulation. Secure all saddles and shields to the insulation to prevent slippage or shifting that may cause the shield to fall to the ground. Saddles shall be spot welded to hangers.

- R. Hangers for vertical pipes shall be spaced no greater than as follows:

PIPING MATERIAL	MAX. VERTICAL SPACING
Cast Iron Pipe	15'-0"
Copper Pipe/Tubing	10'-0"
Galvanized Steel Pipe	15'-0"
PVC Pipe	4'-0"
CPVC Pipe/Tubing	3'-0"

END OF SECTION 230529

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Intent

1. All mechanical equipment, piping and ductwork shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
2. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
3. It is the intent of the seismic portion of this Specification to keep all mechanical building system components in place during a seismic event when required by local code.
4. All such systems must be installed in strict accordance with seismic codes, component manufacturers' and building construction standards. Whenever a conflict occurs between the manufacturers' or construction standards, the most stringent shall apply.
5. This Specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements (i.e., California Title 24; California OSHPD; Canadian Building Codes; or other requirements).
6. The Contractor shall correct any variance or non-compliance with these Specification requirements in an approved manner.
7. Seismic restraints shall be designed in accordance with seismic force levels as detailed in the State Building Codes.
8. All in-line equipment will be braced independently of the ducts or pipes and in conformance with all applicable building codes.

B. The work in this Section includes, but is not limited to, the following:

1. Vibration isolation for piping, ductwork and equipment.
2. Seismic restraints for all new gas piping and sprinkler piping.
3. Equipment isolation bases.
4. Flexible piping connections.
5. Seismic restraints for isolated equipment.
6. Seismic restraints for non-isolated equipment.
7. Certification of seismic restraint designs and installation supervision.
8. Certification of seismic attachment of housekeeping pads.
9. All mechanical systems - equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is typical (equipment not listed is still included in this Specification):

AC Units	Comp. Room Units	Motor Control Ctrs.
Air Distrib. Boxes	Condensers	Piping
Air Handling Units	Condensing Units	Pumps (All Types)
Air Separators	Ductwork	Rooftop Units
Boilers	Fans (All Types)	Tanks (All Types)
Cabinet Heaters	Heat Exchangers	Units Heaters
Chillers	Life Safety Systems	

C. Definitions

1. Life Safety Systems:

- a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.
- b. All systems involved with and/or connected to emergency power supply.
- c. All medical and life-support systems.
- d. Fresh-air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.
- e. All life-safety equipment.

2. Positive Attachment:

- a. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.

3. Transverse Bracing:

- a. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

4. Longitudinal Bracing:

- a. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.2 SUBMITTAL DATA REQUIREMENTS

A. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:

1. Descriptive Data:

- a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the Specification.
- b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive Drawings.

2. Shop Drawings:

- a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
- b. Provide all details of suspension and support for ceiling hung equipment.
- c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.

- d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
3. Seismic Certification and Analysis:
- a. Calculations shall be based on "G" forces appropriate for the zone in which the building is located.
 - b. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a Registered Professional Engineer with at least five years of seismic design experience, licensed in the State of the job location.
 - c. All restraining devices shall have a pre-approval number from California's OSHPD or some other recognized government agency showing maximum restraint ratings. Pre-approvals based on independent testing are preferred to pre-approvals based on calculations. Where pre-approved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a Registered Professional Engineer with at least five years of seismic design experience and licensed in the State of the job location. Testing and calculations must include shear and tensile loads as well as one test or analysis at 45° to the weakest mode.
 - d. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in the State Building Code acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

1.3 CODE AND STANDARDS REQUIREMENTS

A. Typical Applicable Codes and Standards

- 1. Applicable State Building Code.
- 2. Applicable State Mechanical Code.
- 3. Applicable State Plumbing and Gas Codes.
- 4. SMACNA
- 5. NFPA

1.4 MANUFACTURERS' RESPONSIBILITIES

- A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
- 1. Determine vibration isolation and seismic restraint sizes and locations.
 - 2. Provide vibration isolation and seismic restraints as scheduled or specified.
 - 3. Provide calculations and materials if required for restraint of un-isolated equipment.
 - 4. Provide installation instructions, drawings and trained field supervision to ensure proper installation and performance.

1.5 RELATED WORK

A. Housekeeping Pads:

1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor, if not already indicated on the Drawings.
2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

B. Supplementary Support Steel:

1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc., including roof mounted equipment, as required or specified.

C. Attachments:

1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps, etc., in accordance with the requirements of the vibration vendor's calculations.

PART 2 - PRODUCTS

2.1 INTENT

- A. All vibration isolators and seismic restraints described in this Section shall be the product of a single manufacturer. Mason Industry's products are the basis of these Specifications; products of other manufacturers are acceptable provided their systems strictly comply with the Specifications and have the approval of the specifying engineer. Submittals and certification sheets shall be in accordance with Section 230500.
- B. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" and/or horizontal permanent deformation greater than 1/4".

2.2 PRODUCT DESCRIPTIONS

A. Vibration Isolators and Seismic Restraints:

1. Two layers of 3/4" thick neoprene pad consisting of 2" square waffle modules separated horizontally by a 16 gauge galvanized shim. Load distribution plates shall be used as required. Pads shall be Type Super "W" as manufactured by Mason Industries, Inc. or equal.
2. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron casting containing two separated-and-opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal

- and vertical load ratings. Mountings shall be Type BR as manufactured by Mason Industries, Inc. or equal.
3. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between two steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in three planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge-bearing quality. Bushing assemblies shall be Type PB as manufactured by Mason Industries, Inc. or equal.
 4. A one-piece molded bridge bearing neoprene washer/ bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal-to-metal contact. Neoprene bushings shall be Type HG as manufactured by Mason Industries, Inc. or equal.
 5. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or ¼" neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be Type SLF as manufactured by Mason Industries, Inc. or equal.
 6. Restrained spring mountings shall have an SLF mounting as described in Specification 5, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of ½" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage pre-approval "R" number from OSHPD in the State of California certifying the maximum certified horizontal and vertical load ratings. Mountings shall be SLR as manufactured by Mason Industries, Inc. or equal.
 7. Spring mountings, as in Specification 5, built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of ¼" travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be SSLFH as manufactured by Mason Industries, Inc. or equal.
 8. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus 1/8". Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician. Air springs shall be Type MT and leveling valves Type LV, as manufactured by Mason Industries, Inc. or equal.
 9. Restrained air spring mountings shall have an MT air spring, as described in Specification 8, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of ½" shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Housing shall be designed to resist

all seismic forces. Mountings shall be SLR-MT as manufactured by Mason Industries, Inc. or equal.

10. Hangers shall consist of rigid steel frames containing minimum 1¼" thick neoprene elements at the top and a steel spring with general characteristics, as in Specification 5, seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side-to-side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30° capability. Hangers shall be Type 30N, as manufactured by Mason Industries, Inc. or equal.
11. Hangers shall be as described in paragraph 10 above, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Hangers shall be Type PC30N, as manufactured by Mason Industries, Inc. or equal.
12. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an Anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified load ratings. Cable assemblies shall be Type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc. or equal.
 - a. Cables will be wire-core with a minimum breaking strength as shown in the table below. The cable size is for reference only. The actual cable size should be chosen to provide the breaking strength indicated in the table. Use FS = 2.0 when pre-stretched cable is used with end connections that develop the breaking strength of the cables; otherwise, use FS = 5.0.

Minimum Breaking Strength for Cable Braces

Size inches	Breaking Strength FS = 2.0 pounds	Breaking Strength FS = 5.0 pounds
¼	4,940	12,350
3/8	10,980	27,450
½	19,260	48,150

- b. Cable will be zinc-coated to a minimum of 0.4 ounces per square foot or stainless steel per ASTM A304. Tighten cable only to remove slack.
 - c. Use either cable or solid bracing for all situations. Do not mix bracing types.
13. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Seismic solid, brace-end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have anchorage pre-approval "R" number from OSHPD in the State of Cali

fornia verifying the maximum certified load ratings. Solid seismic brace assemblies shall be Type SSB, as manufactured by Mason Industries, Inc. or equal.

- a. Cold-formed angles will conform to the material and identification requirements of the latest *Specifications for the Design of Cold-Formed Steel Structural Members* of the American Iron and Steel Institute with a minimum $F_y = 33$ ksi and a minimum $F_u = 38$ ksi.
- b. The uncoated minimum steel thickness of the cold-formed product as delivered to the job site will not, at any location, be less than 95% of the thickness indicated in the table below. The thickness may be less at bends after cold-forming.

Standard Sheet Metal Gages

Gage	Standard Uncoated Thickness inches	Galvanized Thickness inches
12	0.1046	0.1084
14	0.0747	0.0785
16	0.0598	0.0635

- c. Hot-rolled shapes and plates will conform to ASTM A36. Pipes used as braces will be standard steel pipes (ASTM A120 or A53).

Note: Specifications 12 through 14 apply to trapeze as well as clevis hanger locations. At trapeze anchor locations, piping must be shackled to the trapeze. Specifications apply to hanging equipment as well.

14. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage pre-approval "R" number from OSHPD in the State of California. Rod clamp assemblies shall be Type SRC, as manufactured by Mason Industries, Inc. or equal.
15. Pipe clevis cross-bolt braces are required in all restraint locations. They shall be special purpose, pre-formed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage pre-approval "R" number from OSHPD in the State of California. Clevis cross braces shall be type CCB, as manufactured by Mason Industries, Inc. or equal.
16. All-directional seismic snubbers shall consist of inter-locking steel members restrained by a one-piece-molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of $\frac{1}{4}$ " thick. Rated loadings shall not exceed 1,000 psi. A minimum air gap of $\frac{1}{8}$ " shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubbers shall have an Anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubber shall be Type Z-1225, as manufactured by Mason Industries, Inc. or equal.
17. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of $\frac{3}{4}$ " thick. Rated loadings shall not exceed 1,000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than $\frac{1}{8}$ " nor more than $\frac{1}{4}$ ". Snubbers shall be installed with factory-set clearances. The capacity of the seismic snubber at $\frac{3}{8}$ " deflection shall be

equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to ½" deflection in the X, Y and Z planes. Snubbers shall have an anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be series Z-1011, as manufactured by Mason Industries, Inc. or equal.

18. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder, which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be type SAS, as manufactured by Mason Industries, Inc. or equal.
19. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an Evaluation Report Number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads. Drill-in female wedge anchors shall be Type SAB, as manufactured by Mason Industries, Inc. or equal.
20. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type WF, as manufactured by Mason Industries, Inc. or equal.
21. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of ½" bars welded in place on 6" centers running both ways in a layer 1½" above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts' sleeves and anchors while concrete is being poured. Height-saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Wooden-formed bases leaving concrete rather than a steel finish are not acceptable. Base shall be type BMK or K, as manufactured by Mason Industries, Inc. or equal.
22. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. All directional neoprene snubber bushings shall be a minimum of ¼" thick. Steel springs shall be laterally stable and rest on ¼" thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs' waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs' waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2" of insulation. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail and the lower Z section anchored to the roof structure. Curb shall have anchorage pre-approval "R" from OSHPD in the State of California attesting to the maximum certified horizontal and vertical load ratings. Curb shall be type RSC, as manufactured by Mason Industries, Inc. or equal.

23. Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Dacron tire cord frictioning. Solid steel rings shall be used within the raised face, rubber ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16" to 24" may be single sphere. Sizes ¾" to 1½" may have threaded bolted flange assemblies, one sphere and cable retention. 14" and smaller connectors shall be rated at 250 psi up to 190°F with a uniform drop in allowable pressure to 190 psi at 250°F. 16" and larger connectors are rated 180 psi at 190°F and 135 psi at 250°F. Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a five-minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal-ended expansion joints.

Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods, as control rods are not desirable in seismic work. If control rods are used, they must have ½" thick Neoprene washer bushings large enough in area to take the thrust at 1,000 psi maximum on the washer area. Expansion joints shall be installed on the equipment side of the shut-off valves.

Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut-off valves. Expansion joints shall be SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR, as manufactured by Mason Industries, Inc. or equal.

24. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

Flanged	Male Nipples
3 x 14	½ x 9
4 x 15	¾ x 10
5 x 19	1 x 11
6 x 20	1¼ x 12
8 x 22	1½ x 13
10 x 26	2 x 14
12 x 28	2½ x 18
14 x 30	
16 x 32	

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS, as manufactured by Mason Industries, Inc. or equal.

25. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum ½" thick, 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA, as manufactured by Mason Industries, Inc. or equal.

26. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum $\frac{1}{2}$ " thickness of 60-durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of $\pm 1\text{-}5/8$ " motion or to meet location requirements. Pipe guides shall be type VSG, as manufactured by Mason Industries, Inc. or equal.
27. Split wall seals consist of two bolted pipe halves with minimum $\frac{3}{4}$ " thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240° F, 10# density fiberglass may be used in lieu of the ponge. Seals shall be type SWS, as manufactured by Mason Industries, Inc. or equal.
28. The horizontal thrust restraint shall consist of a spring element in series with a neoprene-molded cup as described in Specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of $\frac{1}{4}$ " movement at start and stop. The assembly shall be furnished with one rod, and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI/WBD, as manufactured by Mason Industries, Inc. or equal.
29. Bolts will conform to ASTM A307. Bolt holes will be a maximum of $1/16$ " (1.6 mm) larger than the bolt diameter unless noted otherwise.
30. Expansion anchors will have local-governing-jurisdiction-approved values equal to, or greater than, both the shear and tension capacities listed in the table below. Cast-in-place concrete inserts may replace expansion anchors where the approved loads are equal to, or greater than, the values for the specified expansion anchors.

Minimum Approved Values for Expansion Anchors

Size inches	Shear Capacity pounds	Tension Capacity pounds
3/8	675	615
$\frac{1}{2}$	1,130	1,040
5/8	1,580	1,535
$\frac{3}{4}$	2,270	2,020
7/8	5,060	3,705

31. Welding will conform to AWS D1.1 and use either the shielded or submerged arc methods. Attachments to building components may be subject to review by the design professional.

PART 3 - EXECUTION

3.1 GENERAL

- A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- D. The Contractor shall not install any equipment, piping, duct or conduit that makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the A/E's attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible Contractor's expense.
- G. Bring to the A/E's attention any discrepancies between the Specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible Contractor's expense.
- H. At no additional cost, correct all installations that are deemed defective in workmanship and materials, at the Contractor's expense.
- I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the Structural Engineer of record for approval. Generally, bracing may occur from:
 - 1. Flanges of structural beams.
 - 2. Upper truss cords in bar joist construction.
 - 3. Cast-in-place inserts or wedge-type, drill-in concrete anchors.
- J. All attachments to structural elements will be reviewed with the appropriate design professional.
- K. Specification 12 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- L. Specification 12 cable assemblies are installed taut on non-isolated systems. Specification 13 seismic solid braces may be used in place of cables on rigidly attached systems only.
- M. At locations where Specifications 12 or 13 restraints are located, the support rods must be braced where necessary to accept compressive loads with Specification 14 braces.
- N. At all locations where Specifications 12 or 13 restraints are attached to pipe clevis', the clevis cross bolt must be reinforced with Specification Type 15 braces.
- O. Drill-in concrete anchors for ceiling and wall installation shall be Specification Type 18 and Specification Type 19 female wedge-type for floor mounted equipment.
- P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.
- Q. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed Specification 23 capabilities.
- R. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide Specification 27 wall seals.

- S. Air handling equipment and centrifugal fans shall be protected against excessive displacement that results from high air thrust in relation to the equipment weight. Horizontal thrust restraint shall be Specification Type 28.
- T. Locate isolation hangers as near to the overhead support structure as possible.
- U. When conduit is required to be braced, it may be braced the same as the equivalent weight pipe.
- V. All runs will have a minimum of two transverse braces and one longitudinal brace.
 - 1. A run is defined as a length of duct or pipe without any change in direction except as allowed by offsets

3.2 VIBRATION ISOLATION OF PIPING

- A. Horizontal Pipe Isolation: The first three pipe hangers in the main lines near the mechanical equipment shall be as described in Specification 11. Specification 11 hangers must also be used in all transverse braced isolated locations. Brace hanger rods with SRC clamps' Specification 14. Hangers as described in Specification 10 shall isolate horizontal runs in all other locations throughout the building. Floor-supported piping shall rest on isolators as described in Specification 6. Heat exchangers and expansion tanks are considered part of the piping run. The first three isolators from the isolated equipment will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3"; 1½" deflection for pipe sizes up to and including 6"; and 2½" deflection thereafter. Hangers shall be located as close to the overhead structure as practical. Where piping connects to mechanical equipment, install Specification 23 expansion joints or Specification 24 stainless hoses if 23 is not suitable for the service.
- B. Riser Isolation: Risers shall be suspended from Specification 10 hangers or supported by Specification 5 mountings, anchored with Specification 25 anchors and guided with Specification 26 sliding guides. Steel springs shall be a minimum of 0.75" except in those expansion locations where additional deflection is required to limit load changes to $\pm 25\%$ of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.

3.3 SEISMIC RESTRAINT OF PIPING

- A. Seismically restrain all piping listed as 1, 2 or 3 below. If isolated, use Specification 12 cables. Specifications 12 or 13 restraints may be used on un-isolated piping.
 - 1. Fuel oil piping, gas piping, medical gas piping and compressed air piping.
 - 2. Piping located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is 1¼" I.D. and larger.
 - 3. All other piping, 2½" diameter and larger.
- B. Transverse piping restraints shall be at 40' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads or is otherwise noted in this Specification.
- C. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads or is otherwise noted in this Specification.

- D. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
- E. For fuel oil and all gas piping up to 5", transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
- F. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE, or combined stresses are within allowable limits at longer distances.
- G. Hold-down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
- H. Branch lines may not be used to restrain main lines.
- I. Cast iron pipe of all types, glass pipe and any other pipe joined with a shield-and-clamp assembly where the top of the pipe is 12" or more from the supporting structure, will be braced on each side of a change in direction of 90° or more. Riser joints will be braced or stabilized between floors.
- J. Provide joints capable of accommodating seismic displacements where pipes pass through building seismic or expansion joints or where rigidly supported pipes connect to equipment with vibration isolators. The joints must be allowed motion in all directions.
- K. A rigid piping system will not be braced to dissimilar parts of the building or to two dissimilar building systems that may respond differently during an earthquake.
- L. Vertical risers not specifically engineered will be laterally supported with a riser clamp at each floor. For buildings greater than six stories high, all risers will be engineered individually. For risers in hubless piping systems where the riser joints are unsupported between floors, brace in accordance with provisions of this Section.

3.4 VIBRATION ISOLATION OF DUCTWORK

- A. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Specification 10 hangers or Specification 5 floor isolators. Spring deflection shall be a minimum of 0.75".
- B. All duct runs having air velocity of 1,000 fpm or more, shall be isolated from the building structure by Specification 11 hangers or five floor supports. Spring deflection shall be a minimum of 0.75".

3.5 SEISMIC RESTRAINT OF DUCTWORK

- A. Seismically restrain all ductwork with Specification 12 or 13 restraints as listed below:
 - 1. Restrain rectangular ducts with cross sectional area of 6 sq. ft. or larger.
 - 2. Restrain round ducts with diameters of 33" or larger.
 - 3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
- B. Transverse restraints shall occur at 30' intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.

- C. Longitudinal restraints shall occur at 60' intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within four feet of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
- D. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
- E. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
- F. Unbraced ducts will be installed with a 6" minimum clearance to vertical ceiling hanger wires.
- G. Walls, including gypsum board non-bearing partitions, that have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame at all stud wall construction.

3.6 SEISMIC RESTRAINT OF MECHANICAL EQUIPMENT

- A. All mechanical equipment shall be vibration isolated and seismically restrained as per Section 2.02 of this Specification.

3.7 SEISMIC RESTRAINT EXCLUSIONS

- A. Piping:
 - 1. All piping less than 2½" in diameter except those listed in Section 3.03, paragraph A.
 - 2. All piping in boiler and mechanical equipment rooms less than 1¼" I.D except where noted otherwise in this Specification and in Section 3.03, paragraph A.1.
 - 3. All clevis or trapeze supported piping suspended from hanger rods where the point of attachment is less than the 12" in length from the structure to top of pipe, except those listed in Section 3.03, paragraph A.1.
- B. Ductwork:
 - 1. Rectangular, square or oval ducts less than six square feet in cross sectional area.
 - 2. Round duct less than 33" in diameter.
 - 3. No bracing is required if the duct is suspended by hangers 12" or less in length, as measured from the top of the duct to the bottom of the support where the hanger is attached. Hangers must be positively attached to the duct with 2" of the top of the duct with a minimum of two #10 sheet metal screws.
- C. Suspended Equipment:
 - 1. VAV boxes and fan-powered equipment weighing less than 50 lbs. and rigidly connected to the supply side of the duct system and supported with a minimum of four hanger rods.

END OF SECTION 230548

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. General Provisions for Mechanical Work Section 230500 shall apply to all work performed under this Section of the Specifications and shall be considered as included herein.

1.2 SUMMARY

- A. Provide identification devices specified in this section.
- a. Section Includes:
 - b. Equipment labels
 - c. Warning signs and labels.
 - d. Pipe labels.
 - e. Duct labels.
 - f. Stencils.
 - g. Valve tags.
 - h. Warning tags.

1.3 RELATED SECTIONS

- A. All Sections of Division 23 apply to work in this Section.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
- 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
 - a. The following colors shall be used for piping identification unless noted otherwise:

Service	Legend	Background Color
Refrigerant Liquid Pipe	Liquid	Yellow
Refrigerant Suction Pipe	Suction	Yellow
Refrigerant Hot Gas Pipe	Hot Gas	Yellow
A/C Condensate	AC Cond	Yellow

Note: Color banding shall meet latest edition of NSI and OSHA requirements.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8 ½ "x 11" bond paper. Tabulate valve number, piping system, system abbreviation (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Section 01780 Project Closeout.
- F. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of 01780 Project Closeout.

1.6 WARRANTIES

- A. Provide one year maintenance warranty for all pieces of equipment. See Division 1 for additional warranty requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, products are limited to Seton, Brady or Brimar whom have a minimum of 5 years experience in the manufacturing of mechanical identification products.

2.2 MECHANICAL IDENTIFICATION MATERIALS

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 15 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

- A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 duct work.
- B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
- B. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.4 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1. Must be secured to pipe with adhesive flow arrow tape at both ends.
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.
- C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
- D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker secured to pipe with flow arrow tape.
 - 2. Adhesive lap joint in pipe marker overlap.
 - 3. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than $\frac{3}{4}$ " wide; full circle at both ends of pipe marker, tape lapped 1 $\frac{1}{2}$ ".
- E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and or required length), fastened by one of the following methods:
 - 1. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1 $\frac{1}{2}$ " wide, full circle at both ends of pipe marker, tape lapped 3".
 - 3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
- F. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
 - 1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.5 VALVE TAGS

- A. Brass Valve Tags: Provide 1/16" (1.5mm) thick polished brass valve tags with stamp-engraved piping system abbreviation in 3/8" (8mm) high letters and sequenced valve numbers $\frac{3}{4}$ " 918mm high, and with 1/8" (3mm) hole for fastener.
 - 1. Provide 1 $\frac{1}{2}$ " (37mm) diameter tags, except as otherwise indicated.
 - 2. Provide size and shape as specified or scheduled for each piping system.
 - 3. Fill tag engraving with black enamel.
- B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

- C. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.6 VALVE SCHEDULE FRAMES

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.7 EQUIPMENT LABELS

- A. All equipment labels shall be made of 3 ply 3/16" engraved phenolic with low glare finish. Labels shall be electrically non-conductive and abrasion resistant. Labels shall have mounting holes and adhesive backing.

2.8 WARNING SIGNS AND LABELS

- A. All WARNING labels shall be made of 3 ply 3/16" engraved phenolic with low glare finish. Labels shall be electrically non-conductive and abrasion resistant. Labels shall have mounting holes and shall be permanently attached. Background color shall be yellow with red lettering.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces which required insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Where air or hydronic systems have been balanced, the Contractor shall permanently mark, ON THE DEVICE, the correct balancing settling of each valve, damper, or similar device.

3.2 DUCTWORK IDENTIFICATION

- A. General: Identify air supply, return, exhaust, intake and relief ductwork with stenciled signs and arrow, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).
- B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 foot spacing along exposed runs.
- C. Access Doors: Provide plastic duct access door markers on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information. Where acoustic ceilings are below the access, provide duplicate marker on ceiling tile, ceiling grid, or ceiling access panel.

3.3 PIPING SYSTEM IDENTIFICATION

- A. General: install pipe markers on each system listed on the color chart Paragraph 1.04.B.1.a. indicate nominal pipe size (i.e. 4" HS) and include arrows to show normal direction of flow.

- B. Locate pipe markers and color bands as follows wherever piping and ductwork is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations and concealed above ceiling spaces.
1. Near each valve and control device.
 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
 4. At access doors, manholes and similar access points which permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.
 7. On piping above removable acoustical ceilings.

3.4 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, and HVAC terminal devices 50 mm and smaller and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
1. Tagging Schedule: Valve tags shall be sequential.
- B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by the Owner.

3.5 EQUIPMENT LABELS

- A. Equipment labels shall include, but not limited to the following applicable information:

Schedule Tag	CFM
Equipment Served	Static Pressure
Equipment Manufacturer	Head
Equipment Model	GPM
Horsepower	Valve CV
Fan RPM	lbs/HR
Voltage Inlet Pressure	
Sheaves	Outlet Pressure
Belt Size, Model, Quantity	Pressure Drop
Zone Served	Type of Service
	Filter Size & Quantity

- B. Provide equipment labels for (Not all equipment listed is provided as part of this project):

Exhaust Fans	Pumps
All Fans & Air Handling Units	Chillers
Variable Frequency Drives	Rooftop Units/ERVs
Boilers	Temperature Control Panels
Condensing Units	Expansion Tanks
Room Fan Coil Units	Storage Tanks
VAV Boxes	Control Valve
Cabinet and Unit Heaters	

3.6 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.7 EXTRA STOCK

- A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 12) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
 - 1. Where stenciled markers are provided (ductwork only), clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION 230553

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Work in this section shall be performed by a certified TAB contractor retained by the Mechanical Contractor as part of this Project.
- B. The Mechanical contractor and ATC sub-contractor's services are required to assist in and support the TAB work. The cooperation and participation of the Mechanical Contractor and all subcontractors is required.
 - 1. The Mechanical contractor shall include any costs for required TAB activities, including those of their subcontractors in the contract price.
 - 2. Include TAB participation requirements and activities in all subcontracts and schedules.
 - 3. Include the services of the sheet metal contractor for temporary capping of the duct mains for pressure testing, and reconnection of the branch ducts after testing is complete.
- C. Section Includes:
 - 1. Commissioning Responsibilities of the TAB contractor.
 - 2. Pressure testing of air duct systems.
 - 3. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 4. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

- A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

- B. Certified TAB reports.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.5 COMMISSIONING TEAM RESPONSIBILITIES

- A. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved prior to final CxA Testing of equipment and systems.
- B. Prior to scheduling of Testing, Adjusting and Balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- C. The Mechanical Contractor shall notify the GC and CxA at least ten (10) days in advance of systems being ready for testing and balancing work, for dates to be scheduled with the CxA and TAB contractor and shall provide access for the CxA to witness testing and balancing Work.
- D. Provide technicians, instrumentation, and tools to support testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification in order for dates and times to be coordinated with the CxA, Mechanical contractor, and the ATC sub-contractor. Notice will not include data points to be verified.
 - 2. If re-testing is required, the testing and balancing subcontractor shall use the same instruments by model and serial number that were used when original data were collected.
 - 3. Failure of an item is defined by a deviation of more than 10 percent of any pertinent variable other than sound. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.
 - 4. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise shall be considered.
 - 5. The Mechanical Contractor shall remedy the deficiency and notify the GC and CxA so verification of failed portions can be performed, and so that repeat of the TAB testing can be scheduled.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. This contractor shall pressure test ducts in the presence of the CxA, and as specified in Division 23 Section Metal Ducts. A leakage report shall be submitted to the GC and CxA to be forwarded to the A/E. Repeat testing of failed sections after confirmed repair by the Mechanical Contractor.
 - 1. The MC is responsible for and shall coordinate the requirements of the ductwork pressure test with his sheetmetal subcontractor.
 - 2. Advanced planning is required, including but not limited to installation of temporary caps on duct branches and mains in order to facilitate testing. Failure to plan for the tests does not alleviate the duct pressure test requirement.
 - 3. Failure to schedule the test to include attendance by the CxA will require the test to be repeated.
 - 4. Duct sections that do not pass the pressure test shall be resealed and retested. Additional TAB labor and any delay caused to the work of other trades is the responsibility of the Mechanical Contractor.
 - 5. After successful testing is completed, the duct branches shall be reconnected, sealed, and insulation repaired.
- F. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section Metal Ducts and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- G. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- H. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed. Identify and log all

deficiencies (example: missing volume dampers, disconnected ductwork, missing insulation, obvious air leaks) and submit to the MC and CxA. The MC shall repair all noted deficiencies and sign off log.

- I. Examine test reports specified in individual system and equipment Sections.
- J. Replace all air filters with new.
- K. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation. Construction filters must be replaced with final filters prior to TAB. If additional construction work is on-going after the testing, additional protection should be in place to protect the system such as return register/intake filter material covers.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.
 - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in U.S. standard inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Replace all air filters and identify clean and dirty pressure drops.
- D. Locate all volume dampers in system and correct schematic diagrams of systems' "as-built" duct layouts.
- E. Although this is a variable-air-volume system, there is no diversity – systems must be balanced for operation at 100% (worst case).
- F. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- G. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- I. Verify that motor starters are equipped with properly sized thermal protection.
- J. Check dampers for proper position to achieve desired airflow path.
- K. Check for airflow blockages.
- L. Check condensate drains for proper connections and functioning.
- M. Check for proper sealing of air-handling-unit components.
- N. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

- d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
 - B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
 - C. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
 - D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.6 PROCEDURES FOR MOTORS
- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.8 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: +/- 10%.
2. Air Outlets and Inlets: +/- 10%.
3. Heating-Mode Water Flow Rate: +/- 10%.
4. Cooling-Mode Water Flow Rate: +/- 10%.

3.9 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.

2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Weather conditions and operating mode of system at time of testing.
10. Signature of TAB supervisor who certifies the report.
11. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
12. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
13. Nomenclature sheets for each item of equipment.
14. Data for terminal units, including manufacturer's name, type, size, and fittings.
15. Notes to explain why certain final data in the body of reports vary from indicated values.
16. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

3.11 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

3.12 SPECIAL REQUIREMENTS

- A. If readings shown on the balancing report or from actual site visit are not acceptable to the Engineer, the Balancing Contractor shall spot test (witnessed by the Engineer) as many pieces of equipment or air outlets at no additional cost.

3.13 TRAINING OF OWNER PERSONNEL

- A. The TAB contractor shall have the following training responsibilities:
 - 1. TAB shall meet with facility staff after completion of TAB and instruct them on the following:
 - a. Review the final TAB report, explaining the layout and meanings of each data type.
 - b. Discuss any outstanding deficiencies in control, ductwork, piping or system design that may affect the proper delivery of air or water.
 - c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 - d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 - e. Other salient information that may be useful for facility operations, relative to TAB.

END OF SECTION 230593

SECTION 230700

HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Polyolefin.
 - e. Polystyrene.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied jackets.
10. Tapes.
11. Securements.
12. Corner angles.

B. Related Sections:

1. Division 22 Section "Plumbing Insulation."
2. Division 23 Section "Metal Ducts" for duct liners.

C. Scope:

1. Insulate refrigerant piping.
2. Insulate all copper AC condensate piping.
3. Insulate all supply, return and outside air ducts.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at duct access panels and volume dampers.
 8. Detail application at linkages of control devices.
 9. Detail field application for each equipment type.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 REFRIGERANT/COOLING CONDENSATE INSULATION

- A. Provide and install insulation on all piping and equipment as listed manufactured by Armacell.
1. Copper AC Condensate Piping: 1" thick insulation
 2. PVC or Vinyl AC Condensate Piping: No Insulation Required
 3. Refrigerant Piping, Indoors, for Split Systems: 1" thick insulation with PVC Jacket
 4. Refrigeration Piping, Outdoors, for Split Systems: 2" thick insulation with Pittwrap Jacket
 5. Refrigerant Piping from Chiller to Outdoor Condenser: No Insulation
 6. Chilled Water Buffer Tank, Expansion Tank, Air Separator: 1-1/2" thick sheet Armaflex insulation
- B. Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular form model AP Armaflex SS and AP Armaflex Sheet. Product shall meet the requirements as defined in ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."
- C. Insulation material shall have a closed-cell structure to prevent moisture from wicking, which makes it an efficient insulation.
- D. Insulation material shall be manufactured without the use of CFC's HFC's or HCFC's. It shall also be formaldehyde free, low VOC's, fiber free, dust free and resists mold and mildew.
- E. Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.

- F. Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft²-°F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
- G. Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision. The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity and water vapor transmission.
- H. Closed-cell type insulation (Armaflex) is not allowed for use as piping insulation, other than for refrigerant piping, unless otherwise specified.

2.2 DUCT INSULATION (INDOORS)

- A. All leakage testing of ductwork to be insulated shall be completed, and resealing of areas found to not be tight, prior to the application of any insulation materials.
- B. Supply, return, and outside air intake ductwork shall be insulated with a minimum of 2" thick R-8 (as rated on manufacturer's packaging) fiberglass duct insulation when located within interior unconditioned spaces.
- C. Duct insulation shall be continuous through wall openings and sleeves.
- D. Insulation shall be as manufactured by Owens Corning or approved equal. Insulation shall have a foil-faced vapor barrier.
- E. Where noted on drawings, supply, return, and exhaust ducts may have both internal duct sound lining and exterior wrap. Where both internal and external insulation are used, the internal lining shall be ½ " Imcoa sheet closed cell engineered polymer foam insulation OR 1" Acoustical Duct Liner by Johns Manville Model Linqcoustic HP AND foil-faced duct wrap of a thickness to meet a combined total R-8 INSTALLED value. Supply and return air ductwork shall be installed with internal sound-lining minimum of the first ten (10) feet from the unit being served.
- F. Where noted on drawings, supply and return ducts may ONLY be internally sound lined with 2 " Acoustical Duct Liner by Johns Manville Model Linqcoustic HP with a minimum insulating value of R-8. Supply and return air ductwork shall be installed with internal sound-lining minimum of the first ten (10) feet from the unit being served.

2.3 DUCT INSULATION EXPOSED TO WEATHER

- A. All leakage testing of ductwork to be insulated shall be completed, and resealing of areas found to not be tight, prior to the application of any insulation materials.
- B. Insulate with a minimum 3" extruded polyiso board insulation to achieve a minimum of R-12 installed rating.
- C. Insulation shall be Energy Shield as manufactured by Atlas Roofing Corporation or engineer approved equal.
- D. Wrap board insulation with Venture Tape VentureClad1577CW® or approved equal is a patented, zero permeability, absolute vapor barrier for insulation cladding and jacketing applications. A 5-ply, self adhesive material installs quickly and easily with no special tools required.

- E. Product is available in natural aluminum, white, black, and stucco embossed texture finish. Finish to be approved by Engineer, Architect and Owner.

2.4 PVC PIPE JACKET

- A. Provide and install Zeston 300 Series PVC heavy-duty fitting covers and Zeston PVC pipe jacket or approved equal on all insulated piping in the mechanical room and where exposed to view, specifically designed for industrial and commercial applications.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Refer to the manufacturer's written installation instruction & product data sheets for additional information, and for product specific installation requirements and instructions.
- B. All testing of ductwork and piping to be insulated shall be completed prior to the application of any insulation materials.
- C. All surfaces to be insulated shall be cleaned of all scale, rust, oil, and foreign matter and shall be dry and free of frost prior to and during application of insulation.
- D. All insulation and accessory materials shall be stored in an area that is dry and protected from the weather before and during insulation application.
- E. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- F. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- G. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- H. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- I. Install multiple layers of insulation with longitudinal and end seams staggered.
- J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- K. Keep insulation materials dry during application and finishing.

- L. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- M. Install insulation with least number of joints practical.
- N. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- P. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches on center.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches on center.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement after start-up.
- S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- T. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
 - 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.4 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply, return and outdoor air.
 - 2. Indoor, exposed supply and outdoor air located in non-conditioned space.
 - 3. Indoor, concealed return located in non-conditioned space.
 - 4. Indoor, exposed return located in non-conditioned space.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- B. Items Not Insulated:
 - 1. Fabric DuctSox.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe

- insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 PENETRATIONS

- A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.7 CELLULAR-GLASS INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges 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 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.

D. 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 not available, 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. Install insulation to flanges as specified for flange insulation application.
4. 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.

3.9 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums:

1. Secure with adhesive and insulation pins.

2. At volume damper and duct access door locations, cut insulation back to expose damper adjusters and access doors. Tape seal insulation to duct. Provide an insulation "Door" to cover the access point and mark the "Door" with highly visible fluorescent marker or tape.
 3. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 4. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 5. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches on center, each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 6. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch on center. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches on center.
 8. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 9. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches on center.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches on center. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch on center. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches on center.

3.10 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges 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 Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin 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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. 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.

3.11 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.12 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.
- C. 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 on center. and at end joints.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

END OF SECTION 230700

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. See Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.
- C. The following specification describes components of the control system required for this project. Provide all components necessary for a complete automatic control system that will accomplish all of the "Sequences of Operations" described in Section 230993 of these specifications.

1.2 SUBMITTALS

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
 - 1. Schematic flow diagrams.
 - 2. Power, signal, and control wiring diagrams.
 - 3. Details of control panel faces.
 - 4. Damper schedule.
 - 5. Valve schedule.
 - 6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
 - 7. Control System Software: Schematic diagrams, written descriptions, and points list.
- C. Software and firmware operational documentation.
- D. Field quality-control test reports.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Control for the majority of the equipment shall be by the equipment manufacturer.
- B. Control equipment, where required, shall be comprised of readily available parts, and open protocol type controllers. Proprietary systems and equipment are not acceptable.

2.2 CONTROL SYSTEM

- A. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories.
- C. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
 - 1. Output ripple of 5.0 mV maximum peak to peak.
 - 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 - 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.3 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 - 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72 hour battery backup.
 - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
 - 3. Enclosure: Dustproof rated for operation at 32 to 120 deg F .

2.4 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
 - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.5 TIME CLOCKS

- A. Manufacturers:
 - 1. ATC-Diversified Electronics.
 - 2. Grasslin Controls Corporation.
 - 3. Paragon Electric Co., Inc.
 - 4. Precision Multiple Controls, Inc.

5. SSAC Inc.; ABB USA.
 6. TCS/Basys Controls.
 7. Theben AG - Lumilite Control Technology, Inc.
 8. Time Mark Corporation.
- B. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.
- C. Solid-state, programmable time control with 8 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.6 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. Ebtron, Inc.
 - c. Heat-Timer Corporation.
 - d. I.T.M. Instruments Inc.
 - e. MAMAC Systems, Inc.
 - f. RDF Corporation.
 2. Accuracy: Plus or minus 0.5 deg F at calibration point.
 3. Wire: Twisted, shielded-pair cable.
 4. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 5. Averaging Elements in Ducts: use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 7. Room Sensor Cover Construction: Provide sample for Owner approval.
 8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. Humidity Sensors: Bulk polymer sensor element.
1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
 2. Accuracy: 2 percent full range with linear output.
 3. Room Sensor Range: 20 to 80 percent relative humidity.
 4. Room Sensor Cover Construction: Provide sample for Owner approval.
 5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
 6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F.

7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

D. Pressure Transmitters/Transducers:

1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg.
3. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
4. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.
5. Room Sensor Cover Construction: Provide sample for Owner approval

2.7 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

2.8 GAS DETECTION EQUIPMENT

- A. Manufacturers:
 1. Ebtron, Inc.
 2. Honeywell International Inc.; Home & Building Control.
 3. TSI Incorporated.
- B. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F; with 2 factory-calibrated alarm levels at 50 and 100 ppm.

- C. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output for wall mounting.
- D. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.9 THERMOSTATS (NON-DDC)

A. Manufacturers:

- 1. Erie Controls.
- 2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
- 3. Heat-Timer Corporation.
- 4. Sauter Controls Corporation.
- 5. Tekmar Control Systems, Inc.
- 6. Theben AG –Lumilite Control Technology, Inc.

B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

- 1. Automatic switching from heating to cooling.
- 2. Preferential rate control to minimize overshoot and deviation from set point.
- 3. Set up for four separate temperatures per day.
- 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
- 5. Short-cycle protection.
- 6. Programming based on every day of week.
- 7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
- 8. Battery replacement without program loss.
- 9. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."

C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

- 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
- 2. Selector Switch: Integral, manual on-off-auto.

E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

- 1. Bulbs in water lines with separate wells of same material as bulb.
- 2. Bulbs in air ducts with flanges and shields.
- 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.

4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- F. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:
1. Reset: Manual.
 2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.
- G. Room Thermostat Cover Construction: Provide sample for Owner approval.
- H. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- I. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, automatic reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft of coil surface.
- J. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, automatic reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- K. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.
- 2.10 HUMIDISTATS
- A. Manufacturers:
1. MAMAC Systems, Inc.
 2. ROTRONIC Instrument Corp.
- B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.
- 2.11 ACTUATORS
- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

3. Non-spring-Return Motors for Valves Larger Than NPS 2-1/2 : Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf .
 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf .
 5. Non-spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf .
 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf .
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
 - a. Belimo Air Controls (USA), Inc.
 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
 4. Coupling: V-bolt and V-shaped, toothed cradle.
 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
 7. Power Requirements (Two-Position Spring Return): 24 / 120 / 230 V ac.
 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 10. Temperature Rating: Minus 22 to plus 122 deg F.
 11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F .

2.12 DAMPERS

- A. Manufacturers:
1. Air Balance Inc.
 2. TAMCO (T. A. Morrison & Co. Inc.).
 3. Nailor
 4. Greenheck
- B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch minimum thick, galvanized-steel or 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less

than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.13 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- B. Install guards on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.
- C. Install automatic dampers according to Division 23 Section "Air Duct Accessories." Provide a duct access panel at all automatic dampers.
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- F. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- G. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- H. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 6. Test each system for compliance with sequence of operation.
 7. Test software and hardware interlocks.
- C. Verification:
 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 6. Check temperature instruments and material and length of sensing elements.
 7. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 DEMONSTRATION

- A. Engage an-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 230900

SECTION 230923.27

TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Air temperature sensors.

B. Related Requirements:

1. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 DEFINITIONS

- A. HART (Highway Addressable Remote Transducer) Protocol: The global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bidirectional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from a technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.
- B. PIR: Passive infrared.
- C. RTD: Resistance temperature detector.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For the following:
 - a. Air temperature sensors.
 - b. Multi-variable air temperature sensors and transmitters.
 - c. Wireless air temperature sensors.
 - d. Combination air temperature sensors and switches.
 - e. Air temperature switches.
 - f. Air temperature RTD transmitters.
2. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
3. Operating and performance characteristics, electrical characteristics, functional characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including pressure, temperature, and humidity.

4. Product description with complete technical data, performance curves, and product specification sheets.
5. Installation operation and maintenance instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

C. Samples: For each exposed product installed in finished space.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades:

1. Product installation location shown in relationship to room, duct, pipe, and equipment.
2. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
3. Sizes and locations of wall access panels for instruments installed behind walls.
4. Sizes and locations of ceiling access panels for instruments installed in inaccessible ceilings.

B. Product Certificates: For each product requiring a certificate.

C. Product Test Reports: For air temperature sensors, for tests performed by a qualified testing agency.

D. Source quality-control reports.

E. Field quality-control reports.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Provide two matching product(s) in Project inventory for each unique type of the following:

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments are to operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
 - a. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure is to be internally insulated, electrically heated, filtered, and ventilated as required by instrument and application.
2. Instruments and accessories are to be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated are to be housed in protective secondary enclosures. Instrument's installed location is to dictate NEMA 250 enclosure requirements:
 - a. Outdoors, Protected: Type 2.
 - b. Outdoors, Unprotected: Type 4, or, Type 4X.
 - c. Indoors, Heated with Filtered Ventilation: Type 1.
 - d. Indoors, Heated with Nonfiltered Ventilation: Type 2.
 - e. Indoors, Heated and Air Conditioned: Type 1.
 - f. Mechanical Equipment Rooms:
 - 1) Air-Moving Equipment Rooms: Type 2.
 - g. Localized Areas Exposed to Washdown: Type 4, Type 4X.
 - h. Within Duct Systems and Air-Moving Equipment not Exposed to Possible Condensation: Type 2.
 - i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.
 - j. Hazardous Locations: Explosion-proof rating for condition.

2.2 AIR TEMPERATURE SENSORS

A. Platinum RTD, Single-Point Duct Air Temperature Sensors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Honeywell International Inc.
 - b. Johnson Controls, Inc.
 - c. Siemens Industry, Inc., Building Technologies Division
2. Source Limitations: Obtain all platinum RTD single-point air temperature duct sensors from a single manufacturer.
3. Factory Calibration: Factory calibrate each instrument to traceable standards and include instrument with a calibration certificate
4. Performance:
 - a. Repeatability: Within 0.5 deg F.
 - b. Self-Heating: Negligible.
 - c. Two- or three-wire, PTFE-insulated, minimum 22-gauge stranded copper leads.
 - d. Resistance: 100 ohms.
 - e. Temperature Coefficient of Resistance (TCR): 0.00385 ohm/deg C.

- f. Temperature Range: As required by application, not less than Minus 40 to 185 deg F.
 - g. Accuracy: At 32 deg F within .
- 5. Output Signal: Resistance in ohms.
- 6. Sensor Assembly:
 - a. Probe: Single-point RTD wired within a rigid stainless steel sheath.
 - b. Length: As required by application to achieve probe tip near midpoint of air tunnel, up to 18 inches long.
- 7. Enclosure:
 - a. Material: Metal box with removable cover.
 - b. Rating: NEMA 250, Type 1 for indoor applications and Type 4, or for outdoor applications.
 - c. Field Wiring Connection: Terminal block.
 - d. Conduit Connection: 1/2-inch trade size.
- 8. Gasket: For attachment to duct or equipment to seal penetration airtight.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests and Inspections: Test and inspect assembled pressure instruments, as indicated by instrument requirements. Affix standards organization's certification and label.
- B. Prepare test and inspection reports as applicable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.
- C. Fastening Hardware:

1. Wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- E. Corrosive Environments:
1. Use products that are suitable for environment to which they are subjected.
 2. If possible, avoid or limit use of materials in corrosive environments.
 3. When conduit is in contact with a corrosive environment, use Type 316 stainless steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
 4. Where instruments are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 INSTALLATION OF TEMPERATURE INSTRUMENTS

- A. Mounting Location:
1. Roughing In:
 - a. Outline instrument-mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
 - b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
 - 1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
 - 2) Do not begin installation without submittal approval of mounting location.
 - c. Complete installation rough-in only after confirmation by independent inspector is complete and approval of location is documented for review by Owner and Architect on request.
 2. Install switches and transmitters for air and liquid temperature associated with individual HVAC equipment and associated connected ductwork and piping near HVAC equipment co-located in HVAC equipment system control panel to provide service personnel a single and convenient location for inspection and service.
 3. Install liquid and steam temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
 4. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
 5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Special Mounting Requirements:

1. Protect products installed outdoors from solar radiation and building and wind effect with stand-offs and shields constructed of Type 316 stainless steel.
2. Isolate temperature instruments having performance impacted by temperature of mounting substrate with an insulating barrier located between instrument and substrate to eliminate effect on performance. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.

C. Mounting Height:

1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height is to comply with codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.
 - a. Make every effort to mount at 60 inches.

D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

E. Installation of Space Temperature Sensors:

1. Conceal assembly and field wiring connections in an electrical box of sufficient size to house sensor and transmitter, if provided.
2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
3. In finished areas, recess electrical box within wall.
4. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted. Use a cast-aluminum electric box for surface-mounted installations.
5. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.

F. Installation of Outdoor Air Temperature Sensors:

1. Mount sensor in an accessible and discrete location facing north.
2. Protect installed sensor from solar radiation and other environmental influences that could impact performance.
3. If required to have a transmitter, mount transmitter remotely from sensor in an accessible and serviceable location indoors that is not readily accessible by building occupants.

G. Installation of Single-Point Duct Temperature Sensors:

1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed near center of duct cross section and located to sense near average temperature. Do not exceed 18 inches in sensor length.
2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
3. Rigidly support sensor to duct and seal penetration airtight.
4. If required to have transmitter, mount transmitter remotely from sensor at accessible and serviceable location indoors that is not readily accessible by building occupants.

5. Install duct access doors of sufficient size for inspection, removal, and replacement of single-point duct temperature sensors. Comply with Section 233300 "Air Duct Accessories" for access doors.

H. Installation of Averaging Duct Temperature Sensors:

1. Install averaging-type air temperature sensor for temperature sensors located within air-handling units, similar HVAC equipment, and large ducts with air tunnel cross-sectional area of 10 sq. ft. and larger.
2. Install sensor length to maintain coverage over entire cross-sectional area and measure an average temperature. Install multiple sensors where required to maintain coverage.
3. Fasten and support sensor with manufacturer-furnished clips to keep sensor properly supported and taut throughout entire length.
4. If required to have transmitter, mount transmitter in an accessible and serviceable location indoors that is not readily accessible by building occupants.
5. Install duct access doors of sufficient size for inspection, removal, and replacement of averaging duct temperature sensors. Comply with Section 233300 "Air Duct Accessories" for access doors.

I. Installation of Multivariable Air Temperature Sensors and Transmitters: Comply with requirements indicated for air temperature sensors.

J. Installation of Wireless Air Temperature Sensors:

1. Mount sensors to substrate at height indicated, using mounting kits furnished with sensors.
2. In areas with ceilings, conceal mounting of receivers, transceivers, or repeaters above ceilings.
3. Test communication signal to ensure a strong and uninterrupted signal to all connected devices and for proper coverage. Add additional receivers, transceivers, or repeaters if required.

K. Installation of Combination Air Temperature Sensors and Switches:

1. Install combination air temperature sensors and switches to maintain coverage over entire cross-sectional area of air tunnel and to account for stratification. Install multiple instruments if required to maintain coverage over entire cross-sectional area of air tunnel and to account for stratification.
2. Fasten and support sensing element with manufacturer-furnished clips to keep element properly supported and taut throughout entire length.
3. Mount instrument enclosure outside of airstream at a location and mounting height to provide easy access for set-point adjustment and manual reset.
4. Install on entering side of cooling coil unless otherwise indicated on Drawings.
5. Install duct access doors of sufficient size for inspection, removal, and replacement of combination air temperature sensors and switches. Comply with Section 233300 "Air Duct Accessories" for access doors.

L. Installation of Low-Limit Air Temperature Switches:

1. Install low-limit switches to maintain coverage over entire cross-sectional area of air tunnel and to account for stratification. Install multiple switches if required to maintain coverage over entire cross-sectional area of air tunnel and to account for stratification.
2. Fasten and support sensing element with manufacturer-furnished clips to keep sensor properly supported and taut throughout entire length.
3. Mount switches outside of airstream at a location and mounting height to provide easy

- access for switch set-point adjustment and manual reset.
- 4. Install on entering side of cooling coil unless otherwise indicated on Drawings.
- 5. Install duct access doors of sufficient size for inspection, removal, and replacement of low-limit air temperature switches. Comply with Section 233300 "Air Duct Accessories" for access doors.

M. Installation of Liquid and Steam Temperature Sensors:

- 1. Install all sensors in a matching thermowell.
- 2. For pipe NPS 4 and larger, install sensor and thermowell length to extend into pipe between 50 to 75 percent of pipe cross section.
- 3. For pipe smaller than NPS 4:
 - a. Install reducers to increase pipe size to NPS 4 at point of thermowell installation.
 - b. For pipe sizes NPS 2-1/2 and NPS 3, thermowell and sensor may be installed at pipe elbow or tee to achieve manufacturer-recommended immersion depth in lieu of increasing pipe size.
 - c. Minimum insertion depth is to be 2-1/2 inches.
- 4. Fill thermowell with heat-transfer compound before inserting sensor.
- 5. Install tip of spring-loaded sensors to contact inside of thermowell.
- 6. For insulated piping, install thermowells with extension neck to extend beyond face of insulation.
- 7. Install thermowell in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement. If top dead center location is not possible due to field constraints, install thermowell at location along top half of pipe.
- 8. Install sensors and thermowells to provide a leak-free installation when subjected to system, pressures, temperatures, and velocities encountered.
- 9. Install high-end commercial and industrial grade liquid and steam temperature sensors with a connection head.
- 10. For applications with transmitters, mount transmitter remotely from sensor in an accessible and serviceable location from floor. Avoid locations that are readily accessible by building occupants.

3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Furnish and install raceways. Comply with requirements in Section 260533.23 "Surface Raceways for Electrical Systems."
- E. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- F. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- G. Install nameplate for each electrical connection, indicating electrical equipment designation and

circuit number feeding connection.

1. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

- A. Install control signal wiring to field-mounted control devices.
- B. Connect control signal wiring in accordance with Division 26.
- C. Furnish and install raceways. Comply with requirements in Section 260533.23 "Surface Raceways for Electrical Systems."

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with instrument identification.

3.7 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

3.8 CHECK-OUT PROCEDURES

- A. Check installed products before continuity tests, leak tests, and calibration.
- B. Check temperature instruments for proper location and accessibility.
- C. Verify sensing element type and proper material.
- D. Check instruments for proper installation with respect to location, elevation, orientation, insertion depth, or other applicable considerations that impact performance.
- E. Verify that wiring is correct and secure.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:
 1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
 2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
 3. For each analog instrument, make a three-point test of calibration for both linearity and

- accuracy.
 - 4. Equipment and procedures used for calibration are to meet instrument manufacturer's written instructions.
 - 5. Provide diagnostic and test equipment for calibration and adjustment.
 - 6. Field instruments and equipment used to test and calibrate installed instruments are to have at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent is to be checked by an instrument with an accuracy of 0.5 percent.
 - 7. Calibrate each instrument in accordance with instrument instruction manual supplied by manufacturer.
 - 8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.
 - 9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Controls Components," in the absence of specific requirements and to supplement requirements indicated.
- B. Analog Signals:
- 1. Check analog voltage signals using a voltage meter at zero, 50, and 100 percent.
 - 2. Check analog current signals using a current meter at zero, 50, and 100 percent.
 - 3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.
- C. Digital Signals:
- 1. Check digital signals using a jumper wire.
 - 2. Check digital signals using an ohmmeter to test for contact.
- D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
- E. Switches: Calibrate switches to make or break contact at set points indicated.
- F. Transmitters:
- 1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
 - 2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
- C. Tests and Inspections: Perform the following tests and inspections:
- 1. Perform in accordance with manufacturer's written instruction.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.11 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.12 MAINTENANCE SERVICE

- A. Beginning at Substantial Completion, verify that maintenance service includes 12 months' full maintenance by skilled employees of systems and equipment Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Verify that parts and supplies are manufacturer's authorized replacement parts and supplies.

3.13 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.
- B. Coordinate training video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- C. Record Owner training and submit digital files with closeout documents for Owner's future use.

END OF SECTION

SECTION 230993

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Provide controls to make systems function in accordance with good practice considering energy conservation and actual intended use for all equipment that is not covered by these descriptions.

1.2 RELATED SECTIONS

- A. See Division 23 Section 230900 "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
- B. See Division 23 Section 230593 "Testing, Adjusting, and Balancing" for coordination requirements.

1.3 GENERAL

- A. All systems shall be controlled through the equipment manufacturer's programs
- B. Provide automatic controls to make systems function in accordance with good practice considering energy conservation and actual intended use for all equipment that is not covered by these descriptions.
- C. All operating sequences must be demonstrated through conditional tests during the Commissioning process (not commanded operation) to the satisfaction of the OPM, engineer and CXA.
- D. All starters shall have HAND/OFF/AUTO function. Label all starters with phenolic nameplates indicating equipment serviced.
- E. Smoke Detection: All equipment over 2,000 CFM shall include fire alarm interface to shut down.

1.4 SEQUENCE OF OPERATION

A. GENERAL DESCRIPTION:

- 1. Indoor ERVs serving the Gym (ERV-1) with natural gas heating and DX cooling will serve as heating and cooling, as well as ventilation and exhaust for the Gym. Positive building pressure will be maintained.
- 2. The system OAT sensor shall be installed on the north side of the building in a location not subject to direct sunlight.
- 3. Building Occupied/Unoccupied schedule shall be maintained by the 7-day programmable thermostats.

B. INDOOR GAS/DX ENERGY RECOVERY VENTILATOR (ERV-1)

1. General:

- a. The primary purpose of this system is to provide heating and cooling to the Gym and CO2 controlled ventilation air for varying occupant loads.
- b. All control of the ERV is field supplied and installed with the exception of the VFDs (2-SA fan, 2-RA fan, 1-ERV) which are factory supplied, field installed.
- c. The ERV unit shall run during occupied mode and pre-cool Economizer Mode, and be off during unoccupied mode unless there is a call for heating from the (4) averaging space sensors in the Gym.
- d. This indoor modular gas/DX ERV includes:
 - 1) Plenum-style supply and exhaust fans with VFDs (2 VFDs each fan section)
 - 2) Outdoor air and Exhaust air dampers with airflow stations
 - 3) Energy recovery wheel with bypass dampers
 - 4) Heating and Cooling coil
 - 5) Dehumidification
 - 6) Filter status shall be monitored at each filter bank with both a magnahelic gauge and a DDC differential pressure sensor. Set the target pressure differential for a required filter change during TAB work.
 - 7) The ERV shall have return air capability
 - 8) Supply Air Setpoints:
 - a) Heating Max = 85°F
 - b) Cooling = 55°F - 60°F
 - c) Economizer Cooling = 50°F - 65°F
 - d) RH Max = 60% (measured in return air)

2. Unoccupied:

- a. The ERV unit shall be off during unoccupied mode unless there is a call for heating from one of the four space sensors in the gymnasium.
- b. During Unoccupied mode:
 - 1) the supply air dampers shall be closed
 - 2) the supply and exhaust air fans shall be off
 - 3) the energy recovery wheel shall be disabled
 - 4) the bypass dampers shall be closed

3. Occupied Mode:

- a. During Occupied mode the outdoor and exhaust air dampers shall be CLOSED (subject to CO2 levels in the space), the supply and return/exhaust air fans shall modulate, the energy recovery wheel and bypass dampers shall be enabled, and the unit will run in 100% return air at the minimum fan speed required to satisfy the (4) averaging space sensors in the Gym.
 - 1) The outside air and exhaust dampers shall modulate between 0% and 100% open to maintain ventilation requirements to maintain CO2 levels below 500 ppm as sensed as an average of the four space sensors in the Gymnasium.
 - 2) The supply fan speed shall be modulated as required to maintain the room temperature setpoint at four space sensors.
 - 3) The return/exhaust fan speed shall be modulated to follow the supply fan speed.
 - 4) The energy recovery wheel shall run, subject to frost conditions as sensed by the frost sensor (field supplied and installed by the ATC) or Economizer conditions as described below.
 - a) If frost build-up is sensed at the wheel, the bypass dampers shall open and the wheel shall stop. After 5 minutes the wheel shall restart and the bypass dampers

shall close. The wheel shall run for at least 10 minutes before switching into defrost cycle again.

4. Pre-Cool & Economizer Mode:

- a. During occupied mode, when the outside air temperature is between 50°F and 75°F, and the return air enthalpy is greater than the outside air enthalpy, the ERV shall operate in Economizer Mode.
- b. On a scheduled occupied weekday, if the OAT is between 45°F and 70°F at 2-hours before scheduled occupied time, the system will start and will run in Economizer mode to pre-cool the spaces.
- c. The outside air and exhaust dampers shall remain 100% open. The energy recovery wheel shall stop and the wheel bypass dampers shall open fully subject to a discharge air low limit control set at 50°F (adjustable). The supply fan shall run up to maximum speed to maintain duct static pressure, and exhaust fans shall run at maximum speed.
- d. Economizer shall be disabled and the system shall operate in normal occupied mode if any of the following is true:
 - 1) If the outdoor air temperature is >75°F.
 - 2) If the outside air enthalpy is greater than the return air enthalpy.
 - 3) If the supply air temperature is greater than the average space temperature.
 - 4) If the supply air temperature is <50°F (adjustable).

5. ERV operation is subject to Safeties including:

- a. Duct mounted smoke detectors - Both Supply air and Return/Exhaust air smoke detectors are required for this unit.
 - 1) During detection of smoke or a general alarm condition, the unit shall be deactivated and the exhaust fan shall be de-energized & supply/return dampers shall be closed. Duct mounted smoke detectors are furnished by Division 26 for installation in the ductwork by Division 23 and wiring by Division 26.
- b. Low Temperature Detection:
 - 1) A manual reset Low Temperature Detection sensor shall be on the leaving side of the water coil. –The set point shall be set at the device for 35°F.
 - 2) If the OAT is below 30°F, and a low temp alarm is signaled at the low temperature stat in ERV-9, the supply and exhaust fans shall stop, the OSA and exhaust dampers will close, the energy recovery wheel shall be disabled, the bypass dampers shall be closed. Operation shall remain in this mode until the alarm is manually cleared.
- c. Alarms:
 - 1) Fan motor failure.
 - 1) If a static pressure greater than 3.0"wc or less than -3.0"wc is sensed by the duct-mounted pressure sensors, the supply and return fans shall stop and an alarm shall be generated.

C. INDOOR ENERGY RECOVERY VENTILATOR (ERV-2)

1. General:

- a. The primary purpose of this system is to provide continuous exhaust for bathrooms, and custodian closets, and to supply ventilation air into the return of the AHUs for heating and cooling/dehumidification. Heating and cooling of these spaces also includes a room gas/DX air handling unit (AHU).
- b. The ERV unit shall run during "Building" occupied modes and be off during unoccupied mode set by the 7-day programmable thermostat.
- c. This packaged indoor ERV includes:
 - 1) ECM supply and exhaust fans with shall run continuously at constant velocity during occupied hours.

- 2) Outdoor air and exhaust air dampers with airflow monitoring
 - 3) An energy recovery media
 - 4) No heating or cooling is included in this ERV
 - 5) This ERV DOES NOT have return air capability
 - 6) Filter status shall be monitored at each filter bank with both a manahelic gauge and a DDC differential pressure sensor. Set the target pressure differential for a required filter change during TAB work.
 - 7) This ERV supply air is ducted into the RA side of the AHUs for tempering and distribution to spaces.
2. Unoccupied:
 - 1) the exhaust/outdoor air dampers shall be closed
 - 2) the supply and exhaust air fans shall be off
 3. Occupied Mode:
 - a. The ERV shall operate in normal occupied mode:
 - 1) The outside air and exhaust dampers shall remain 100% open to maintain ventilation requirements during "occupied".
 - b. The supply fan and exhaust air fan shall operate at full speed continuously during occupied mode.
- D. ROOM ZONE CONTROL – GAS/DX AIR HANDLING UNITS (AHUs)
1. General:
 - a. Sequences and descriptions below are typical for all AHU zones.
 - b. All AHUs shall operate subject to fire alarm shutdown and AC condensate pan overflow switch shutdown.
 - c. The AHU systems shall operate to maintain room temperature by modulation of the ECM fan motor between the minimum and maximum set points and modulation of the dual temperature control valve.
 - d. Ventilation air is ducted directly into the return of the AHU from the local ERV to provide outdoor air ventilation to each space. Spaces also have a return/exhaust register which is ducted to the return of the AHU and exhaust side of the ERV for balancing and space pressure maintenance.
 2. Temperature Control:
 - a. Room Thermostats:
 - 1) Each room thermostat shall have an LCD display to toggle between the current room temperature and the set point. A space temperature dead band of 5°F, as required by the IECC, shall be provided to avoid hunting between heating and cooling modes.
 - 2) Room temperature adjustment shall be allowed within a 4° range adjusted by the space occupants. The space temperature range limits shall be programmed into the room thermostat and the user adjustable range shall be +/-2 of the nominal programmed set point.
 - b. Room Temperature Occupied/Unoccupied Set points:
 - 1) Unoccupied Heating: 55° (adjustable) heating available at OAT<40°F
 - 2) Unoccupied Cooling: Not Available
 - 3) Occupied Heating Room Set Point: 69° - User adjustable 67°-71° (adjustable) available at OAT<49°F
 - 4) Occupied Economizer Cooling Room Set Point: 71°F - User adjustable 69° - 73° (adjustable) available at OAT>45°F
 - 5) Warm-Up/ Pre-Cool Mode Room Set Point: 74°F cooling & 67°F heating (adjustable)

3. Occupied Sequence

- a. During Occupied (during occupied building hours) the fan coil unit fan shall run continuously, and the dual temperature-control valve shall modulate for heating or cooling to satisfy the room thermostat setpoint.

E. DUCTLESS SPLIT SYSTEMS (IDU/ODU)

1. Units shall operate via manufacturer's controls.
2. Set the thermostat to maintain a room temperature of 78 degrees.
3. Provide DDC wall sensor for space temperature monitoring.
4. Units operate 24/7, no summer shut-down, and are scheduled to operate on standby-generator power.

F. ELECTRIC CABINET HEATER/UNIT HEATER (EUH)

1. Electric heat with integral thermostat.
2. Set the thermostat to maintain a room temperature of 64 degrees.
3. Provide DDC wall sensor for space temperature monitoring.
4. Units operate 24/7, no summer shut-down, and are scheduled to operate on standby-generator power.

G. NATURAL GAS METERS

1. One natural gas thermal mass flow meter shall be supplied by the ATC subcontractor for installation by the Mechanical Contractor on the building's gas main upstream of gas boosters.

H. PERFORMANCE

1. Unless stated otherwise, control temperatures shall be maintained within plus or minus 3% of the set point, and the flow and static pressure within 10% of set point.

I. ACCEPTANCE PROCEDURE

1. Refer to Commissioning specification section 230800 and Testing, Adjusting, and Balancing section 230593 for coordination requirements included in the ATC scope of work.
2. Upon completion of the calibration, Contractor shall start up the system and perform all necessary testing and run diagnostic tests to ensure proper operation. A detailed acceptance test in the presence of the Owner's representative or Engineer shall be performed, showing the operation of the building automation system and all of its integrated components.
3. Contractor shall be responsible for generating all graphics, installing and configuring software, completing and testing programming, and populating all database necessary to perform the sequence of control, over-rides and special sequences, alarm and notifications, and trending. Contractor shall demonstrate all operations to the CxA (if hired for the project) and engineer and shall provide complete documentation of commissioning of each terminal unit, all pumps, chiller, condenser, boilers, water treatment system, all fan coil units, ERVs, VAVs and all other controlled mechanical equipment. Verification shall be by visual confirmation of the action of the device in the field to verify the selected input at the workstation.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 232300

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:

- 1. Suction Lines for Air-Conditioning Applications: 185 psig.
- 2. Suction Lines for Heat-Pump Applications: 325 psig.
- 3. Hot-Gas and Liquid Lines: 325 psig.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L.

- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 3. Operator: Rising stem and hand wheel.
 - 4. Seat: Nylon.
 - 5. End Connections: Socket, union, or flanged.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze.
 - 2. Packing: Molded stem, back seating, and replaceable under pressure.
 - 3. Operator: Rising stem.
 - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 - 5. Seal Cap: Forged-brass or valox hex cap.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Working Pressure Rating: 500 psig.
 - 8. Maximum Operating Temperature: 275 deg F.
- C. Check Valves:
 - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 - 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 - 3. Piston: Removable polytetrafluoroethylene seat.
 - 4. Closing Spring: Stainless steel.
 - 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Maximum Opening Pressure: 0.50 psig.
 - 8. Working Pressure Rating: 500 psig.
 - 9. Maximum Operating Temperature: 275 deg F.
- D. Service Valves:
 - 1. Body: Forged brass with brass cap including key end to remove core.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.

3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig.
- E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter.
 6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 deg F.
 8. Manual operator.
- F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig.
 6. Maximum Operating Temperature: 240 deg F.
- G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 deg F.
 6. Superheat: Adjustable.
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: 700 psig.
- H. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig.
 5. Maximum Operating Temperature: 275 deg F.
- I. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig.
 6. Maximum Operating Temperature: 275 deg F.
- J. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.

5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

M. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

C. ASHRAE 34, R-410A: Puron.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

- B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type K, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Hot-Gas and Liquid Lines and Suction Lines for Heat-Pump Applications:
 - 1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
 - 2. NPS 2 to NPS 3: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
 - 3. NPS 4: Copper, Type K, drawn-temper tubing and wrought-copper fittings with soldered joints.
- D. Safety-Relief-Valve Discharge Piping: Copper, Type K, drawn-temper tubing and wrought-copper fittings with soldered joints.
- E. Safety-Relief-Valve Discharge Piping:
 - 1. NPS 1-1/2 and Smaller: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
 - 2. NPS 2 to NPS 3: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
 - 3. NPS 4: Copper, Type K, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve and in the suction line at the compressor.
- L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
 - P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
 - Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
 - R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
 - S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
 - T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
 - U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
 - V. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."
- 3.4 PIPE JOINT CONSTRUCTION
- A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
 - B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- 3.5 HANGERS AND SUPPORTS
- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
 - B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.

2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Division 23 Section "Vibration and Seismic Control for HVAC Piping and Equipment" for vibration and seismic control requirements.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design:** Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance:** Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
- C. Airstream Surfaces:** Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2013.

1.3 SUBMITTALS

- A. Product Data:** For each type of product indicated.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

D. Coordination Drawings: 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

E. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports or AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2013, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2013, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Square throat round heel elbows are not allowed. Any square throat round heel elbows found installed by this contractor will be ordered to remove and replace with square throat square heel elbows with vanes at no additional cost to the project.

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Carbon-Steel Sheets: 16 GAUGE Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER (ANTI MICROBIAL GROWTH)

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F (24 deg C) mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F (24 deg C) mean temperature.
 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 4. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick aluminum; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.

- c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
- 9. Terminate duct liner with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 4 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Ductmate Industries, Inc.
 3. Hilti Corp.
 4. Kinetics Noise Control.
 5. Loos & Co.; Cableware Division.
 6. Mason Industries.
 7. TOLCO; a brand of NIBCO INC.
 8. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction].
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.[Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."]

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- 3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION
- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
1. Space lateral supports a maximum of 40 feet O.C., and longitudinal supports a maximum of 80 feet O.C.
 2. Brace a change of direction longer than 12 feet (3.7 m).
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 DUCT CLEANING

- A. Clean all new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
2. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 4-inch wg.
4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 4-inch wg.

B. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 4-inch wg.

C. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Positive 3-inch wg.
2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive 4-inch wg.
3. Ducts Connected to Dishwasher Hoods:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: stainless steel finish.
 - c. Concealed: 304 stainless steel finish.
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - e. Pressure Class: Positive or negative 4-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 4-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. PVC-Coated Ducts:
 - a. Exposed to Airstream: Match duct material.
3. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
4. Aluminum Ducts: Aluminum.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 with vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: 45-degree entry.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 45-degree lateral.
 - b. Velocity 1000 to 1500 fpm: 45-degree lateral.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers and Remote Operated Volume Dampers
3. Control dampers.
4. Fire dampers.
5. Smoke dampers
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.
12. Louvers

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual and Remote Operated volume damper installations.
 - c. Control damper installations.
 - d. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems", and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and top grade finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 4-inch wg.
- E. Frame: 0.063-inch thick extruded aluminum, with welded corners and mounting flange.
- F. Blades: Multiple opposed blades, with sealed edges.
- G. Blade Action: Opposed Blade.
- H. Blade Seals: Low leak, Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Galvanized steel.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.

L. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage minimum.
 - b. Sleeve Length: 6 inches minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Aluminum.
8. Screen Type: Bird.
9. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C& S Air Products.
 - b. Air Balance Inc.; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
2. Low leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel.
7. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C& S Air Products.
 - b. Air Balance Inc.; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.

2. Low leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
6. Blade Axles: Galvanized steel.
7. Tie Bars and Brackets: Aluminum.

C. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Manual Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

E. Remote Operated Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C& S Air Products.
 - b. Air Balance Inc.; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
2. Low leakage rating, with linkage concealed in frame.
3. Suitable for horizontal or vertical applications.
4. Frames: Steel hat-shaped 13 gauge channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. 6" 16-gauge triple v, opposed blade, or single blade.
6. Blade Axles: 1/2" plated steel hex.
7. Bearings: Synthetic
8. Sleeve: Optional 20 gauge 10" long

F. Remote Operated Damper Hardware:

1. Control Shaft: 1/2" × 3" round drive axle with a control arm/screw-drive assembly factory installed on a stand-off bracket attached to an 10" × 20 ga. side plate secured to the damper frame.
2. Remote Control Cable Assembly: 5/32" Ø × length to suit application cable with 3/16" allen hex-head drive, 2" wide steel mounting bracket, 15/16" × 1-1/2" long round plastic tube and optional nickel plated steel finishing plug.
3. Include tee-handle hex tool for operator.
4. Label finishing plug to identify service.

2.4 CONTROL DAMPERS

- A. Control dampers meeting the following specifications shall be furnished and installed where shown on plans and/or as described in schedules. Basis of design for outside air dampers is Greenheck model VCD-34. Basis of design for return air dampers is Greenheck model VCD-33.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. C&S Air Products
 2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Ruskin Company.
- C. Dampers shall consist of a 16 ga galvanized steel channel frame with 5 in depth; airfoil shaped, galvanized steel double skin construction blades 14 ga equivalent thickness filled with 0.5 in fiberglass insulation; blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow in either direction or pressure on either side of the damper; 0.5 in dia. Plated steel axles turning in synthetic sleeve bearings; extruded silicone rubber blade seals for 300 f maximum temperature; 304 ss jamb seals; and external (out of the airstream) blade-to-blade linkage.
- D. Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval showing damper suitable for pressures to 8 in wg, velocities to 4,000 ft/min and temperatures to 180 f. Testing and ratings to be in accordance with AMCA standard 500.
- E. Damper manufacturer's printed performance data showing standard air leakage less than 6 CFM @ 4 in w.g. shall be submitted for approval. Testing and ratings shall be per AMCA standard 500.

2.5 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Air Balance Inc.; a division of Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Ruskin Company.
- B. Type: Dynamic Out of Airstream; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours (as required for wall rating).
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- K. Heat-Responsive Device: Electric resettable link and switch package, factory installed, 165 deg F rated.

2.6 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- F. Leakage: Class I / Class II (as required for assembly).
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- I. Damper Motors: two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for signaling, fan control, or position indication.
2. Momentary test switch, Test and reset switches, damper remote mounted.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Air Balance Inc.; a division of Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours (as required for wall rating).
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, 165 deg F rated.
- H. Smoke Detector: Integral, factory wired for single-point connection.
- I. Blades: Roll-formed, horizontal, interlocking, 0.034 inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- J. Leakage: Class I / Class II (as required for assembly).
- K. Rated pressure and velocity to exceed design airflow conditions.
- L. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- M. Damper Motors: two-position action.
- N. Rated pressure and velocity to exceed design airflow conditions.

- O. Master control panel for use in dynamic smoke-management systems.
- P. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- Q. Accessories:
 - 1. Auxiliary switches for signaling, fan control, or position indication.
 - 2. Momentary test switch, Test and reset switches, damper remote mounted.

2.8 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.9 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
 - C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."
 - E. Vane Construction: Single and Double wall.
 - F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.
- 2.10 DUCT-MOUNTED ACCESS DOORS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Greenheck Fan Corporation.
 3. McGill AirFlow LLC.
 4. Nailor Industries Inc.
 - B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
 - C. Pressure Relief Access Door:
 1. Door and Frame Material: Galvanized sheet steel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 4. Factory set at 10-inch wg.
 5. Doors close when pressures are within set-point range.
 6. Hinge: Continuous piano.
 7. Latches: Cam.

8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.11 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 1. Minimum Weight: 24 oz./sq. yd..
 2. Minimum Tensile Strength: 500 lbf/inch in the warp and 440 lbf/inch in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F.

- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.13 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 4. Temperature Range: Minus 20 to plus 210 deg F.
- B. Insulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil; fibrous-glass insulation; polyethylene vapor-barrier film.
1. Pressure Rating: 8-inch wg positive or negative.
 2. Maximum Air Velocity: 5000 fpm.
 3. Temperature Range: Minus 20 to plus 250 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
- C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
 2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.14 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.15 LOUVERS

- A. Extruded Aluminum Stationary Louver with Horizontal Drainable Blades.
- B. Louvers shall be warranted against manufacturing defects for a period of 5 years.
- C. Louvers shall be licensed to bear the AMCA Certified Ratings label for Water and Air Performance.
- D. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
- E. Manufacturers
 - 1. All-Lite.
 - 2. Greenheck Fan Corporation.
 - 3. Arrow United.

F. EXTERIOR HINGED

- 1. Construction:
 - a) Continuous hinge for 6"-deep aluminum louvers in openings up to 100" (2540) wide × 120" (3048) high.
 - b) Hinged louvers will be constructed as a double door.
 - c) Hinged louvers shall include an aluminum channel subframe (door frame) around the perimeter of the opening with an optional 1-1/2" sub-frame flange.
 - d) Hinged louvers will include a flanged frame to prevent the door from over-rotating through the opening.
 - e) Material: Mill Finish 6063-T5 extruded aluminum.
 - f) Frame: 6" deep x 0.081" thick (152 mm x 2 mm) channel. [flanged].
 - g) Blades: 37½° x 0.081" (2 mm) thick Horizontal drainable style.
 - h) Locking device: Steel hasp plate to accommodate field-supplied padlock
 - i) Mounting hardware: Optional aluminum clip angles or Continuous angles
 - j) Factory head and sill flashing with dams
 - k) Screen: ½" x 0.063" (12.7 mm x 1.6 mm) expanded and flattened aluminum screen.
 - l) Mullion: Visible.
 - m) Color to be selected by architect from manufacturer standard colors.
- 2. Performance Data:
 - a) Based on testing 48 inch x 48 inch (1222 mm x 1222 mm) size unit in accordance with AMCA 500L.
 - b) Free Area: 59.4% nominal
 - c) Free area size: 9.5 ft² (0.88 m²)
 - d) Maximum Recommended Air Flow thru Free Area: 990 fpm (5.03 m/s).
 - e) Air Flow: 9,405 cfm (4.44 m³/s).
 - f) Maximum Pressure Drop: 0.11 in. wg. (27 Pa).
 - g) Water penetration: Maximum of 0.01 ounces per square foot (3.1 g/m²) of free area at an air flow of 990 fpm (5.03 m/s) free area velocity when tested for 15 minutes.
- 3. Design Load:
 - a) Wind Load: Louver designs shall withstand the effects of 30 psf (1.44 kPa) of uniform pressure acting inward or outward.
 - b) Seismic Performance: Louvers, including attachments to other construction, shall withstand seismic effects determined by ASCE-7.

4. Finish louvers after assembly as follows: Finish and custom color selected by Architect.

G. INTERIOR FIXED

1. Construction:

- a) 4"-deep aluminum louver.
- b) Material: Mill Finish 6063-T5 extruded aluminum.
- c) Frame: 6" deep x 0.081" thick (152 mm x 2 mm) channel, 1-1/2" flanged
- d) Blades: 37½° x 0.081" (2 mm) thick Horizontal drainable style.
- e) Screen: Indoor application, no birdscreen.
- f) Mullion: Visible.

2. Performance Data:

- a) Based on testing 48 inch x 48 inch (1222 mm x 1222 mm) size unit in accordance with AMCA 500L.
- b) Free Area: 59.4% nominal
- c) Free area size: 9.5 ft² (0.88 m²)
- d) Maximum Recommended Air Flow thru Free Area: 990 fpm (5.03 m/s).
- e) Air Flow: 9,405 cfm (4.44 m³/s).
- f) Maximum Pressure Drop: 0.11 in. wg. (27 Pa).
- g) Water penetration: Maximum of 0.01 ounces per square foot (3.1 g/m²) of free area at an air flow of 990 fpm (5.03 m/s) free area velocity when tested for 15 minutes.

3. Design Load:

- a) Wind Load: Louver designs shall withstand the effects of 30 psf (1.44 kPa) of uniform pressure acting inward or outward.
- b) Seismic Performance: Louvers, including attachments to other construction, shall withstand seismic effects determined by ASCE-7.

4. Finish louvers after assembly as follows: Finish and custom color selected by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts regardless of whether shown on the plans or not. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
 - 3. Do not install volume dampers upstream of variable air volume boxes (VAV).

- E. Set all dampers to fully open position during installation, before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. Upstream from duct filters.
 - 2. At outdoor-air intakes and mixed-air plenums.
 - 3. At drain pans and seals.
 - 4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 5. Control devices requiring inspection.
 - 6. At Air-flow stations for inspection and cleaning of probes.
 - 7. Elsewhere as indicated.
- H. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 12 by 12 inches.
 - 2. Two-Hand Access: 16 by 12 inches.
 - 3. Head and Hand Access: 18 by 12 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 30 by 30 inches.
 - 6. Body plus Ladder Access: 42 by 30 inches.
- I. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- J. Install flexible connectors to connect ducts to equipment.
- K. Do not use flexible duct work on terminal units, in concealed spaces, or to change directions. Maximum length of flexible duct is 6'. Secure at ends with a minimum of 3 screws and tape
- L. Connect diffusers or light troffer boots to ducts with MAXIMUM 60-inch lengths of flexible duct clamped or strapped in place.
- M. Connect flexible ducts to metal ducts with draw bands and screws.
- N. Install duct test holes where required for testing and balancing purposes.

3.2 LOUVERS

A. EXAMINATION

- 1. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance.
- 2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. PREPARATION

- 1. Clean Opening thoroughly prior to installation.
- 2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. INSTALLATION

- 1. Install louvers at locations as indicated on the drawings and in accordance with manufacturer's instructions.
- 2. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
- 3. Install joint sealants as specified in Section 079000.

D. CLEANING

1. Clean exposed surfaces of louvers with water and mild soap or detergent not harmful to finish taking care to remove fingerprints and soil. Thoroughly rinse surfaces and dry. Do not let soil accumulate during construction period.
2. Touch-up, repair, or replace louvers damaged during installation and construction so that no evidence remains of the corrective work.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement and tight closure.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 23 34 33

AIR CURTAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes air curtains with no heating.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each unit indicated.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with AMCA 220, "Test Methods for Air Curtain Units," for airflow, outlet velocity, and power consumption.
- C. Comply with NSF 37, "Air Curtains for Entranceways in Food and Food Service Establishments."

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace air curtains that fail in materials and workmanship within one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mars Air Products
 - 2. Berner International Corp.
 - 3. Cambridge Engineering, Inc.
 - 4. Marley Engineered Products.

2.2 MATERIALS

- A. Housing Materials: Galvanized steel with electrostatically applied epoxy enamel finish over powdered mirror.

- B. Intake Louvers: Integral part of the housing, mechanically field adjustable and capable of reducing air-outlet velocity by 60 percent with louver in totally closed position.
- C. Discharge Nozzle: Integral housing, containing part of the adjustable air-directional vanes.

2.3 FANS

- A. Fans: Galvanized steel statically and dynamically balanced.
- B. Fan Drives: Direct drive.

2.4 MOTORS

- A. Motor Type: Multispeed, resiliently mounted, continuous duty.
- B. Bearings: Permanently sealed, lifetime, prelubricated, ball bearings.
- C. Disconnect: Internal power cord with plug and receptacle.

2.5 FILTERS

- A. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with holding frames.
 - 1. Media: Interlaced glass-fibers sprayed with nonflammable adhesive in galvanized-steel frame.
- B. Washable Panel Filters: Removable, stainless-steel, baffle-type filters with spring-loaded fastening; with minimum 0.0781-inch thick, stainless-steel filter frame.
- C. Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

2.6 ACCESSORIES

- A. Built-in / Field-Installed Thermostat: Line voltage, factory installed and wired to the junction box on air curtain.
- B. Automatic Door Switch: Plunger type installed in door area to activate air curtain when door opens and to deactivate air curtain when door closes.
- C. Start-Stop, Push-Button Switch: Manually activates and deactivates air curtain.
- D. Time-Delay Relay: Factory installed and adjustable to allow air curtain to operate from 0.5 seconds to 10 hours.
- E. Motor-Control Panel: Complete with motor starter, 115-V ac transformer with primary and secondary fuses, terminal strip, and NEMA 250 enclosure.
- F. Mounting Brackets: Adjustable mounting brackets for drum-type roll-up doors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air curtains with clearance for equipment service and maintenance.

3.2 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing air curtains completely, perform visual and mechanical check of individual components.
 - 2. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation. Certify compliance with test parameters.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Repair or replace malfunctioning units and retest as specified above.

END OF SECTION 233433

SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Diffusers, registers and grilles – All Type.

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 DIFFUSERS, REGISTERS AND GRILLES

A. Provide diffusers, registers and grilles for supply, return and exhaust outlets, of size, type, construction and design shown on Drawings.

B. Acceptable manufacturers:

1. Krueger
2. Metalaire
3. Price Industries
4. Titus
5. Tuttle & Bailey.

B. Equipment shall be tested and rated per ASHRAE 91-70.

C. Equipment shall handle air quantities at operating velocities:

1. With maximum diffusion within space supplied or exhausted.
2. Without objectionable air movement as determined by Architect.
3. With sound pressure level not to exceed NC 25.

- D. Supply, return and exhaust outlets shall have opposed blade volume dampers operable from front (unless otherwise noted).
 - E. Supply registers shall have two sets of directional control blades.
 - F. Diffusers within same room or area shall be of same type and style to provide Architectural uniformity.
 - G. Diffusers, registers and grilles shall be furnished with gaskets and installed with faces set level and plumb, tightly against mounting surface.
 - H. Diffusers, registers and grilles shall be aluminum construction and painted with white enamel. Finish shall receive final approval from the Architect prior to ordering.
 - I. Provide all necessary equipment for complete installation, including: lined plenum boxes, frame types, etc.as called for on the drawings.
 - I. Coordinate diffusers, registers and grilles with ceiling and wall construction. Refer to Architectural Drawings for exact lengths and for framing and mitering arrangements that may differ from those shown on HVAC Drawings.
- 2.2 SOURCE QUALITY CONTROL
- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 23 63 13

AIR-COOLED REFRIGERANT CONDENSERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes packaged, air-cooled condensers for outdoor installation.

1.2 RELATED DOCUMENTS

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

1.3 PERFORMANCE REQUIREMENTS

- A. Outdoor air cooled, roof-mounted, horizontal, utilizing refrigerant per schedule on drawings, operating at voltage and power per schedule on drawings.
- B. The separate packaged scroll compressor chiller is located in the basement Mechanical Equipment Room; refer to specification section 236419.
- C. Refer to the Product section of this Specification and the schedule in the Appendix section of the specification

1.4 SUBMITTALS

- A. Product Data: For each air-cooled refrigerant condenser. Include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.
- B. Wiring diagrams for power and control wiring.
- C. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- D. Manufacturer's Field quality-control and start-up reports and checklists.
- E. Operation and maintenance data.
- F. Warranty.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

- C. ASHRAE/IESNA 90.1-2013 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2013, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

- A. Coordinate installation of equipment supports and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
- B. Coordinate location of refrigerant piping and electrical rough-ins.
- C. Coordinate control requirements with chiller manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Trane-Mitsubishi
 - 2. Gunter
 - 3. Bohn - Heatcraft Refrigeration Products, LLC
 - 4. Chandler – Heatcraft Refrigeration Products, LLC

2.2 MANUFACTURED UNITS

- A. Description: Factory assembled and tested; utilizing refrigerant, consisting of casing, condenser coils, condenser fans and motors, and unit controls.
- B. Condenser Coil: The condenser shall consist of an Adiabatic Cooling System, a heat exchanger, powder coated galvanized steel casing, and one or more low noise axial fans with maintenance-free motors with Motor Management for fan speed control. The heat exchanger shall consist of coils fitted with fins (copper pipe, aluminum fins), distribution and header pipes (copper) and pipe connections to the pipeline system.
- C. Condenser Fans and Drives: The condenser coil shall have a floating coil design that prevents any contact of the refrigerant-carrying tubes with the supporting frame allowing for thermal expansion and contraction of the tubes without risk of tube damage at the tube sheet. The coil shall use expanded support tubes to minimize flexing during installation. Coil shall be constructed of 0.47 inch diameter copper tubes. Fins shall be constructed of aluminum, full drawn collar with tubes expanded into collar. Coil tubes shall be connected to copper headers. Coils shall be pressure tested at 1.1 times maximum operating pressure (depending on refrigerant) with dry air underwater and shipped with a 25 psig (1.7 bar) dry air holding charge. Coil shall be ETL listed for the required refrigerant condensing pressure.
- D. Fans: Fan sets shall consist of a system utilizing external rotor motor with die cast aluminum sickle bladed impeller and fan guard. Impeller and rotor shall form one complete unit to ensure proper balancing. Fan sets shall be supplied with full bell mouth fan plate, optimized for highest efficiency. Wire fan guards shall be of welded construction, coated in a weather proof durable synthetic finish for maximum corrosion protection and in compliance with safety standard EN294. Fans shall be subject to balance quality Q6.3 according to VDI 2060.
- E. Fan Motors: Fan motors shall be Electronically Commutated (EC) with inherent ability to control fan speed without auxiliary components. Use of alternating current (AC) motors shall not be acceptable. Fan motors shall be furnished for operation. Fan motor shall be maintenance free. Motors requiring periodic lubrication shall not be acceptable. Motors shall be sealed with a

labyrinth seal impeding the ingress of splash water and include drain holes for condensation water drainage. Thermal contacts shall be integrated into the motor windings. Motors shall have protection class IP 54 and windings with thermal class F according to DIN EN 60 034-1.

- F. Unit Casings: The condenser casing shall be robust, self-supporting construction of powder coated galvanized steel, varnished with RAL 7035 (light grey). Within the casing, each fan chamber shall be separated by an internal baffle to prevent wind milling during off-cycle
- G. CONTROLS
 - 1. Cooler shall be supplied with an intelligent fan motor system that optimizes operation of the cooler and simplifies maintenance. The controller adjusts fan motor speed based on temperature and regulating processes to provide reliability and information for the system. Systems that only allow steps of motors control or only motor cycling shall not be acceptable. The system reduces sound emission due to no control-induced noise, especially in part-load operation.
 - 2. Controller operation to include: Auto Internal for automatic control of fan speed based on factory supplied sensor
 - 3. Controller shall have ability to measure energy.
 - 4. Motors shall include Bypass mode. In the event of sensor fault, or loss of communication with control signal or fault in GMM, fan motors shall initiate emergency mode and run at a configurable fan speed. Factory default bypass mode fan speed shall be 100%.
 - 5. Controller shall include freeze protection mode and will oscillate fans in increasing amounts of torque in the event an obstruction such as snow or ice is detected. GMM shall take fan out of operation and indicate alarm in the event oscillation does not free fan from obstruction.
 - 6. Low Capacity Motor Management (LCMM) shall be available in order to provide more precise control during extreme low ambient or low load conditions. The controller shall utilize LCMM to cycle fans while maintaining capacity and minimizing fan energy consumption.
 - 7. The controller shall utilize cleaning function to help remove dirt and debris from coil by running the fans in reverse at configurable intervals.
 - 8. Maintenance Run function shall be available to activate fan motors after configurable time of unit non-operation. Occasional use of fan motors is recommended during prolonged periods of non-operation.
 - 9. The controller shall include digital outputs for alarms (Fault/Warning), operational signal and threshold met. Additionally, it shall include analog output (0-10V signal) to indicate fan speed.
 - 10. The controller shall include digital inputs for enabling of unit, night limit activation signal (which limits the fan speed and hence noise during configurable times) and secondary set point.
 - 11. Optional modes of communication shall be available including BACnet IP or BACnet MSTP.
- H. Streamers shall be provided attached to fan motor assembly to enhance discharge air velocity, reducing risk of warm air recirculation.
- I. Repair switches shall be provided to allow disconnect of fan motor (or pair of fan motors) without disconnecting main power from control panel.
- J. Vent and drain ball valves shall be provided on each coil header.
- K. Refer to schedule on drawings for detail.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate air-cooled condensers according to ARI 460.
- B. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.
- C. UL listed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install unit level and plumb, firmly anchored on vibration isolator or neoprene pad mounts in locations indicated; maintain manufacturer's recommended clearances.
- B. Install roof-mounting air-cooled condenser unit on equipment supports specified in Division 07.
- C. Dimensionally coordinate supports with building structure and equipment to be supported.
- D. Vibration Isolation: Mount air-cooled condensers on equipment rails with vibration isolating mounts with a minimum deflection sized by Mason Industries. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Bolt units to isolators and isolators to rails using stainless steel bolts and nuts.
- F. Maintain manufacturer's recommended clearances for service and maintenance.
- G. Refrigerant Piping:
 - 1. Connect piping to unit per the manufacturer's recommended piping arrangement and with all accessories including pressure relief, service valve, filter-dryer, and moisture indicator on each refrigerant-circuit liquid line.
 - 2. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping."
 - 3. Support piping independent of condensing unit.
 - 4. Where refrigerant piping penetrates walls or roof, utilize sleeves with EPDM linkseals for each pipe.

3.2 FIELD QUALITY CONTROL AND START-UP

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform electrical test and visual and mechanical inspection.
 - a. Inspect for physical damage to unit casing.
 - b. Verify that access doors move freely and are weathertight.
 - c. Clean units and inspect for construction debris.
 - d. Verify that all bolts and screws are tight.
 - e. Adjust vibration isolation and flexible connections.
 - f. Verify that controls are connected and operational.
 - 2. Leak Test: After installation, evacuate system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Charge system to manufacturer's specifications.
 - 4. Operational Test: After electrical circuitry has been energized, start units according to manufacturer's written instructions and to confirm proper motor rotation and unit operation. Complete manufacturer's start-up checklist.

5. Lubricate bearings on fan motors.
 6. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
 7. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Record settings for pressure switches.
 8. Verify proper airflow over coils. Measure and record airflow and air temperature rise over coils.
 9. Verify proper operation of capacity control devices.
 10. Make field adjustments to eliminate any objectionable noise.
 11. Complete the manufacturer's start-up report to include in Operation and Maintenance Data.
 12. After startup and performance test, lubricate bearings.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- C. Remove and replace malfunctioning air-cooled condensers and retest as specified above.
- 3.3 DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-cooled refrigerant condensers.
- B. Include (1) 4-hour training by a manufacturer's rep. The mechanical contractor shall video record all trainings and include digital copy in the O & M manuals.

END OF SECTION 236313

SECTION 23 73 13

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes variable air-volume heat recovery air-handling units for indoor and outdoor use.

1.3 PERFORMANCE REQUIREMENTS

- A. Design vibration isolation using performance requirements and design criteria indicated.

1.4 SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
 - 1. Unit dimensions and weight.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 - 3. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
 - 4. Certified coil-performance ratings with system operating conditions indicated.
 - 5. Energy recovery wheel performance data.
 - 6. Dampers, including housings, linkages, and operators.
 - 7. Filters with performance characteristics.
 - 8. Electrical Drive data
 - 9. Sound power data
 - 10. Drain pan construction
- B. Delegated-Design Submittal: For vibration isolation indicated to comply with performance requirements and design criteria.
 - 1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
- C. Source quality-control reports.
- D. Operation and maintenance data.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
 - 2. Support location, type, and weight.
 - 3. Field measurements.
- B. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2010, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1-2010 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of ductwork and piping to allow for installation and working clearances.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: The basis of design is Trane Co. (The); Worldwide Applied Systems Group.
- B. Substitutions with prior approval include products by one of the following:
 - 1. Approved equal subject to review prior to project bid – refer to Specification section 230500 for substitution requirements.
- C. MANUFACTURED UNITS
 - 1. General

- a. Per ASHRAE 62.1 recommendation, indoor air handling units will be shipped stretch-wrapped to protect unit from in-transit rain and debris.
 - b. Installing contractor is responsible for long term storage in accordance with the Installation, Operation, and Maintenance manual (CLCH-SVX07B-EN).
 - c. Unit shall be UL and C-UL Listed.
 - d. Supply fans within the scope of AHRI Standard 430 shall be certified in accordance with AHRI Standard 430.
 - e. Unit sound performance data shall be provided using AHRI Standard 260 test methods and reported as sound power. Trane, in providing this program and data, does not certify or warrant NC levels. These levels are affected by factors specific to each application and/or installation and therefore unable to be predicted or certified by Trane. Refer to product data for specific fan footnote references.
 - f. Manufacturer provided VFDs shall be certified to AHRI Standard 1210 "Performance Rating of Variable Frequency Drives" to ensure documented and reliable VFD efficiency.
2. Unit Construction
- a. All unit panels shall be 2" solid, double-wall construction to facilitate cleaning of unit interior. Unit panels shall be provided with a mid-span, no-through-metal, internal thermal break. Casing thermal performance shall be such that under 55°F supply air temperature and design conditions on the exterior of the unit of 81°F dry bulb and 73°F wet bulb, condensation shall not form on the casing exterior.
 - b. All exterior and interior indoor AHU panels will be made of galvanized steel.
 - c. Unit Paint: Unit to ship unpainted from factory.
 - d. Casing Deflection
 - 1) The casing shall not exceed 0.0042 inch deflection per inch of panel span at 1.25 times design static pressure. Total maximum static shall not exceed +8 inches w.g. in all positive pressure sections and -8 inches w.g. in all negative pressure sections.
 - e. Floor Construction
 - 1) The unit floor shall be of sufficient strength to support a 300.0 lb load during maintenance activities and shall deflect no more than 0.0042 inch per inch of panel span.
 - f. Unit base
 - 1) Manufacturer to provide a full perimeter integral base frame for either ceiling suspension of units or to support and raise all sections of the unit for proper trapping. Indoor unit base frame will either be bolted construction or welded construction. All outdoor unit base frames shall be welded construction. For indoor units, refer to schedule for base height and construction type. Contractor will be responsible for providing a housekeeping pad when unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in total height required for proper trap height.
 - g. Insulation
 - 1) Panel insulation shall provide a minimum thermal resistance (R) value of 13 ft²-h-°F/Btu throughout the entire unit. Insulation shall completely fill the panel cavities in all directions so that no voids exist and settling of insulation is prevented. Panel insulation shall comply with NFPA 90A.
 - h. Drain Pan
 - 1) In sections provided with a drain pan, the drain pan shall be designed in accordance with ASHRAE 62.1. To address indoor air quality (IAQ) the

drain pan shall be stainless steel, sloped in two planes promoting positive drainage to eliminate stagnant water conditions. Drain pan shall be insulated, and of double wall construction. The outlet shall be the lowest point on the pan, and shall be of sufficient diameter to preclude drain pan overflow under normally expected operating conditions. All drain pans connections shall have a threaded connection, extending a minimum of 2-1/2" beyond the unit base, and shall be made from the same material as the drain pan. Drain pan located under a cooling coil shall be of sufficient size to collect all condensate produced from the coil.

- 2) Refer to Product Data for specific information on which sections are supplied with a drain pan, the drain pan material and connection location.

i. Access Door Construction

- 1) Access doors shall be 2" double wall construction. Interior and exterior door panels shall be of the same construction as the interior and exterior wall panels respectively. All doors shall be provided with a thermal break construction of door panel and door frame. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage. Surface mounted handles shall be provided to allow quick access to the interior of the functional section and to prevent through cabinet penetrations that could likely weaken the casing leakage and thermal performance. Handle hardware shall be designed to prevent unintended closure. Access doors shall be hinged and removable for quick easy access. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section. Door hinges shall be galvanized.
- 2) All doors shall be a minimum of 60" high when sufficient height is available or the maximum height allowed by the unit height.
- 3) Door handles shall be provided for each latching point of the door necessary to maintain the specified air leakage integrity of the unit. Optionally for indoor AHUs and as standard on outdoor AHUs, outward swing doors are provided with a single handle linked to multiple latching points. An optional shatterproof window shall be provided in access doors where indicated on the plans. Window shall either be single pane, or thermal dual pane, as defined on schedule. Window shall be capable of withstanding unit operating pressures and shall be safe for viewing UV-C lamps.
- 4) Refer to Product Data for specific information on which sections are supplied with an access door, the door location, a single handle and a window.

3. Mixing Section

- a. A mixing section shall be provided to support the damper assembly for outdoor, return, and/or exhaust air.
- b. For air handling units requiring both a supply and return/exhaust fan plus an energy wheel or desiccant dehumidification wheel, the unit manufacturer shall supply single point power wiring, factory installed and tested to all motors starters or variable frequency drives. Individual high voltage enclosures will be supplied for all motor starters or variable frequency drives. Single point power wiring shall include a high voltage distribution block located in the supply fan starter or variable frequency drive cabinet. Single point power wiring shall not compromise the UL or ETL certification of the unit. Single point power wiring shall also include factory installed and wired control systems if ordered.
- c. Dampers

- 1) Dampers shall modulate the volume of outdoor, return, or exhaust air. The dampers shall be of double-skin airfoil design with metal, compressible jamb seals and flexible blade-edge seals on all blades. The blades shall rotate on stainless-steel sleeve bearings. The dampers shall be rated for a maximum leakage rate of 3 cfm/ft² at 1 in. w.g. complying with ASHRAE 90.1 maximum damper leakage. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Dampers may be arranged in a parallel or opposed-blade configuration.
- d. This unit contains Economizer that meets or exceeds all mandatory requirements prescribed by Title 24, including but not limited to:
 - 1) 5 yr parts only warranty
 - 2) Successfully tested to 60,000 Actuations
 - 3) Less than 10 cfm/sq.ft. of damper leakage at 1" WG per AMCA 500L
- e. Filters
 - 1) Mixing sections shall be provided with a filter rack as indicated in the Product Data and As-Built sections of the submittal.
 - 2) 4-inch pleated media filters made with 100% synthetic fibers that are continuously laminated to a supported steel-wire grid with water repellent adhesive shall be provided. Filters shall be capable of operating up to 625 fpm face velocity without loss of filter efficiency and holding capacity. The filters shall have a MERV 8 rating when tested in accordance with the ANSI/ASHRAE Standard 52.2.
4. Averaging Temperature Sensor
 - a. An averaging temperature sensor shall be serpentine across the module. All capillaries bends shall be radiused and fastened with capillary clips to prevent crimping and minimize wear.
 - b. A 10,000 ohm, Type II thermistor is the sensor material that shall be mounted.
5. Mixing Section Damper Actuators
 - a. Spring return actuators shall be mounted with the outside air damper normally closed and the return air damper normally open. Actuator feedback will be wired to the unit controls system.
6. Coil Section with Factory Installed Coil
 - a. The coil section shall be provided complete with coil and coil holding frame. The coils shall be installed such that headers and return bends are enclosed by unit casings. If two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil and be of the same material as the primary drain pan. Like the primary drain pan, the intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.
 - b. Casing penetrations supplied for hydronic drain and vents. Piping contractor shall provide extended piping.
 - c. No casing penetrations supplied for hydronic drain and vents. If required, piping contractor will need to drill drain and vent penetrations using factory located features provided in coil panel.
 - d. Refrigerant Cooling Coils
 - 1) The coils shall have aluminum fins and seamless copper tubes. The fins shall have collars drawn, belled, and firmly bonded to tubes by mechanical expansion of the tubes. Suction and liquid line connections shall extend to

- the unit exterior. The coil casing may be galvanized or stainless steel. Refer to the Product Data section of the submittal for the coil casing material.
- 2) The coils shall be proof-tested to 715 psig and leak-tested to 650 psig air pressure under water or equivalent tracer gas leak test. After testing, the inside of the coils shall be dried, all connections shall be sealed, and the coil shall be shipped with a charge of dry air or nitrogen.
 - 3) Suction headers and liquid connections shall be constructed of copper tubing with connections penetrating unit casings to permit sweat connections to refrigerant lines. The coils shall have equalizing vertical distributors sized according to the capacities of the coils. Refer to the Product Data section of the submittals for AHRI certification status.
 - 4) Tubes are 3/8" [9.5 mm] OD 0.0132" [0.335 mm] thick copper.
7. Gas Heat Section
 - a. Indirect-fired gas heaters shall be completely factory assembled, piped, and operationally fire tested at the factory prior to shipment. The heat exchanger primary drum and secondary tubes shall be constructed from 14-gauge, 409 stainless steel. The industrial / commercial burner shall be UL listed, forced draft, and fully modulating. The gas heat section construction shall match the rest of the air handling unit and be an integral part of the unit. All burner and control components shall be housed in a burner vestibule with a large access door. The entire section shall bear a UL or CUL label for Commercial-Industrial Gas Heating Equipment (ANSI / UL Standard 795) and Industrial Gas-Fired Package Furnaces (CGA Standard 3.2-1976).
 8. Access/Inspection / Turning Section
 - a. A section shall be provided to allow additional access/inspection of unit components and space for field-installed components as needed. An access door shall be provided for easy access. All access sections shall be complete with a double-wall, removable door downstream for inspection, cleaning, and maintenance. Interior and exterior door panels shall be of the same construction as the interior and exterior wall panels, respectively. All doors downstream of cooling coils shall be provided with a thermal break construction of door panel and door frame.
 9. Direct-Drive Plenum Fan Section
 - a. The fan type shall be provided as required for stable operation and optimum energy efficiency. The fan shall be a single-width, single-inlet, multiblade-type direct-drive plenum fan. Motor bearing life of the direct-drive plenum fan shall be not less than L-10 250,000 hrs. Refer to the Product Data section for fan quantity and number of blades selected within each unit. Fans shall be certified as complying with AHRI Standard 430 for airflow performance. Fans shall be tested and rated in-accordance with AHRI Standard 260 for sound performance.
 - b. Fans that are selected with inverter balancing shall first be dynamically balanced at design RPM. The fans then will be checked in the factory from 25% to 100% of design RPM to insure they are operating within vibration tolerance specifications, and that there are no resonant frequency issues throughout this operating range. Inverter balancing that requires lockout frequencies inputted into a variable frequency drive to in order to bypass resonant frequencies shall not be acceptable. If supplied in this manner by the unit manufacturer, the contractor will be responsible for rebalancing in the field after unit installation. Fans selected with inverter balancing shall have a maintenance free grounding assembly installed on the fan motor to discharge both static and induced shaft currents to ground.
 - c. On units supplied with plenum or motorized impeller fans, expanded metal door guard(s) shall be supplied on the access door(s) to the fan and those downstream access door(s) where unintended access to the plenum or motorized impeller fan could occur. Door guard is intended to deter unauthorized entry and incidental contact with rotating components. Refer to the Product Data section for fans with access door guard(s).

- d. Motor Frame
 - 1) The motor shall be mounted integral to the isolated fan assembly and furnished by the unit manufacturer. The motor is mounted inside the unit casing on an adjustable base to permit adjustment of drive belt tension (not applicable for direct drive plenum fans). The motor shall meet or exceed all NEMA Standards Publication MG 1 requirements and comply with NEMA Premium efficiency levels when applicable except for fractional horsepower motors which are not covered by the NEMA classification. The motor shall be T-frame, squirrel cage with size, type, and electrical characteristics as shown on the equipment schedule. Refer to the Product Data section for selected fan motors within each unit.
 - 2) Two-Inch Spring Isolators
 - a) Direct-drive fan and motor assemblies shall be internally isolated from the unit casing with 2-inch (50.8 mm) deflection spring isolators. The isolation system shall be designed to resist loads produced by external forces, such as earthquakes, and conform to the current IBC seismic requirements.
- e. Starter/VFD shall be mounted externally in a NEMA Type 1 enclosure on the supply fan section. An external disconnect shall be mounted through-the-door to the starter/VFD to disconnect full power from starter/VFD.
- f. Multiple VFDs, on a common panel, shall be provided for each fan array to provide redundancy in case of loss of function of one of the VFDs or fan motors. Individual VFDs shall be sized based on motor FLA to reduce overall panel input current. In the event of a VFD failure, the remaining VFDs must be capable of compensating and maintaining normal fan array operation. VFD panel shall have a common disconnect that is accessible from the outside of the unit. Disconnect shall open input power to all VFDs simultaneously. Disconnect shall be lockable in the off position. Disconnect shall utilize circuit breaker to provide overcurrent and short circuit protection. VFD panel shall be provided with a single point of field connection for field input power. Each VFD shall be supplied with independent input fusing, as required. VFDs shall be capable of onboard diagnostics to monitor individual fan motor performance. Externally mounted VFDs shall be provided with independent keypad. VFD panel shall be provided with a common point connection for speed input signal, start/stop signal, and fault status. Field safety interlock relay shall be field wired and provided
- g. Dampers
 - 1) Dampers within the fan section shall modulate the volume of exhaust air. The dampers shall be of double-skin airfoil design with metal, compressible jamb seals and flexible blade-edge seals on all blades. The blades shall rotate on stainless-steel sleeve bearings. The dampers shall be rated for a maximum leakage rate of 3 cfm/ft² at 1 in. w.g. complying with ASHRAE 90.1 maximum damper leakage. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D.
 - 2) Each fan in the multiple-fan array shall be provided with integral back flow prevention: a backdraft damper that prohibits recirculation of air in the event a fan or multiple fans become disabled. Dampers are tested and rated based on AMCA Standard 500. Dampers to be heavy duty type capable of a maximum back pressure that exceeds the design total static pressure with minimal leakage. The dampers should have a minimal total effect on airflow performance-both pressure drop when open and system effect on the fan. The damper blades and frame shall be extruded aluminum with blade edge seals locked into the blade edge. Adhesive type seals are unacceptable. AHU manufacturer responsible for providing proper spacing upstream of dampers to ensure full, uniform airflow through upstream components. For units where the damper(s) are supplied at the jobsite, the installing

contractor shall contract a certified TAB contractor to verify uniform airflow thru upstream components.

3) All plenum fans in this unit are supplied with a backdraft damper.

10. Energy Wheel Section

- a. The air-handling unit shall have an AHRI 1060-certified total energy recovery wheel sized per the ventilation requirement of the unit. The air-handling unit nameplate shall bear the AHRI 1060 certification label. The energy recovery cassette shall be an Underwriters Laboratories (UL) Recognized Component certified for mechanical, electrical, and fire safety in accordance with UL Standard 1812.
- b. The energy recovery wheel cassette frame shall be insulated and incorporate a rotary wheel with all necessary seals, drive motor, and drive belts. The total energy recovery wheel shall incorporate a desiccant without the use of binders or adhesives. Coated segments shall be washable using standard detergent or alkaline-based coil cleaners. The desiccant shall not dissolve in the presence of water or high humidity. The rim shall be of continuous rolled stainless steel and forms an even concentric circle, preventing leakage around the rim and minimizing the wear of components. All diameter and perimeter seals shall be provided as part of the cassette assembly. Perimeter seals shall be self-adjusting; diameter seals are adjustable. The wheel drive motor shall be thermally protected and UL Component Recognized. Drive belts shall not require belt tensioners. Wheel bearings shall be permanently sealed and lubricated and have a minimum L-10 life of 400,000 hours.
- c. The energy recovery wheel shall be provided in the form of removable segments. The segments shall be removable without the use of tools to facilitate maintenance and cleaning as required. The cassette shall be removable through the energy recovery section side panel. Access doors shall be provided immediately upstream and downstream of the energy recovery wheel cassette. Adequate space shall be provided for cleaning, service, and maintenance of the wheel, motor, bearing, and belt.
- d. Mixed Airflow Wheel
 - 1) The air-handling unit shall be constructed with internal bypass dampers to bypass air around the wheel during economizing. The pressure drop across the wheel does not increase during economizing.
- e. Wheel Control
 - 1) The energy recovery wheel section shall incorporate a variable effectiveness / exhaust air bypass damper to control the energy wheel recovery capacity. The variable effectiveness control shall have the ability to modulate the total energy recovery effectiveness to 40 percent of the initial total recovery capacity.
- f. Frost Control
 - 1) Frost control prevention shall be achieved by either outside air bypass, or return air preheat. Frost setpoint temperatures based on scheduled design air conditions shall be provided by the air handling manufacturer. Winter design supply and exhaust air conditions leaving the energy wheel provided by the unit manufacturer shall include any derate in performance due to frost protection measures.
- g. Wheel Warranty
 - 1) In conjunction with the Trane standard unit warranty, the energy recovery wheel shall be warranted for a period of five years. Warranty applies to all parts and components of the energy recovery cassette with the exception of the motor. Applying a VFD to an energy wheel motor can cause premature motor failure and could void the warranty.
- h. Primary Filters
 - 1) 2 inch pleated media filters made with 100% synthetic fibers that are continuously laminated to a supported steel wire grid with water repellent

adhesive shall be provided. Filters shall be capable of operating up to 625 fpm face velocity without loss of filter efficiency and holding capacity. The filters shall have a MERV 8 rating when tested in accordance with the ANSI/ASHRAE Standard 52.2.

i. Lifting Instructions

- 1) The air handling units must be rigged, lifted, and installed in strict accordance with the Installation, Operation, and Maintenance manual (CLCH-SVX07G-EN). The units are also to be installed in strict accordance with the specifications. Units may be shipped fully assembled or disassembled to the minimum functional section size in accordance with shipping and job site requirements.
- 2) Indoor units shall be shipped on an integral base frame (variable from the standard 2.5" to 8" height) for the purpose of mounting units to a housekeeping pad and providing additional height to properly trap condensate from the unit. The integral base frame may be used for ceiling suspension, external isolation, or as a housekeeping pad. Indoor sizes 3 to 30 will also be shipped with a shipping skid designed for forklift transport. Refer to the unit As-Built or Product Data section of the submittal for the base frame height of each unit.
- 3) All units will be shipped with an integral base frame designed with the necessary number of lift points for safe installation. All lifting lugs are to be utilized during lift. The lift points will be designed to accept standard rigging devices and be removable after installation. Units shipped in sections will have a minimum of four points of lift.

j. Variable Volume Control System

- 1) Factory-mounted direct-digital control (DDC) systems shall be engineered, mounted, wired, and tested by the air handler manufacturer to reduce installed costs, improve reliability, and save time at unit startup. Each control system shall be fully functional in a stand-alone mode or may be tied to a building automation system with a single pair of twisted wires. All factory-mounted controls shall be covered by the air handler manufacturer's standard warranty.

2.2 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Outdoor Equipment Mounting: Install outdoor air-handling units on vibration isolating roof curbs. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Equipment Mounting: Install indoor air-handling units on concrete bases using continuous neoprene pad selected and sized by Mason Industries. Secure units to anchor bolts installed in

concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Install galvanized steel plate to equally distribute weight over elastomeric pad.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 3. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters before project is turned over for occupancy.
- E. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on each filter bank, installed with separate static-pressure taps upstream and downstream of filters.
- F. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- G. Install piping adjacent to air-handling unit with unions and flanges to allow for removal, service and maintenance.
- H. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- I. Connect condensate drain pans using ASTM B 88, Type M copper tubing (size shown on drawings). Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- J. Dual Temperature-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- K. Refrigerant Piping: Comply with applicable requirements in Division 23 Section "Refrigerant Piping".
- L. Natural Gas Piping: Comply with applicable requirements in Division 22 Specification Sections.
- M. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories." Provide 1" internal sound lining for the first 10 feet off of each ducted connection to the unit.

END OF SECTION 237313

SECTION 23 81 23

COMPUTER-ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceiling-mounted & wall-mounted computer-room air conditioners.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.
 - 2. Warranty Period for Control Boards: Manufacturer's standard, but not less than 3 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED & WALL-MOUNTED UNITS

- A. Manufacturers: The basis of design is Mitsubishi. Substitutions with prior approval include products by one of the following:
 - 1. Trane Co. (The); Worldwide Applied Systems Group.
 - 2. Daikin.
- B. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for horizontal ceiling mounting to fit T-bar ceiling opening of 24 by 48 inches.
- C. Cabinet: Galvanized steel with baked-enamel finish, insulated with 1/2-inch thick duct liner.
 - 1. Integral factory-supplied supply and return grille to fit ceiling grid kit of 24 by 48 inches, with filter.
 - 2. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Supply-Air Fan: Forward curved, centrifugal, and directly driven by two-speed motor.
- E. Refrigeration System:
 - 1. Compressor: Hermetic, with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
 - 2. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
 - 3. Refrigerant: R-410A.
 - 4. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.
 - 5. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube aluminum-fin coil with centrifugal fan, direct driven.
 - 6. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.
- F. Filter: 1-inch thick, disposable, glass-fiber media. Merv 8 (ASHRAE 52.2):
- G. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature and humidity control modules, humidity contactor, time-delay relay, Heating contactor, and high-temperature thermostat. Provide solid-state, wall-mounted control panel with start-stop switch, adjustable humidity set point, and adjustable temperature set point.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances. Install according to ARI Guideline B.
- B. Computer-Room Air-Conditioner Mounting: Install using restrained spring isolators. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

- C. Suspended Computer-Room Air Conditioners: Install using continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of computer-room air conditioner.
 - 1. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required.
 - 2. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- D. Air-Cooled Refrigerant Condenser Mounting: Install using restrained spring isolators. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Water and Drainage Connections: Comply with applicable requirements in Division 22 Section "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.
- D. Refrigerant Piping: Comply with applicable requirements in Division 23 Section "Refrigerant Piping." Provide shutoff valves and piping.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. After startup service and performance test, change filters and flush humidifier.

3.4 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to 2 visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 238123

SECTION 238239.19

WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Wall and ceiling unit heaters with propeller fans and electric-resistance heating coils.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

- B. Sustainable Design Submittals:

- 1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."

- C. Shop Drawings:

- 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include details of anchorages and attachments to structure and to supported equipment.
 - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Wiring Diagrams: Power, signal, and control wiring.

- D. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 WALL AND CEILING UNIT HEATERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1. Berko; Marley Engineered Products
 - 2. INDEECO
 - 3. QMARK

- B. Heaters: Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CABINET

- A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.3 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless steel, machine-staked terminals secured with stainless steel hardware, and limit controls for high-temperature protection.

2.4 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230500 "Common Work Results for HVAC."

2.5 CONTROLS

- A. Controls: Unit-mounted thermostat.
- B. Electrical Connection: Factory wire motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WALL AND CEILING UNIT HEATERS

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with

Drawings and room details before installation.

- D. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS (Read these DIVISIONS carefully. For purposes of bidding, assume that all work of the DIVISION referenced is to be performed under that DIVISION unless specifically indicated therein to be performed under the ELECTRICAL DIVISION. Coordinate with all divisions to ensure a complete installation)
- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.
 - B. Temporary wiring for building construction - see DIVISION 1.
 - C. Cutting and patching - see DIVISION 17
 - D. Allowances – see DIVISION 1.
 - E. Alternatives - see DIVISION 1.
 - F. Excavation and backfilling - see DIVISION 31.
 - G. Concrete - see DIVISION 3.
 - H. Manholes and handholes - see DIVISION 3.
 - I. Magnetic door release - see DIVISION 8.
 - J. Access panels - see DIVISION 8.
 - K. Painting of all backboards (on all sides and edges before mounting); painting of panels (trims and doors - 2 coats before mounting); painting of exposed electrical raceways, boxes and fittings - see DIVISION 9.
 - L. Sprinkler flow switches and gate valve switches - see DIVISION 21.
 - M. Temperature controls, temperature control wiring, interlock wiring, and boiler control wiring (except as indicated on the electrical drawings) - see DIVISION 23.
- 1.2 SUMMARY
- A. Section Includes:
 - 1. Work that applies to all sections of DIVISION 26.
 - 2. Temporary electrical wiring.
 - 3. Concrete bases.
 - 4. Electrical equipment coordination and installation.
 - 5. Sleeves for raceways and cables.
 - 6. Sleeve seals.
 - 7. Grout.

8. Common electrical installation requirements.

1.3 DEFINITIONS

- A. Provide: Furnish and install.
- B. Wiring: Wire, raceways, boxes and fittings.
- C. EPDM: Ethylene-propylene-diene-terpolymer rubber.
- D. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Do all wiring and provide all equipment in accordance with the prevailing issue of the National Electrical Code, State Building Code, State Fire Code, OSHA and any additional local rules or requirements.
- C. Obtain and pay for all necessary permits, certificates, etc. Present satisfactory proof of final inspection and approval by all inspection authorities.
- D. Consider the following Industry Standards as minimum requirements for all materials, equipment and systems where such standards are established for materials in question:
 - 1. National Board of Fire Underwriters
 - 2. National Electrical Manufacturers Association
 - 3. National Fire Protection Association
 - 4. Institute of Electrical and Electronic Engineers
 - 5. Local Electric Utility Company
 - 6. Local Telephone Company
 - 7. A nationally recognized testing laboratory (UL, ETL, etc.)
 - 8. Factory Mutual
 - 9. Americans with Disabilities Act
- E. Where applicable, this installation shall comply with the following NECA (National Electrical Contractors Association) "National Electrical Installation Standards." Except, if there is a conflict between this specification and these standards, the requirements of this specification shall prevail.
 - 1. NECA 1-2000 Standard Practices for Good Workmanship in Electrical Contracting
 - 2. NECA 101-2001 Standard for Installing Steel Conduit (Rigid, EMT)
 - 3. NECA/AA 104-2000 Recommended Practice for Installing Aluminum Building Wire and Cable

4.	NECA 400-1998	Recommended Practice for Installing and Maintaining Switchboards
5.	NECA/EGSA 404-2000	Recommended Practice for Installing Generator Sets
6.	NECA/IESNA 500-1998	Recommended Practice for Installing Indoor Commercial Lighting Systems
7.	NECA/IESNA 501-2000	Recommended Practice for Installing Exterior Lighting Systems
8.	NECA/IESNA 502-1999	Recommended Practice for Installing Industrial Lighting Systems

1.6 PROJECT CONDITIONS

- A. Comply with NFPA 70E.

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.
- E. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment that requires positioning before closing in the building.
- F. Coordinate electrical service connections to components furnished by utility companies.

1.8 TEMPORARY ELECTRICAL WIRING: (Separate Service)

- A. Provide temporary electrical wiring of power and lighting for construction. Coordinate temporary electrical service with the local electric utility company. Pay all costs related to this service including utility company charges. Coordinate with the general contractor and other trades, so that conflicts are avoided.
- B. Size the service adequate for normal construction needs for a project of this type including the load required for construction trailers. However, the service to and wiring of construction trailers is the responsibility of each trade contractor and not part of the work of this section.

- C. The General Contractor shall pay for the cost of energy consumed.
- D. Service to be 120/208 volts, 3 phase, 4 wire. (Verify with the General Contractor before installation.)
- E. Provide all required connections, panels, circuit breakers, metering provision, feeders, branch circuit wiring, transformers, lighting fixtures, lamps, receptacles, switches, etc. for a complete and operating temporary electrical system.
- F. Provide a minimum of 10 foot candles of temporary general illumination throughout the floor area of the building, including all corridors and stairways.
- G. Provide feeders of sufficient capacity for the requirements of the work, sufficient number of outlets, 120/208 volt, or equivalent, conveniently located so that extension cords not exceeding 100 feet will reach all work requiring artificial light or power.
- H. All receptacles must be GFCI protected, and the entire installation must comply with all applicable OSHA requirements.
- I. At the end of the day's work, disconnect all lights and power, other than the minimum required security illumination.
- J. Provide replacement light bulbs and maintenance of the temporary wiring system, as required, throughout the period of construction.
- K. Conform to all codes and regulations.
- L. Completely remove temporary wiring system, upon completion of construction.

1.9 CHANGE ORDERS/PROPOSAL REQUESTS:

- A. During the course of construction, changes in the work may occur. When a significant change is to be made, a Proposal Request will be issued.
- B. Provide a complete cost breakdown when responding to each Proposal Request.
- C. Each item of work to be priced separately.
- D. Each line item to be broken down including quantities and listing separately labor and material.
- E. Both credits and extras shall be separately and clearly quantified.
- F. Allowances for overhead and profit shall be as listed in the supplementary conditions.
- G. If you become aware of a field condition, code requirement, error, or omission that you feel should result in a change to the work, please contact the Engineer for discussion. The Engineer may be able to clarify the situation and avoid unnecessary paperwork.
- H. It is recognized that the Owner benefits when the construction process is a cooperative effort instead of an adversarial relationship. Reasonable give-and-take allows the construction process to move smoothly. Your efforts in this regard will be appreciated by all parties.

1.10 PACKAGED PRICES:

- A. It is in the facility owner's interest, that all bidders receive the best possible quotes on all materials during bidding so that any savings can result in a lower bid price. It is the policy of this Engineer not to specify brands that will result in "packaged" prices. Therefore, manufacturers' representatives are hereby notified that "packaged prices" are prohibited on this project. Upon request, suppliers are to provide bidders with complete material breakdown including each lighting fixture, system, component of system, each piece of equipment, etc. In keeping with this policy, Contractors are hereby cautioned not to anticipate deep discounts after the contract is awarded.

1.11 INSPECTIONS/SITE OBSERVATIONS

- A. The authority having jurisdiction (usually the Municipal Electrical Inspector) shall be notified at periodic intervals that an inspection is requested. Inspections shall be requested at points of progress, meeting the approval of the inspector and as a minimum include the following:
 - 1. Prior to enclosing walls.
 - 2. Prior to enclosing ceilings.
 - 3. Prior to installation of panel/switchgear trims/covers.
 - 4. For observation of connections and grounding at switchboards, transformers and generators.
- B. Do not cover the work before the Engineer has had a chance to observe it in completed form. The electrical foreman shall request a meeting with the Engineer within 10 days after the start of electrical construction to assure that there is agreement on the scope of work and to answer questions.
- C. The electrical foreman shall provide assistance to the Engineer during site observations:
 - 1. Describe the progress of the electrical work in detail.
 - 2. Accompany the Engineer on his tour of the site, upon request.
 - 3. Provide use of a suitable ladder, scaffolding or bucket truck to observe the work, upon request.
 - 4. Remove ceiling tiles, panel trims, junction box covers, etc. for observation of the work, upon request.
 - 5. Provide use of project drawings, specifications and shop drawings.

1.12 GUARANTEES/WARRANTIES:

- A. See other portions of the Project Manual for details on Guarantees and Warranties. However, minimum shall be one year from date of acceptance by the Engineer.
- B. The Owner reserves the right to make appropriate modifications or extensions of systems and equipment furnished under this contract during the guarantee/warranty period without "voiding" or modifying the guarantee/warranty of equipment and wiring installed under this contract. If manufacturer voids guarantee, it shall not relieve this contractor of his responsibilities for guarantee/warranty period.

1.13 MISCELLANEOUS

- A. Provide all systems complete. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both.
- B. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.
- C. All wiring and connections shall be executed with associated circuit de-energized.

PART 2 - PRODUCTS

2.1 MATERIALS - General:

- A. All materials and equipment shall be new unless specifically stated otherwise.
- B. Materials and equipment shall be suitable for their intended use and for the environment in which they are installed. For example, equipment located outside shall be weatherproof and constructed of materials that will not rust. This includes brackets, screws, etc.
- C. Coordinate all dimensions to make sure that boxes, raceways, equipment, fixtures, etc., fit properly in the finished construction. If special provisions, such as shallow boxes, are required, they shall be provided at no increase in contract price, regardless of catalog numbers listed in contract documents or on shop drawings.
- D. As it is not practical to enumerate in these specifications (or show on the drawings) all details of fittings and accessory equipment required for proper operation of the various electrical systems herein described, it is understood that they will be supplied without extra compensation. Provide all fittings, terminations, relays, components of panels and equipment, etc., needed for the best performance possible at the present state-of-the-art.

2.2 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe", equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.3 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - a. Tyco/RayChem.
 - b. Advance Products & Systems, Inc.
 - c. Calpico, Inc.
 - d. Metraflex Co.
 - e. Pipeline Seal and Insulator, Inc.
 - f. Equal approved by Engineer.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- F. Right of Way: Give to piping systems installed at a required slope.
- G. Record of Addenda and Change Orders: To avoid overlooking addenda and change order modifications, mark all changes on all copies of drawings and specifications, in a manner acceptable to the Engineer. One method of accomplishing this is to make copies and tape them on the back of the preceding page (tape all edges). Also, circle the changed area and note: see addenda #1, etc. If whole pages or sheets change, either remove the superseded document or put a bold "X" through it.
- H. Record Drawings: Owner's record drawings shall be updated as the project progresses. Maintain documents in a safe, dry location. Indicate clearly and accurately any changes necessitated by field conditions and dimension all raceways built into or under concrete slabs or buried under ground. Contractor to prepare as-built drawings in CAD format at contractor's expense. Contract drawings in CAD format to be furnished to contractor at no cost to

contractor. Contractor to provide two compact discs and two hard copies of final as-built drawings.

- I. Operating Instructions and Manuals: Provide the Owner or his representative with complete operating instructions by qualified personnel of all electrical systems. Provide three (3) bound sets (indexed and bound in three sturdy three-ring binders) of operating and maintenance instructions of all electrical systems employed and all shop drawings.
- J. Letter of Confirmation: Include in the above manuals a letter confirming that the following items have been completed. Provide written receipt signed by the Owner or his representative indicating that the first 4 items listed below have been received.
 - 1. The number of circuit breaker locks called for have been provided.
 - 2. Keys have been provided for all locked electrical equipment.
 - 3. The provisions of the "Operating Instructions and Manuals" paragraph of these specifications have been met.
 - 4. Spare fuses have been provided.
 - 5. Identification is complete and in accordance with these specifications.
 - 6. As-built electrical drawings have been completed and submitted.
 - 7. All tests are complete and in accordance with these specifications.
 - 8. All required shop drawings have been submitted and approved.
 - 9. The entire installation has been accepted by all authorities.

3.2 SEQUENCE AND BALANCE:

- A. Maintain correct phase sequence of all feeders and circuits by establishing phase identification and maintaining correct relationship throughout the system. Provide line balance within 10% of normal loads.

3.3 LAYOUTS

- A. The electrical system layouts indicated are generally diagrammatic and locations of outlets and equipment are approximate only; govern exact routing of wiring and locations of outlets and equipment by structural conditions and obstructions. This is not to be construed to permit redesigning systems. Interconnect as shown.
- B. Locate all equipment requiring maintenance and operation so that it will be readily accessible. The right is reserved to make any reasonable change in location of outlets and equipment prior to roughing-in without involving additional expense. This may involve slightly longer wiring runs, longer stems, additional mounting provisions, etc. Allow for this in your bid because additional compensation will not be provided. Items not specifically located on the plans shall (for the purposes of bidding) be assumed to be in the farthest, most difficult location. Exact location to be as directed in the field.

3.4 ELECTRICAL SERVICE: (120/208)

- A. Provide complete electrical service conforming to all requirements of the local electrical utility company, municipality and state.
- B. Service to be as indicated on the drawings.
- C. Provide connectors for secondary terminations and torque as directed by electric utility company.

- D. Pay all power company charges related to providing service.
- E. Electric utility company to provide the following: primary cable, transformers, meters and current transformers.
- F. Service voltage to be 120/208 volts, 3 phase, 4 wire.
- G. Prior to start of construction, coordinate service with the electric utility company,

Contact _____ of

RI Energy
280 Melrose Street
Providence, RI 02901
(401) 784-4000

3.5 Conform to all requirements of the local electrical utility company, municipality and state

3.6 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable (unless sleeve seal is to be installed), unless seismic criteria require different clearance, or indicated otherwise.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry, and with approved joint compound for gypsum board assemblies.
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with firestopping requirements in Division 07.
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.7 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.8 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07.
- B. Penetrations through exterior surfaces shall be made watertight.
- C. Floor boxes, fed from floor below, shall be fire-rated, poke-through type with UL labeled fire rating to match floor rating.

3.9 CUTTING AND PATCHING

- A. This trade (specification section) is responsible for its respective cutting and patching.
- B. Do not endanger any work by cutting or altering work or any part of it.
- C. Do not cut or alter work of another Contractor without written consent of the Engineer.
- D. Prior to cutting which affects structural safety of project, or work of another Contractor, submit written notice to the Engineer, requesting consent to proceed with cutting.

- E. Perform all work of fitting, adjustment, cutting, patching, finishing and restoration to perfectly match the quality as specified throughout these specifications. Painting shall match and be feathered into adjacent surfaces.

3.10 CORE DRILLING:

- A. All holes through masonry surfaces must be "core drilled". This trade (specification section) is responsible for its respective core drilling, if any.
- B. Do not endanger any work by drilling or altering work or any part of it.
- C. Do not drill or alter work of another Contractor without written consent of the Engineer.
- D. Prior to drilling which affects structural safety of project, or work of another Contractor, submit written notice to the Engineer, requesting consent to proceed with cutting.
- E. Perform all work of core drilling to perfectly match the quality as specified throughout these specifications.

3.11 ACCESS PANELS:

- A. This trade (specification section) is responsible for determining the number of access panels required for existing and new electrical work (including one under each above ceiling thermodetector) and furnishing them to the mason or drywall contractor for installation. See DIVISION 8.

3.12 CLEANING, PAINTING AND REFINISHING:

- A. Paint all new plywood backboards on all sides and edges before mounting.
- B. Thoroughly clean all new electrical equipment, devices and enclosures upon completion of all work.
- C. Refinish any new electrical equipment whose finish is damaged or rusted, as determined by the Engineer.

END OF SECTION 260500

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600V-COPPER ONLY)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.
- B. Specification Section 260500 Common Work Results For Electrical.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.
 - 3. General Cable Corporation.
 - 4. Southwire Company.
 - 5. Equal approved by Engineer.
- B. All conductors, insulation, and cables shall comply with NEMA WC 70.
- C. Conductor Material: Copper complying with NEMA WC 5 solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
- D. Conductor Insulation Types: Type THHN-THWN or XHHW complying with NEMA WC 5.
- E. Multiconductor Cable: Metal-clad cable, Type MC.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
 - 6. Equal approved by Engineer.
- B. Description: Spring-type factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. Do not use push-in type wire connectors, use spring type instead.

2.3 SLEEVES AND SLEEVE SEALS: See Specification Section 260500/2.1 & 2.2.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway, Type XHHW, single conductors in raceway, or, Type SE or USE multiconductor cable. See One-Line Diagram.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway, or Mineral-insulated, metal-sheathed cable, Type MI.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC, or Mineral-insulated, metal-sheathed cable, Type MI.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC, or Mineral-insulated, metal-sheathed cable, Type MI.
- F. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC, or Mineral-insulated, metal-sheathed cable, Type MI.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway, or Mineral-insulated, metal-sheathed cable, Type MI.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC, or Mineral-insulated, metal-sheathed cable, Type MI.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC, or Mineral-insulated, metal-sheathed cable, Type MI.
- K. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC, or Mineral-insulated, metal-sheathed cable, Type MI.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- M. Fire Alarm Circuits: see FIRE ALARM SECTION.

- N. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- O. Class 2 Control Circuits: Type THHN-THWN, in raceway, Power-limited cable, concealed in building finishes, or Power-limited tray cable, in cable tray.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values. Confirm conduit ID and that conduit will be at or below 40% filled. Confirm jam ratios and take precautions when pulling.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."
- H. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.
- I. Where the number of current-carrying conductors in a raceway or cable exceeds three, the allowable ampacity shall be reduced per NEC table based on no diversity. Consider neutrals to be current carrying conductors.

3.4 CONNECTIONS

- A. Make all final connections required for a complete and fully operational facility.
- B. Wiring connections to equipment shall include connections to all accessories. For example, if a fan has an associated damper, the wiring must be extended from the fan to the damper at no additional charge. Another example is interconnection of equipment. Some items of equipment consist of several pieces, which must be interconnected before connecting to the circuit. No additional compensation will be paid for interconnections.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- E. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

- F. Locations of junction boxes, stub-ups and disconnects are diagrammatic. At the time of design, the exact brand of equipment is usually not known. Therefore, the exact locations of connections are not known. For the purposes of bidding assume the worst, farthest locations. During construction, coordinate connections with final approved shop drawings and coordinate with other trades. Conform to manufactures written installation instructions. Provide working space in compliance with code.

3.5 FIELD QUALITY CONTROL

- A. All cables installed under this contract are to be protected from damage prior to installation, during installation, and after installation. Store cable in a dry area protected from physical damage. Before installing cable, raceway shall be clear, dry and free from burs or sharp edges. When cables pass through metal partitions, provide permanently installed insulating bushings; this applies to all cables installed under this contract (systems, communications, etc.). Insulated bushings are to be installed prior to pulling in of cable. Cables shall be installed back from edge of studs as required by Code.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance conductors, all feeder conductors, and conductors #8AWG and larger for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- D. Test Reports: Prepare and provide to Owner and Engineer a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Ground rings.
 - 3. Grounding arrangements and connections for separately derived systems.
 - 4. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at ground rings and grounding connections for separately derived systems, based on NETA MTS.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable, insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
 - 1. No. 4 AWG minimum, soft-drawn copper.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 5/8 in diameter by 96 inches (16 by 2400 mm).
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 3/0 WG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install as indicated on plans.
 - 1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors and as otherwise indicated.
 - 3. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- F. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized the same as the system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods (or ufer and two rods) spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes,

- using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install bare copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches (600 mm) from building foundation.
- I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 1/0 AWG.
 - 1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 3. Prepare dimensioned drawings locating each ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration and Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Metallic slotted support systems.
 - 2. Nonmetallic slotted support systems.

- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs. Strength rating to suit structural loading. Comply with MFMA-4, factory-fabricated components for field assembly.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - h. Equal approved by Engineer.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - e. Equal approved by Engineer.
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers. As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron with hot-dip galvanized finish..
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 5) Equal approved by Engineer.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.

- 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 6) Equal approved by Engineer.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Support individual horizontal single raceways with separate, malleable-iron pipe hangers or clamps except use spring-steel fasteners for 1-1/2-inch (38-mm) and smaller single raceways above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

- D. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- E. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads (+25 percent minimum) within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- F. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, or beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
 - 9. Fasteners: Select so load applied to each fastener does not exceed 25 percent of its proof-test load.
- G. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete (Limited Applications)."
- C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.
- J. RGS: Rigid galvanized steel conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways, fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.

- b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
 - C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
 - D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - E. Qualification Data: For professional engineer and testing agency.
 - F. Source quality-control test reports.
- 1.5 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflec Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.

7. Maverick Tube Corporation.
 8. O-Z Gedney; a unit of General Signal.
 9. Wheatland Tube Company.
 10. Equal approved by Engineer.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. IMC: ANSI C80.6.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: ANSI C80.3.
- G. FMC: Zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket.
- I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel, set-screw type.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Arnco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corp.; Pipe & Plastics Group.
 6. Condux International, Inc.
 7. ElecSYS, Inc.
 8. Electri-Flex Co.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Manhattan/CDT/Cole-Flex.
 11. RACO; a Hubbell Company.
 12. Thomas & Betts Corporation.
 13. Equal approved by Engineer.
- B. ENT: NEMA TC 13.

- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Arnco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.
 - 5. Equal approved by Engineer.
- B. Description: Comply with UL 2024; flexible type, approved for plenum, riser, or general-use installation, as needed.

2.4 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
 - 4. Equal approved by Engineer.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, 12, or 3R, as indicated or required by environmental conditions.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: Hinged type, screw-cover type, or flanged-and-gasketed type, as indicated.
- F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
 - 3. Equal approved by Engineer.

- B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.6 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
 - d. Equal approved by Engineer.

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.
 - 10. Spring City Electrical Manufacturing Company.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
 - 14. Equal approved by Engineer.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- F. Nonmetallic Floor Boxes: Nonadjustable, round.

- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- J. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Green.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, as indicated for each service.
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
 - 8. See drawings for additional information.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
 - e. Equal approved by Engineer.

2.9 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
 - D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section on penetration firestopping.
- 2.10 SLEEVE SEALS
- 1. See Section 260500.
- 2.11 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES
- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: Rigid steel conduit.
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Underground Conduit, over 600 volts: RNC, Type EPC-80-PVC, direct buried.
 - 4. Underground Conduit, under 600 volts: RNC, Type EPC-40-PVC, direct buried.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): In dry conditions, use FMC. Use LFMC in damp, wet, or dirty conditions.
 - 6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or 4, as indicated.
 - 7. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed and Subject to Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.

- b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Per drawings.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp, wet, or dirty locations.
 - 5. Damp or Wet Locations: Rigid steel conduit.
 - 6. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 - 7. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 - 8. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 - 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in corrosive locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
- 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.
- 3.2 INSTALLATION
- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
 - B. Keep raceways at least 12 inches (300 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
 - C. Complete raceway installation before starting conductor installation.
 - D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
 - E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
 - F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
 - G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - H. Raceways Embedded in Slabs:

1. Run conduit larger than 2-inch (54-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 2. Arrange raceways to cross building expansion joints at right angles; with expansion fittings.
 3. Change from Type EPC-40-PVC, to rigid steel conduit before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors of all sizes.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
 2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated or heated spaces.
 2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject.
- P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- Q. Set metal floor boxes level and flush with finished floor surface.
- R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
5. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line; or 40 inches below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. See Section 260500.

3.6 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543

UNDERGROUND DUCTS AND UTILITY STRUCTURES

PART 1 – GENERAL

1.1 SUMMARY

A. Scope of Specification

1. This Section includes underground conduits and ducts, duct banks, pull boxes and handholes, manholes, and other underground utility structures.
2. Products furnished but not installed under this Section include pulling eyes, cable stanchions, cable arms, and insulators.

B. Related Specifications

1. Drawing and general provisions of the Contract, including AIA A201 and Division 1 Specifications Sections, apply to this Section.
2. Related Sections: The following Sections contain requirements that relate to this Section:
 - a Division 31 Section for general requirements for excavation, backfill and related items for ducts, manholes, and handholes.
 - b 033000 – “Cast-In-Place Concrete” for cast-in-place concrete requirements.
 - c Division 7 Section for dampproofing of manholes and handholes.

C. Definitions

1. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground, embedded in earth or concrete.
2. Duct Bank: 2 or more conduits or other raceway installed underground in the same trench or concrete envelope.
3. Handhole: An underground junction box in a duct or duct bank.
4. Manhole: An underground utility structure, large enough for a person to enter, connecting with ducts to afford facilities for installing and maintaining cables.
5. Vault: An underground utility structure, large enough for a person to enter, connecting with ducts to afford facilities for installing, operating, and maintaining equipment and wiring.

D. Applicable Standards

1. NFPA 70 – “National Electric Code”
2. UL 1990 – “Underground Conduit, Non Metallic”
3. ASTM C 858 – “Underground Precast Concrete Utility Structures”
4. ASTM C1037 – “Inspection of Underground Precast Concrete Utility”
5. ASTM C857- “Minimum Structural Design, Loading for Underground Precast Concrete Utility structures”
6. Conduit Standards listing in Section 2.2

E. Submittals

1. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.
2. Product data for metal accessories for manholes and handholes, conduit and duct, duct bank materials, and miscellaneous components.
3. Shop drawings showing details and design calculations for precast manholes and handholes, including reinforcing steel. Stamp drawings with seal of registered professional structural engineer.
4. Certificate for concrete and steel used in underground precast concrete utility structures, according to ASTM C 858.
5. Inspection report for factory inspections, according to ASTM C 1037.
6. Coordination drawings showing duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to accurate scale.
7. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architect and Owner, and other information specified.
8. Field test reports indicating and interpreting test results relative to compliance with performance requirements of "Field Quality Control" Article in Part 3 of this Section.
9. Record Documents: Show dimensioned locations of underground ducts, handholes, and manholes.

F. Quality Assurance

1. Manufacturer Qualifications: Firm experienced in manufacturing underground precast concrete utility structures of types and sizes required and similar to those indicated for this project. Firm must have a record of successful in-service performance.
2. Comply with NFPA 70 "National Electrical Code" and ANSI C2 "National Electrical Safety Code" for components and installation.
3. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - a The Terms "Listed " and "Labeled": As defined in the "National Electrical Code," Article 100.
 - b Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
4. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities ads determined in the field.
5. Coordinate elevations of duct and duct bank entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and ensure duct runs drain to manholes and handholes, and as approved by the Architect.

G. Delivery, Storage and Handling

1. Deliver ducts to site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
2. Store precast concrete units at site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
3. Lift and support precast concrete units only at designated lifting or supporting points.

H. Extra Materials

1. Furnish extra materials matching products installed, packaged with protective covering for storage and with identification labels clearly describing contents.
2. Furnish cable stanchions, support arms, insulators, and associated fasteners each in quantities equal to 5 percent of quantities installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering the specified products that may be incorporated in the Work include, but are not limited to the following:

1. Underground Precast Concrete Utility Structures:
 - a Precast Division; Carder Concrete Products.
 - b Christy Concrete Products, Inc.
 - c Elmhurst-Chicago Stone Co.
 - d Riverton Concrete Products.
 - e Rotondo & Sons, Inc.
 - f Rotondo/Penn-Cast, Inc.
 - g Smith-Midland Corp.
 - h Utility Vault Co.
 - i Wausau Concrete Co.
2. Frames and Covers:
 - a Campbell Foundry Co.
 - b East Jordan Iron Works, Inc.
 - c McKinley Iron Works, Inc.
 - d Neenah Foundry Co.
3. Nonmetallic Ducts:
 - a Arnco Corp.
 - b Breeze-Illinois, Inc.
 - c CANTEX, Inc.
 - d Carlon; Lamson & Sessions Company
 - e Pipe & Plastic Group; Certainteed Products Corp.
 - f Cole-Flex Corp.
 - g Electri-Flex Co.
 - h Spiraduct, Inc.

2.2 CONDUIT AND DUCT

- A. Rigid Steel Conduit: ANSI C80.1, galvanized.
- B. Plastic-Coated Rigid Steel Conduit and Fittings: NEMA RN 1.
- C. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC, rated for use with 90 deg. C conductors under all installation conditions.

- D. PVC Conduit and Tubing Fittings: NEMA TC 3.
- E. Rigid Plastic Underground Conduit: UL 651A, Type A PVC.
- F. Rigid Plastic Underground Conduit: UL 651A, Type EB PVC.
- G. Rigid Plastic Underground Conduit: High-density polyethylene, Schedule 40.
- H. Rigid Plastic Underground Conduit: Fiberglass-reinforced epoxy.
- I. Plastic Utilities Duct: NEMA TC 6.
- J. Plastic Utilities Duct Fittings: NEMA TC 9; match to duct type and material.
- K. Plastic Communication Duct and Fittings: NEMA TC 10.
- L. Manufactured Bends: Not less than 36-inch (900 mm) radius.
- M. Coilable Plastic Duct: NEMA TC 12.

2.3 PULL BOXES AND HANDHOLES

- A. Cast Metal Boxes: Cast aluminum, sized as indicated, with outside flanges and recessed, gasketed cover for flush mounting. Nonskid finish on cover.
- B. Fiberglass Handholes: Molded fiberglass, sized as indicated, with 6-inch square (150 mm) cable entrance at each side, weatherproof cover with nonskid finish.
- C. Cover Legend: ELECTRIC.

2.4 UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES

- A. Precast Units: Interlocking, mating sections, complete with accessory items, hardware, and features as indicated. Include concrete knockout panels for conduit entrance and sleeve for ground rod.
- B. Design structure according to ASTM C 858.
- C. Structural Design Loading: ASTM C 857, Class A-16.
- D. Fabricate according to ASTM C 858.
- E. Joint Sealant: Continuous extrusion of asphaltic butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand the maximum hydrostatic pressures at the installation location with the ground water level at grade.
- F. Source Quality Control: Inspect structures according to ASTM C 1037.

2.5 ACCESSORIES

- A. General

1. Furnish removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, for installation under another Contract. For each manhole/handhole furnish 1 stanchion for each 30 linear inches (750 mm) of interior floor perimeter. In addition, furnish 1 arm for each stanchion, 3 insulators for each arm, and a total of 3 pulling eyes. Furnish materials complete with associated fasteners, packaged with protective covering for storage and with identification labels clearly describing contents.
2. Duct Supports: Rigid PVC spacers selected to provide minimum duct spacings and concrete cover depths indicated, while supporting ducts during concreting.
3. Frames and Covers: Cast iron with cast-in legend ELECTRIC or SIGNAL as appropriate. Machine cover-to-frame bearing surfaces.
4. Sump Frame and Grate: Comply with FS RR-F-621, Type VII for frame and Type I for cover.
5. Pulling Eyes in Walls: Eyebolt with reinforcing bar fastening insert. 2-inch (50 mm) diameter eye, 1-inch (25 mm) by 4-inch (100 mm) bolt. Working load embedded in 6-inch (150 mm), 4000 psi (27.6 Mpa) concrete: 13,000 pounds minimum tension.
6. Pulling and Lifting Irons in Floor: 7/8-inch-diameter (21 mm), hot-dipped galvanized, bent steel rod, stress relieved after forming, and fastened to reinforced rod. Exposed triangular opening. Ultimate yield strength: 40,000 pounds shear and 60,000 pounds tension.
7. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemical resistant, nonconductive thermoplastic material; ½-inch (12 mm) internal diameter by 2-3/4 inches (68 mm) deep, flared to 1-1/4 inch (30 mm) minimum at base. Tested ultimate pull-out strength: 12,000 pound minimum.
8. Expansion Anchors for Installation After Concrete is Cast: Zinc-plated carbon steel wedge type with stainless-steel expander clip ½-inch (12 mm) bolt size, 5300-pound rated pull-out strength, and 6800 –pound rated shear strength minimum.
9. Cable Stanchions: Hot-rolled, hot-dipped galvanized “T” section steel, 2-1/4-inch (56 mm) size, punched with 14 holes on 1-1/2-inch (35 mm) centers for cable arm attachment.
10. Cable Arms: 3/16-inch (5 mm) thick hot-rolled, hot-dipped galvanized sheet steel pressed to channel shape, approximately two 12 inches (300 mm) wide by 14 inches (350 mm) long and arranged for secure mounting in horizontal position at any position on cable stanchions.
11. Cable Support Insulators: High glaze, wet-process porcelain arranged for mounting on cable arms.
12. Ground Rods: Solid copper clad steel, ¾-inch (18 mm) diameter by 10-feet (3 m) length.
13. Ground Wire: Stranded bare copper, No.6 AWG minimum.
14. Ladder: UL-listed, heavy-duty wood, specifically designed for electrical manhole use. Minimum length equal to the distance from the deepest manhole floor to grade plus 3 feet (1 m).
15. Duct Sealing Compound: Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35 deg. F (1 deg C), withstands temperature of 300 deg F (149 deg C) without slump, and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and the common metals.

2.6 CONSTRUCTION MATERIALS

- A. Dampproofing: Conform to Division 7 Section “Bituminous Dampproofing”.
- B. Brick: Conform to ASTM C 55, concrete brick Type I, Grade N.
- C. Mortar: Conform to ASTM C 270, Type M, except for quantities less than 2.0 cr. Ft. (60 L), where packaged mix complying with ASTM C 387, Type M may be used.

- D. Concrete: Conform to Division 3 Section "Cast-In-Place Concrete" for concrete and reinforcing.
 - 1. Strength: 3000 psi (20.7 Mpa) minimum 28-day compressive strength.
 - 2. Aggregate For Duct Encasement: 3/8-inch (10 mm) maximum size.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Underground Ducts For Electrical Utility Service: Plastic conduit encased in "Red" concrete.
- B. Underground Ducts For Electrical Feeders: Plastic conduit encased in "Red" concrete.
- C. Underground Ducts For Telephone Utility Service: Plastic utilities duct encased in concrete.
- D. Underground Ducts For Communication Circuits: Plastic underground conduit encased in concrete.
- E. Handholes; Underground precast concrete utility structures.
- F. Manholes: Underground Precast concrete utility structures.

3.2 EXAMINATION

- A. Examine site to receive ducts, handholes and manholes for compliance with installation tolerances and other conditions affecting performance of the underground ducts and manholes. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 EARTHWORK

- A. Excavation and Backfill: Conform to Division 2 Section "Earthwork," but do not use heavy-duty, hydraulic-operated compaction equipment.
- B. Restore surface features at areas disturbed by excavation, and reestablish original grades except as otherwise indicated. Replace removed sod as soon as possible after backfilling is complete. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Perform according to Division 2 Section "Landscape Work."
- C. Restore disturbed paving. Refer to "Cutting and Patching" in Division 1.

3.4 CONDUIT AND DUCT INSTALLATION

- A. Install nonmetallic conduit and duct as indicated according to manufacturer's written instructions.
- B. Slope: Pitch ducts minimum of 4 inches per 100 feet (1:300) to drain toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between 2 manholes to drain in both directions.
- C. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet (7.5 m) both horizontally and vertically at other locations.

- D. Make joints in ducts and fittings watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- E. Duct Entrances to Manholes and Handholes: Space end bells approximately 10 inches (250 mm) on center for 5-high (125 mm) ducts and varied proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances.
- F. Building Entrances: Transition for underground duct to conduit 10 feet (3 m) minimum outside the building wall. Use fittings manufactured for the purpose. Follow appropriate installation instructions below.
- G. Concrete-Encased Ducts: Install reinforcing in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.
- H. Direct-Buried, Nonencased Duct Entering Nonwaterproofed Walls: Install a Schedule 40 galvanized-steel pipe sleeve for each duct. Caulk space between conduit and sleeve with duct-sealing compound on both sides for moisture-tight seal.
- I. Waterproofed Wall and Floor Entrances: Install a watertight entrance-sealing device with the sealing gland assembly on the inside. Anchor device into masonry construction with 1 or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.
- J. Separation Between Direct-Buried, Nonencased Ducts: 3 inches (75 mm) minimum for like services, and 12 inches (300 mm) minimum between power and signal ducts.
- K. Concrete-Encased Nonmetallic Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install according to the following:
- L. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to the earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
- M. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. So not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in 1 continuous operation. When more than one pour is necessary, terminate each pour in a vertical plane and install $\frac{3}{4}$ -inch (18 mm) reinforcing rod dowels extending 18 inches (450 mm) into the concrete on both sides of joint near the corners of the envelope.
- N. Reinforcing: Reinforce duct banks where they cross disturbed earth and where indicated.
- O. Forms: All ductbanks shall be formed. Use the walls of the trench to form the side walls of the duct bank is unacceptable.
- P. Minimum Clearances Between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall and for like services, and 10 inches (250 mm) between power and signal ducts.

- Q. Depth: Except as otherwise indicated, install top of duct bank at least 24 inches (600 mm) below finished grade in nontraffic areas and at least 30 inches (750 mm) below finished grade in vehicular traffic areas.
- R. Stub-Ups: Use rigid steel conduit or stub-ups to equipment. For equipment mounted on outdoor concrete pads, extend steel conduit a minimum of 5 feet (1.5 m) from edge of pad. Install insulated grounding bushings on the terminations. Couple steel conduits to the ducts with adapters designed for the purpose and then encase coupling with 3 inches (75 mm) of concrete.
- S. Sealing: Provide temporary closure at terminations of ducts that are wired under this Project. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15 psi (1.03 Mpa) hydrostatic pressure.
- T. Pulling Cord: Install 100-pound-test nylon cord in ducts, including spares.

3.5 UNDERGROUND UTILITY STRUCTURE INSTALLATION

- A. Elevation: Install manholes with rooftop at least 15 inches (375 mm) below finished grade. Install handholes with depth as indicated. Where indicated, cast handhole cover frame directly into roof of handhole and set roof surface 1 inch (25 mm) above grade.
- B. Drainage: Install drains in bottom of units where indicated. Arrange to coordinate with drainage provisions indicated or specified.
- C. Access: Install cast-iron frame and cover. For manholes, use 30-inch (750 mm) cover except as indicated. Use 30-inch (750 mm) cover for handholes, except use 24-inch (600 mm) covers for 24-inch (600 mm) by 24-inch (600 mm) handholes. Install brick chimney to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch (25 mm) above finished grade.
- D. Waterproofing: Apply waterproofing to exterior surfaces of units after concrete has cured at least 3 day. Apply according to Division 7 Section "Sheet Membrane Waterproofing". After ducts have been connected and grouted, and prior to backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole/handhole chimneys after brick mortar has cured at least 3 days.
- E. Dampproofing: Apply dampproofing to exterior surfaces of units after concrete has cured at least 3 days. Apply according to Division 7 Section "Bituminous Dampproofing". After ducts have been connected and grouted, and prior to backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole/handhole chimneys after brick mortar has cured at least 3 days.
- F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cable and conductors and as indicated.
- G. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches (96 mm) for anchor bolts installed in the field. Use a minimum of 2 anchors for each cable stanchion.
- H. Grounding: Install ground rod through floor in each structure with top protruding 4 inches (100 mm) above floor. Seal the floor opening against water penetration with waterproof non-shrink grout. Ground exposed metal components and hardware with bare copper ground conductor.

Train conductors neatly around corners. Install on walls and roof using cable clamps secured with expansion anchors.

- I. Cast-In-Place Underground Structure installation: Conform to applicable requirements of Division 3 Section "Cast-In-Place Concrete."
- J. Finish interior surfaces with a smooth troweled finish.
- K. Windows for Future Duct Connections: Form and pour concrete knock-out panels 1-1/2 to 2 inches (37 to 50 mm) thick, arranged as indicated.
- L. Precast Concrete Underground Structure Installation: Install as indicated, according to manufacturer's written instructions and ASTM C 891.
- M. Install units plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.
- N. Support units on a level bed of crushed stone or gravel, graded from the 1-inch (25 mm) sieve to the No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3.6 FIELD QUALITY CONTROL

- A. Testing: Demonstrate capability and compliance with requirements upon completion of installation of underground duct and utility structures.
- B. Grounding: Test manhole grounding to ensure electrical continuity of bonding and grounding connections. Measure ground resistance at each ground rod and report results. Use an instrument specifically designed for ground-resistance measurements.
- C. Duct Integrity: Rod ducts with a mandrel $\frac{1}{4}$ inch (6 mm) smaller in diameter than internal diameter of ducts. Where rodding indicated obstructions in ducts, remove the obstructions and retest.
- D. Water Tightness: Make internal inspection of manholes 3 months after completion of construction for indications of water ingress. Where leakage is noted, remove water and seal leak sources. Re-inspect after 2 months and reseal remaining leak sources. Repeat process at 2 month intervals until leaks are corrected.
- E. Correct installation where possible, and retest to demonstrate compliance. Otherwise, remove and replace defective products and retest.

3.7 CLEANING

- A. Pull brush through full length of ducts. Use round bristle brush with a diameter $\frac{1}{2}$ inch (12 mm) greater than internal diameter of duct.
- B. Clean internal surfaces of manholes including sump. Remove foreign material.

END OF SECTION 263353

SECTION 260548

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Spring isolators.
 - 3. Restrained spring isolators.
 - 4. Channel support systems.
 - 5. Restraint cables.
 - 6. Hanger rod stiffeners.
 - 7. Anchorage bushings and washers.
- B. Related Sections include the following:
 - 1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.
- D. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independently of other structural elements during an earthquake.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the RIBC: Obtain value from Structural Engineer.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the RIBC: Obtain value from Structural Engineer.
 - a. Component Importance Factor: Obtain value from Structural Engineer.
 - b. Component Response Modification Factor: Obtain value from Structural Engineer.
 - c. Component Amplification Factor: Obtain value from Structural Engineer.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): Obtain value from Structural Engineer.
4. Design Spectral Response Acceleration at 1.0-Second Period: Obtain value from Structural Engineer.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

- E. Qualification Data: For professional engineer and testing agency.
- F. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with NFPA 70.
- A. It is a requirement of these specifications that the electrical systems of this facility comply with the local requirements of the State Building Code.
- B. Conform to SMACNA guidelines for seismic restraint of mechanical systems.
- C. All vibration isolators shall have calibration markings or some method to determine after installation and adjustment, the actual deflection under the imposed load.
- D. The theoretical vertical natural frequency for each support point based upon load per isolator and isolator stiffness shall not differ from the design objectives for the equipment as a whole by more than +/- 10% and shall be non-resonant with equipment forcing frequencies or support structure natural frequency.
- E. Substitution of internally isolated and restrained equipment in lieu of the isolation and restraints specified in this section, is acceptable provided all conditions of this section are met. The equipment manufacturer shall provide a letter of guarantee stamped and certified stating that the specified noise and vibration levels will be obtained and that the seismic restraints shall be in compliance with these specifications. All costs for converting to the specified external vibration isolation and/or restraints shall be born by the equipment manufacturer should submissions or installations be found to be unacceptable pursuant to the intent of this specification.
- F. All isolators shall operate within the linear portion of their load versus deflection curves. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50 percent above the design deflection.

1.7 PROJECT CONDITIONS

- A. The SEISMIC HAZARD EXPOSURE GROUP shall be determined by the Structural Engineer to determine the level of compliance.
- B. At a minimum the "Emergency or Standby Electrical Systems" must comply with this section.

1.8 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structure, architectural features, and mechanical, fire-protection, electrical, and other building systems.
- B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
 - 10. Equal approved by Engineer.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Mason Industries
 - 2. Korfund Dynamics Corp.
 - 3. Vibration Mounting and Control, Inc.
- C. All vibration isolation and seismic devices shall be the product of a single manufacturer. Mason Industries is the basis of these specifications (W.T. Morgan, Inc., 10 Errant Way, West Greenwich, RI 02817) (401) 392-0706.
- D. Manufacturer of vibration and seismic control equipment shall have the following responsibilities:
 - 1. Determine vibration isolation and seismic restraint sizes and locations.
 - 2. Provide equipment vibration isolation and seismic restraints as scheduled or specified.
 - 3. Guaranteed specified isolation system deflections.
 - 4. Provide installation instructions, drawings, and field supervision to insure proper installation and performance of systems.

- E. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- F. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
 - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- G. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 ANCHORAGE REQUIREMENTS

- A. Anchorage of electrical equipment and wiring shall comply with local State Building Code. Requirements shall include the following:
 - 1. Conduit
 - a. Raceways shall have lateral supports (type III).
 - 1) Exception: Those less than 2 1/2" trade size.
 - 2) Exception: Those suspended by individual hangers that are 12 inches or less in length from the top of the raceway to the bottom of the support for the hanger.
 - 2. Equipment Supports

- a. Provide anchorage/lateral supports to prevent lateral motion and to prevent overturning.
 - 1) Transformers - floor mounted (type IV).
 - 2) Transformers - suspended from overhead (Type III and VI).
 - 3) Switchboards and other floor mounted equipment such as large transfer switches (type III and anchor to floor with non-seismic anchors).
 - 4) Option: If floor anchoring supports of equipment are seismically rated, only Type V is required.
- 3. Generators (type I & II).
- 4. Battery Racks (type V) also strap batteries to rack.
- 5. Lighting Fixtures:
 - a. All lighting fixtures (surface or recessed) on suspended ceilings shall be supported independent of the ceiling grid by jack chain of suitable strength (#12 minimum). Fixtures over one foot in length shall be supported at all four corners. All other fixtures (including incandescent) shall be supported with a minimum of one jack chain. Pendant fixtures shall have boxes supported per NEC 410-16.
 - b. Lighting fixtures in critical areas (as listed herein or noted on the drawings) shall be supported by type III supports, in addition to jack chain.
- 6. Bus Duct and Cable Tray (type V and VI for horizontal support).
(type IV for vertical support).
- 7. Equipment Bracing:
 - a. Provide certification from the manufacturer that the following equipment is internally braced to withstand a zone 2 earthquake without damage:
 - 1) Switchboards
 - 2) Electrical panels
 - 3) Bus duct and cable tray
 - 4) Fire alarm control panels
 - 5) Emergency standby generators including controls
 - 6) Automatic transfer switches

2.3 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti Inc.
 - 5. Loos & Co.; Seismic Earthquake Division.
 - 6. Mason Industries.
 - 7. TOLCO Incorporated; a brand of NIBCO INC.
 - 8. Unistrut; Tyco International, Ltd.
 - 9. Equal approved by Engineer.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.4 MATERIALS

- A. General:
 1. All isolation and seismic restraint devices shall be capable of accepting without failure one-half "G" external forces and one "G" for life safety equipment. Shall maintain the equipment in a captive position and not short circuit isolation during normal operating conditions. Isolators shall have provisions for bolting and/or welding to the structure.
 - a. Attachment plates to be cast into housekeeping pads, concrete inserts, beam clamps, etc. that may be required for seismic compliance, shall be provided by this section.
 - b. Housekeeping pad attachment to the structure shall be designed and certified by this section. Materials and labor shall be by the concrete section of these specifications.
- B. Type I

1. Shall have the general characteristics of a spring isolator type "A".
 - a. Having a minimum outside diameter to overall height ratio of 0.8:1.
 - 1) Corrosion resistance where exposed to corrosive environment with:
 - a) Springs cadmium plates or electrogalvanized.
 - b) Hardware cadmium plated.
 - c) All other metal parts hot-dip or hot spray galvanized.
 - 2) Reserve deflection (from published load ratings to solid height) of 50% of the rated deflection.
 - 3) Minimum ¼" thick neoprene acoustical base pad or cup on under side; unless designated otherwise.
 - 4) Designed and installed so that ends of springs remain parallel.
 - b. Shall have the following additional features:
 - 1) Incorporate snubbing restraint in all directions and be capable of supporting equipment at fixed elevations during installation and have a one "G" rating. Cast or aluminum housings, except ductile iron, are not acceptable.
 - 2) Mason Industries type SSLFH or as approved.

Note: This must be used with Seismic Restraint II.

C. Type II:

1. Each corner or side of equipment base shall incorporate a seismic restraint snubber having a minimum of 5/8" thick all directional resilient pad limit stop. Restraints shall be fabricated of plate, structural members or square metal tubing. Angle bumpers are not acceptable.

D. Type III:

1. Multiple steel cable type with approved fastening devices to equipment and structure. System to be field bolted to deck or overhead structural members using two sided beam clamps or appropriately designed inserts for concrete. All parts of the system, including cables, are to be by this section to assure seismic compliance.
2. Mason Industries Type SCB Seismic Cable Braces and Type SRC Seismic Rod Clamps.

E. Type IV:

1. Neoprene mounted restraint with cadmium plated cap screw and washer.
2. Mason Industries Type RBA, RCA or as approved.

F. Type V:

1. Non-isolated equipment shall be field bolted or welded (power shots not acceptable) to the structure as required to meet seismic forces.

G. Type VI:

1. Combination spring and neoprene vibration isolation hanger.
2. Mason Industries Type 30N or as approved equal.

2.5 FIELD QUALITY CONTROL

- A. Upon completion of installation of all vibration isolation devices, the local representative of the manufacturer shall inspect the completed project and certify in writing to the contractor that all

systems are installed properly, or detailing required corrections. The contractor shall submit a report including the representative's report, certifying correctness of the installation or detailing corrective work to be done.

2.6 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 INSTALLATION

- A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated. Isolation and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and submittal data. Vibration isolators shall not cause any change of position of equipment resulting in stress on equipment connections.
- B. The minimum operating clearance under bases shall be one inch.

- C. All bases shall be placed in position and supported temporarily by blocks or shims. As appropriate, prior to the installation of the equipment, isolators and restraints.
- D. The isolators shall be installed without raising the equipment.
- E. After the entire installation is complete and under full operating load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators are properly adjusted, barely free and blocks shall be removed. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free in all directions.
- F. Electrical connection to be liquid tight flexible conduit.
- G. All floor mounted equipment, whether isolated or not shall be bolted or welded to the structure to allow for required acceleration. Bolt points, diameter or inserts, embedment depth and weld length as shown on the approved submittal drawings shall be followed in all respects.
- H. All suspended equipment shall be two or four point independently braced with type III restraints, installed taut for non-isolated equipment, such as conduit, and slack with ½" cable deflection for isolated equipment.
- I. Where base anchoring of equipment is insufficient to resist seismic forces, restraints such as type III shall be located above the units center gravity to suitably resist "G" forces.
- J. For overhead supported equipment, overstress of the building structure must not occur. Bracing may occur from:
 - 1. Flanges and structural beams
 - 2. Upper or lower truss chords in bar joists.
 - 3. Cast in place inserts or drilled ad shielded inserts in concrete structures.
- K. Pipe risers through cored shafts require no additional seismic bracing. (Core diameters to be a maximum of 2" larger than pipe O.D.)

3.4 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling.

Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Engineer.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.7 FIELD QUALITY CONTROL

- A. Upon completion of installation of all vibration isolation devices, the local representative of the manufacturer shall inspect the completed project and certify in writing to the contractor that all systems are installed properly, or detailing required corrections. The contractor shall submit a report including the representative's report, certifying correctness of the installation or detailing corrective work to be done.

3.8 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for busway and raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on a yellow field.
 - 2. Legend: Indicate voltage.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 - 1. Black letters on a yellow field.
 - 2. Legend: Indicate voltage.
- C. Indoor: Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Outdoor: Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

2.5 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
- C. Underground Warning Tape (minimum): Permanent, bright-colored, continuous-printed, vinyl tape compounded for permanent direct-burial service, and with the following features:
 - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side, compounded for direct-burial service.
 - 2. Overall Thickness: 5 mils (0.125 mm).
 - 3. Foil Core Thickness: 0.35 mil (0.00889 mm).
 - 4. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
 - 5. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145, Chapter XVII. Colors, legend, and size appropriate to each application.
 - 1. Interior Units: Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
 - 2. Exterior Units: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate with 0.0396-inch (1-mm), galvanized-steel backing. 1/4-inch (6-mm) grommets in corners for mounting.
- B. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.
- C. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

- D. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
 3. The above are sample warning labels. Specific warning labels shall be determined by the Electrical Contractor.
 4. Electrical Contractor shall provide additional warning signs as required by the local AHJ.
 5. Provide additional signage as requested by owner, maintenance and safety personal.

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
1. Engraved legend with white letters on black face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- B. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background, unless otherwise indicated. Minimum letter height shall be 3/8 inch (10 mm).

2.10 CABLE TIES

- A. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self locking.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
- I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Busway, Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 30-foot (10-m) maximum intervals.
- B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30A, and 120V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot (3-m) maximum intervals.
- C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Optional Standby Power.
 - 2. Power.
 - 3. Fire Alarm.
 - 4. Low Voltage.
 - 5. UPS Power.

- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral: White
 - 5) Ground: Green
 - 6) Isolated Ground: Green w/trace ID
 - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- E. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.
- F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- J. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive or mechanical fastened warning labels. For outdoor equipment, weather-resistant, nonfading, preprinted, cellulose-acetate butyrate with 0.0396-inch (1-mm), galvanized-steel backing. 1/4-inch (6-mm) grommets in corners for mounting.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - c. Storm switches.
 - d. Generator docking stations.
- L. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- M. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer, load shedding, kirk key operation.
- N. At each pull box, junction box and outlet box, each circuit contained therein shall be identified by panel designation and circuit number. This shall be accomplished by attaching hand written cardboard labels with string to each set of wires or by other agreed upon methods. In addition, where boxes are concealed, covers shall be marked with the same information using magic marker or other agreed upon means.
- O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, Stenciled legend 4 inches (100 mm) high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 2. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Information shall include circuit numbers, type of load served and location of load served. For example: #1 Receptacles in rooms 5 & 6. Panelboard identification shall be engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchgear.
- e. Transfer switches.
- f. Switchboards.
- g. Generators.
- h. Storm Switches.
- i. Busway.
- j. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- k. Substations.
- l. Emergency system boxes and enclosures.
- m. Motor-control centers.
- n. Enclosed switches.
- o. Enclosed circuit breakers.
- p. Enclosed controllers.
- q. Variable-speed controllers.
- r. Push-button stations.
- s. Power transfer equipment.
- t. Contactors.
- u. Remote-controlled switches, dimmer modules, and control devices.
- v. Battery-inverter units.
- w. Battery racks.
- x. Power-generating units.
- y. Monitoring and control equipment.
- z. UPS equipment.
- aa. Lighting control equipment.

END OF SECTION 260553

SECTION 260573

POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
 - 1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For coordination-study specialist.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
 - 1. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 - 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.

- c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
- a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
- 1. Switchboard buses.
 - 2. Distribution panelboard.
 - 3. Branch circuit panelboard.
 - 4. Transfer Switch.
 - 5. Lighting Control Panel.
 - 6. Variable Frequency Drive.
 - 7. Motor Controllers.
 - 8. Transfer switches.
 - 9. Storm switches.
 - 10. Busway.
 - 11. Generators.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 - 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 3. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
 - 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
- F. Equipment Evaluation Report:
 - 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 - 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 - 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC-FLASH STUDY

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

- F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- G. Arc-Flash Study Output:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Working distance.
 - 6. Incident energy.
 - 7. Hazard risk category.
 - 8. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

3.6 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Nominal voltage.
 - 3. Flash protection boundary.
 - 4. Hazard risk category.
 - 5. Incident energy.
 - 6. Working distance.
 - 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

3.7 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.8 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies:
 - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
 - 2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.9 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.

2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.10 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control centers.
2. Low-voltage switchboards.
3. Switchgears.
4. Transfer Switches.
5. Medium-voltage switches.
6. Control panels.
7. Busways.
8. Generators.
9. Storm Switches.

3.11 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.12 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260573

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
9. When used as "service Entrance Equipment", it is the Contractor's responsibility to submit all shop drawings to the local power company and electrical inspector and obtain their approval (including main circuit breakers characteristics) prior to fabrication.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 5 deg C to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).

1.9 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. If freestanding, coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
 - 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets, per plans.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - f. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
 - 2. Door-In-Trim: Provide with piano hinge on left side of trim, so that trim (and door) can be swung open for easy access to wiring terminals (rather than removed).
 - 3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 5. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel, or same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 - 6. Directory Card: Inside panelboard door, typewritten, mounted in transparent card holder.
 - 7. Equip door with spring latch and tumbler-lock with all locks keyed alike.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Tin-plated aluminum.

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus, where indicated on plans: Adequate for branch-circuit isolated ground conductors; insulated from box.
4. Extra-Capacity Neutral Bus, where indicated on plans: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
5. Split Bus, where indicated on plans: Vertical buses divided into individual vertical sections.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
8. Suitable for use with conductor material

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

- D. Mains: Circuit breaker, fused switch, or lugs only. See drawings.
- E. All branch Overcurrent Protective Devices: Bolt-on circuit breakers.
- F. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit or 24-V control circuit, coordinated with control specific control system.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only, per drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit or 24-V control circuit.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Circuit Breaker Locks: Provide thirty (30).

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Per section 262816 Enclosed Switches and Circuit Breakers.

2.5 PANELBOARD SUPPRESSORS

- A. See Section 264313/2.2.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Floor mounted panelboards: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete"
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard. Where there is no surface, provide a structural steel rack.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Mount panelboard cabinet plumb and rigid without distortion of box.
- F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.

- I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- K. Comply with NECA 1.
- L. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- M. Re-Torque: Once in final location, carefully re-torque all connections with a torque wrench, to match manufacturers recommendations. If equipment is dismantled, it must be re-inspected and re-certified by a nationally recognized testing laboratory, acceptable to the Engineer and the Authority Having Jurisdiction.
- N. Aluminum Cable Connections: If aluminum wire is permitted in Division 26, section "Conductors and Cables", circumferential compression type lugs are required for all terminations on aluminum wire. Where screw type lugs are used, it will be necessary to convert from aluminum to copper wiring before connection. This can be done by use of T & B or Ilsco, compression connectors. Adequate wiring space must be provided for connectors, if used.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Power System Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as security and data equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262420

MECHANICAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

- 1. Electrical work relating to the work of Division 22 "PLUMBING" and Division 23 "MECHANICAL".**

1.2 RELATED DOCUMENTS:

- A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all PLUMBING AND MECHANICAL ELECTRICAL REQUIREMENTS work indicated on the drawings, herein specified or both.**
- B. The applicable portions of section 260500 BASIC ELECTRICAL MATERIALS AND METHODS are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.**

1.3 SUBMITTALS

- A. Product Data: For each product indicated.**
- B. Shop Drawings: Wiring and connection diagrams.**

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.**
- B. Comply with NFPA 70.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufactures listed.**

2.2 HVAC & PLUMBING

- A. Provide all wire, conduit, boxes and fittings for all HVAC and plumbing equipment and final connections. Conform to Division 26, Section "Conductors and Cables".**
- B. Examine DIVISION 22 and 23 carefully for any work specified as performed under this Section and coordinate.**

- C. Provide all disconnects according to Division 26, Section "Enclosed Switches and Circuit Breakers".
- D. Provide nameplates on all disconnects according to Division 26, Section "Basic Materials and Methods".
- E. Automatic starters and manual starters (thermal toggle switches) that are to be furnished under DIVISION 22 and 23 are assumed to be shipped loose, install and wire (both sides) under this Section. Some starters may be variable frequency drive (VFD) type and may have built-in disconnects. Provide wiring on both sides. Some VFD's are large and heavy. Provide adequate mounting support and proper working space.
- F. Provide a manual starter (thermal toggle switch) at each single phase motor not furnished with an automatic starter. Manual starters to consist of a manual operated toggle switch equipped with a melting alloy type thermal overload relay. Starters must be inoperative if thermal unit is removed. Mount at motor location.
- G. Provide an automatic magnetic starter for each three phase motor not furnished with an automatic starter as required to suit the load and control strategy.
- H. Temperature controls are provided under DIVISION 23. Temperature control wiring, interlock wiring, and boiler control wiring are provided under DIVISION 23, except as shown on the electrical drawings or indicated differently herein.
- I. Provide "Fire-O-Matic" detector, remote shut-off, and associated wiring for each indoor boiler/furnace/water heater.
- J. Install and wire to electric heating units furnished under DIVISION 23.
- K. Provide power wiring to all control transformers and temperature control panels.
- L. Control valves and transformers for all heating units are furnished and installed under DIVISION 23.
- M. Do not use electrical drawings for location of feeds to mechanical equipment. In general, use mechanical drawings for bidding purposes and final approved mechanical shop drawings for actual installation. However, report any discrepancies to mechanical and electrical engineer for final determination, prior to installation.
- N. Wire all miscellaneous circulation and condensate pumps.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install according to NEMA standards.
- B. Mount plumb and rigid without distortion of box.
- C. Provide supports and nameplates, according to Division 26 section "Basic Electrical Materials and Methods".
- D. Ground according to Division 26, Section "Grounding, Bonding & Surge Protective Devices".

- E. Provide wiring according to Division 26, Section "Conductors and Cables".
- F. Provide raceways according to Division 26, Section "Raceways and Boxes".

END OF SECTION 262419

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Wall-box motion sensors.
 - 4. Snap switches and wall-box dimmers.
 - 5. Solid-state fan speed controls.
 - 6. Wall-switch sensors.
 - 7. Pendant cord-connector devices.
 - 8. Cord and plug sets.
 - 9. Service poles and multioutlet assemblies.
 - 10. Device trim plates.
 - 11. Emergency lighting relays.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

- D. Field quality-control test reports.
- E. Operation and Maintenance Data: Include all manufacturers' packing label warnings and instruction manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
- B. Provide additional receptacles to suit the particular equipment served.
- C. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. General Electric Company
 - b. Bryant Electric, Inc./Hubbell Subsidiary.
 - c. Hubbell Incorporated; Wiring Device-Kellems.
 - d. Leviton Mfg. Company Inc.
 - e. Pass & Seymour/Legrand; Wiring Devices Div.
 - f. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper)
 - 2. Multioutlet Assemblies:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Wiremold Company (The).
 - c. Equal approved by Engineer.
 - 3. Poke-Through, Floor Service Outlets and Telephone/Power Poles:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand; Wiring Devices Div.
 - c. Thomas & Betts Corporation.
 - d. Wiremold Company (The).
 - e. Equal approved by Engineer.

2.2 RECEPTACLES

A. General

1. Comply with NEMA WD 1, NEMA WD 6, and UL 498.
2. Provide additional receptacles to suit the particular equipment served.
3. Provide other special duty receptacles as indicated on the drawings.
4. Receptacles mounted outdoors or in other wet or damp locations shall be GFI type and installed in weatherproof enclosures, the integrity of which is not affected when the receptacle is in use (attachment plug cap inserted). Also comply with UL 943, Class A, and include indicator light that is lighted when device is tripped.
5. Color as selected by Architect, or as noted.
6. Catalog numbers are for General Electric Company, or as noted.
7. Isolated-Ground, Duplex Convenience Receptacles: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
8. All receptacles open to the public shall be tamper resistant.

B. Provide 20 amp. commercial specification grade, grounded, DUPLEX RECEPTACLES.

20A/125V	Duplex Receptacle	GE #GCR-20
20A/125V	Single Receptacle	GE #4102
30A/125V/250V	4 Wire Receptacle	GE #1439-3
50A/125V/250V	4 Wire Receptacle	GE #4181-3
20A/125V	Duplex Receptacle	GE #5362-IG (Isolated Ground)
20A/125V	Single Receptacle	GE #4102-IG (Isolated Ground)
20A/125V	GFI Dup. Rec.	GE #GFR 5342

C. Provide Wiring Devices for HAZARDOUS (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

D. Provide TWIST-LOCKING RECEPTACLES: Provide single convenience receptacles where indicated.

E. Provide heavy-duty grade PENDANT CORD-CONNECTOR DEVICES.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

F. Provide CORD AND PLUG SETS

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.3 SWITCHES

A. GENERAL

1. Comply with NEMA WD 1 and UL 20.

- B. Provide 20 amp., toggle type, "Federal Specification Grade" lighting switches.

Single pole	GE #5951	Three-way	GE #5953
Double pole	GE #5952	Four-way	GE #5954

- C. Provide heavy duty, specification grade, 20 amp., quiet "AC", "DECORA" TOUCH SWITCHES. Catalog numbers are for Slater Medalist Decora Series.

Single pole	2770	Three-way	2773
Double pole	2772	Four-way	2774

- D. Provide Pilot Light Switches, 20 A, single pole, with neon-lighted handle, illuminated when switch is "ON."
- E. Provide Key-Operated Switches, 120/277 V, 20 A, Single pole, with factory-supplied key in lieu of switch handle.
- F. Provide Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
- G. Provide FAN SPEED CONTROLS: Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
1. Continuously adjustable rotary knob, 5 A.
- H. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters, unless otherwise indicated on the drawings.
1. Control: Continuously adjustable combination slider and toggle switch with single-pole or three-way switching to suit connections. Comply with UL 1472.
- I. Occupancy Sensors
1. As indicated on the drawings.
- J. Wall-Switch Sensors:
1. As indicated on the drawings.
- K. Emergency Lighting Relays
1. Provide relays in emergency lighting circuits to cause emergency lights to automatically light whenever the emergency transfer switch goes to the emergency position, regardless of the position of the local switch.
 2. Provide SPDT transfer relays in NEMA #1 enclosure above accessible suspended ceiling or flush mounted adjacent to lighting panel. Provide one relay for each switch. Provide holding coils rated for continuous operation with 120 ampere contacts. Wire as indicated on the drawings or as directed

2.4 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.

3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, polycarbonate with lockable cover.
- C. Single and combination types to match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Provide smooth (unribbed) high-impact thermoplastic switch and receptacle cover plates. Color as selected by Architect.
 3. Receptacles mounted outdoors or in other wet or damp locations shall be installed in weatherproof enclosures with key lock cover, the integrity of which is not affected when the receptacle is in use (attachment plug cap inserted).

2.5 MULTIOUTLET ASSEMBLIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Wiremold Company (The).
 3. Panduit Corp.
 4. Equal approved by Engineer.
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish.

2.6 SERVICE POLES

- A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices, connections, or outlets in pole near floor.
1. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
 2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
 3. Finishes: Manufacturer's standard painted finish and trim combination.
 4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 3 or 5 voice and data communication cables.
 5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units.
 6. Voice and Data Communication Outlets: Provide type as indicated on the drawings or as directed.

2.7 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. The electrical contractor shall coordinate with the Architect, general contractor, millwork and countertop vendors as required and provide grommets on solid surface countertops to serve devices below.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Install devices and assemblies level, plumb, and square with building lines.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening. Remove wall plates and protect devices and assemblies during painting.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers.
4. Install wall dimmers to achieve indicated rating after derating for ganging.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings. Obtain approval of adjustments from Architect/Engineer prior to installation.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes. Brother P-Touch Labeling System is acceptable, in lieu of engraving.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 3 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating proper polarity, damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Cartridge fuses rated 600-V AC and less for use in control circuits, enclosed switches, switchboards, enclosed controllers, and motor-control centers.
- 2. Spare-fuse cabinets.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

- 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
- 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
- 3. Current-limitation curves for fuses with current-limiting characteristics.
- 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
- 5. Coordination charts and tables and related data.
- 6. Fuse sizes for elevator feeders and elevator disconnect switches.

- B. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

- 1. Ambient temperature adjustment information.
- 2. Current-limitation curves for fuses with current-limiting characteristics.
- 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
- 4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single source from a single manufacturer to the extent possible.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than 3 of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.
 - 5. Gould
 - 6. Equal approved by Engineer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages, at class and current rating indicated.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.
 - 5. Cabinet: suitably identified, lockable, compartmented, steel.
 - 6. Provide one spare set (3) of each size and type used.
 - 7. Mount where directed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance: Class L, time delay.
 - 2. Feeders: Class J, time delay.
 - 3. Motor Branch Circuits: Class RK5, time delay.
 - 4. Other Branch Circuits: Class RK1, time delay.
 - 5. Control Circuits: Class CC, fast acting.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Molded-case switches.
 - 6. Electronic trip circuit breakers.
 - 7. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to Section 260548.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
 - C. Qualification Data: For qualified testing agency.
 - D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - E. Field quality-control reports.
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - F. Manufacturer's field service report.
 - G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application.
- E. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).
- B. Interruption of Existing Electric Service: Per Section 260500.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type GD, General Duty: not allowed.
- C. Type HD, Heavy Duty, Single Throw, 240 or 600-V AC, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 240 or 600-V AC, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 240 or 600-V AC, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Fusible switches, 800 amps and above: NEMA bolted pressure contact switches made by firmly bolting the switchblades to the stationary contact terminals and to the hinge terminals and meet UL 977.

G. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac or 120-V ac as required by the specific control system.

H. All fusible switches: shall be rated for the application voltage specified and have a UL listed short circuit rating to match the fuse installed.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 240 or 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac or 120-V ac as required by the specific control system.

2.3 RECEPTACLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 240 or 600-V ac, at indicated amperage; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 240 or 600-V ac, at indicated amperage; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
- E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

- E. Electronic Trip Circuit Breakers: Where indicated or required, 100% rated, with RMS sensing, field-replaceable rating plug, trip indication (showing which adjustment caused trip), with interrupting capacity to meet available fault current, and with the following field-adjustable settings:
1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I^2t response.
 5. Arc Energy Reduction via Energy-reducing maintenance switching with local status indicator for circuit breakers with 1200A frame or above.
 6. Settings shall be per the power system studies provided by the electrical contractor.
 7. Arc Flash Reduction:
 - a. Breakers where the highest continuous trip setting can be 1200 amps and above shall utilize Arc Flash Reduction Maintenance Technology. The unit shall have a dedicated operation mechanism and visual indication that the reduction technology is operating. The technology shall reduce the trip unit Instantaneous pickup value when activated. The device shall not comprise breaker phase protection when enabled. Once the unit is disabled, the recalibration of trip unit phase protection shall not be required. Activation and deactivation of the technology trip setting shall be accomplished without opening the circuit breaker door and exposing operators to energized parts.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip).
- I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. Arc-Fault Circuit-Interrupter (AFCI):
1. Provide where required or called for.
 2. Conform to NEC 210.12 and UL 1699.
- K. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
- L. Switching Duty: All single pole circuit breakers shall be rated SWD.
- M. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits; Type HACR for heating, air-conditioning, and refrigerating equipment..
 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay

- settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
- 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
- 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
- 7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
- 8. Alarm Switch: One NO or NC contact that operates only when switch has tripped. Coordinate with alarm system for exact configuration.
- 9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- 10. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- 11. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- 12. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

2.5 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
 - 7. Alarm Switch: One NO or NC contact that operates only when switch has tripped. Coordinate with alarm system for exact configuration.
 - 8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
 - 9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
 - 10. Electrical Operator: Provide remote control for on, off, and reset operations.
 - 11. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac or 120-V ac as required by the specific control system.

2.6 DOUBLE THROW SWITCHES

- A. Provide double throw (manual transfer switches) where shown. All double throw switches shall have switchblades, which are fully visible in the "OFF" position when the switch door is open. All current carrying parts shall be plated to resist corrosion and promote cool operation. Lugs shall be UL listed for 75° C, aluminum and copper conductors. The operating handle shall be an integral part of the box, not the cover. Provisions for padlocking the switch in the "OFF" position shall be provided. The handle position shall indicate whether the switch is "ON" or "OFF".
- B. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors. (Provide when neutral is available at switch).

2.7 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 6. Indoor Hazardous Areas Indicated on Drawings, Class 1, Division 1: NEMA 250, Type 7.
 - 7. Indoor/Outdoor Hazardous Areas Indicated on Drawings, Class 1, Division 1: NEMA 250, Type 8.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Anchor floor-mounting switches to concrete base.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

- E. Install fuses in fusible devices.
- F. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- G. Most manufactures of bolted pressure switches make for line entering top and load exiting bottom. Verify shop drawings before running conduits.
- H. Do not mount switches or circuit breakers upside down or side ways.
- I. Aluminum Cable Connections: If aluminum wire is permitted, section "Conductors and Cables", circumferential compression type lugs are required for all terminations on aluminum wire. Where screw type lugs are used, it will be necessary to convert from aluminum to copper wiring before connection. This can be done by use of T & B or IlSCO, compression connectors. Adequate wiring space must be provided for connectors, if used.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
 - 3. Inspect mechanical and electrical connections.
 - 4. Verify switch and relay type and labeling verification.
 - 5. Verify rating of installed fuses.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Power System Studies".
- C. Thermal-magnetic circuit breakers:

1. Test circuit and correct deficiencies
2. Set magnetic trip at minimum.
3. Turn associated loads "on".
4. Turn breaker on/off a minimum of six (6) times.
5. If nuisance tripping occurs, set "up" one notch and repeat test.
6. Repeat steps 4 and 5 until nuisance tripping no longer occurs.

D. Electronic trip-unit circuit breakers:

1. Test circuit and correct deficiencies.
2. Set "long time pickup" at 1.0 (Do not change)
3. Set other adjustments at minimum.
4. Turn associated loads "on".
5. Turn breaker on/off a minimum of six (6) times.
6. If nuisance tripping occurs, adjust setting that caused trip "up" one notch and repeat test.
7. Repeat steps 5 and 6 until nuisance tripping no longer occurs.

END OF SECTION 262816

SECTION 263213

DIESEL - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets suitable for use in applications with the features as specified and indicated where the engine generators will be used as the Standby power source for the system.

1.3 DEFINITIONS

- A. Emergency Standby Power (ESP): Per ISO 8528: The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.
- B. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
 - 3. Sound test data, based on a free field requirement.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Wiring Diagrams: Control interconnection, Customer connections.
- C. Certifications:
 - 1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for EPA, stationary emergency application.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports.

1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.
2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
3. List of factory tests to be performed on units to be shipped for this Project.
4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.

B. Warranty:

1. Submit manufacturer's warranties per the requirements of this specification.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within Massachusetts of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).
- F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.
- G. Comply with UL 2200.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 1. Ambient Temperature: 0°F to 100°F
 2. Relative Humidity: 0 to 95 percent.
 3. Altitude: Sea level to 500.0 feet (152.4 m).

1.8 WARRANTY

- A. Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set for a minimum of twenty-four (24) months for Standby product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: The basis for this specification is CAT Power Generation equipment Model C13 – 400 for outdoor application. Any changes to the design based on other manufacturers will be the responsibility of the installing contractor at no additional cost to the owner, if approved and submitted not less than 2 weeks before scheduled bid date. Proposals by other manufacturers must include a line-by-line compliance statement based on this specification.
- B. Qualifications: Maintain, within 30 miles of project site, a manufacturer direct service center capable of providing training, parts, and emergency maintenance repairs. To be considered a manufacturer, the generator manufacturer must be the manufacturer of the engine, alternator and major components of the generator set. Manufacturers who purchase engines from the original engine manufacturer for use as a vendor component are considered “assemblers” and do not meet the minimum requirements of this specification
- C. The diesel engine shall be EPA Certified in accordance with the Federal and State Emission Laws.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Electrical output power rating for Standby operation at 400 kW / 500 kVA, at 80 percent lagging power factor, 120/208 V, Three phase, 4 -wire, 60 hertz.
 - 2. Alternator shall be capable of accepting maximum 1896 kVA in a single step and be capable of recovering to a minimum of 90% of rated voltage based on requirements of NEMA MG1-32.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.
- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 1.0 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 - 5. Transient Frequency Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within

- the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
 7. Sustained Short-Circuit Current: (For engine-generator sets using a PMG-excited alternator) For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
 8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
 9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

2.3 ENGINE

- A. Engine: Shall be equal to the C13 ACERT as manufactured by CAT Engine Company and designed specifically for generator set duty application. Engine shall be diesel fueled, compression ignited type, 4-cycle, cast iron with replaceable wet cylinder liners, in-line 6 cylinders, turbocharged and air-to-air after-cooled, with forged steel crankshaft and connecting rods. Minimum engine displacement shall be 763 in3 (12.5 liters) and have a minimum gross engine power output of 563 kWm (755 BHP), or better.
- B. Fuel: Diesel
- C. Rated Engine Speed: 1800RPM.
- D. Lubrication System: The following items are mounted on engine or skid:
 1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
 2. Filter and Strainer: Fleetguard provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used, Fleetguard or equal.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
- G. Governor: Adjustable isochronous, with speed sensing and a product of the engine manufacturer.
- H. Cooling System: Closed loop, liquid cooled
 1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 °C (104°F).
 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- I. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure. Provide hospital grade muffler/silencer to achieve the highest degree of sound attenuation possible.
 - J. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.
 - K. Starting System: 24V, as recommended by the engine manufacturer; electric, with negative ground.
 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
 3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
 4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
 5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
 6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
 - a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
 - f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Sub Base-Mounted Fuel Oil Tank: Provide a double wall secondary containment type sub base fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be UL 142 listed and labeled. The fuel tank shall include the following features:
 - 1. Capacity: Fuel for 48 Hour(s) continuous operation at 100 percent rated power output.
 - 2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank, genset, and enclosure.
 - 3. Electrical stub up(s)
 - 4. Normal & emergency vents
 - 5. Lockable fuel fill
 - 6. Mechanical fuel level gauge
 - 7. High and low level switches to indicate fuel level
 - 8. Leak detector switch
 - 9. Sub base tank shall include a welded steel containment basin, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
 - 10. Fill port with overfill prevention valve (OFPV)
 - 11. Tank design shall meet the regional requirements for the Project location

2.5 CONTROL AND MONITORING

- A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.
- B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter (3-phase, line to line and line to neutral values).
 - 2. AC ammeter (3-phases).

3. AC frequency meter.
4. AC kVA output (total and for each phase). Display shall indicate power flow direction.
5. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
6. Emergency Stop Switch: Switch shall be a red "mushroom head" pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
7. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
8. DC voltmeter (alternator battery charging).
9. Engine-coolant temperature gage.
10. Engine lubricating-oil pressure gage.
11. Running-time meter.
12. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.)
13. AC Protective Equipment: The control system shall include over/under voltage, over current, short circuit, loss of voltage reference, and over excitation shut down protection. There shall be an overload warning, and overcurrent warning alarm.
14. Status LED indicating lamps to indicate remote start signal present at the control, existing alarm condition, not in auto, and generator set running.
15. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.

- F. Provide engine start and integrity monitoring meeting the requirements of the NEC, Transfer switch engine start circuit shall be monitored by the generator set's Control Panel and annunciated locally, and on the remote annunciator panel.

Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

1. Overcrank shutdown.
2. Coolant low-temperature alarm.
3. Control switch not in auto position.
4. Battery-charger malfunction alarm.
5. Battery low-voltage alarm.

- G. Remote Alarm Annunciator: Comply with NFPA 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition.
- H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. The control system shall include over/under voltage, over current, short circuit, loss of voltage reference, and over excitation shut down protection. There shall be an overload warning, and overcurrent warning alarm.
- B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications
- C. The alternator shall be provided with an overcurrent protection relay that is UL-listed under category NRGU. The overcurrent protection system shall be coordinated with the thermal

damage curve of the specific alternator provided. Submit thermal damage curve for alternator and protection curve (and settings if applicable) for the overcurrent protective system.

- D. Provide a 100% rated, LSI circuit breaker with amperage rating as indicated on the one-line drawing. Provide KAIC rating of circuit breaker as required to accommodate generator available fault current.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H
- D. Temperature Rise: 125°C
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
- G. Enclosure: Drip-proof.
- H. Voltage Regulator: SCR type, Separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, full wave rectified, and provide a pulse-width modulated signal to the exciter.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Sound Attenuated Aluminum Factory Skin-Tight housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.
- B. Construction:
 - 1. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
 - 2. Exhaust System:
 - a. Muffler Location: Within enclosure.
 - 3. Hardware: All hardware and hinges shall be stainless steel.
 - 4. Wind Rating: Wind rating shall be 150 mph
 - 5. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
 - 6. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.

- C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.
- D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 75 dBA measured at any location 7 meters from the engine generator in a free field environment.
- E. Provide an internally mounted and wired electrical distribution panel to serve the engine generator and enclosure; including:
 - a. 100 amp distribution panelboard connected to a 120/208VAC utility service by the installer.
 - i. Factory wired normal AC service from the panelboard to the engine coolant heater, battery charger and any additional engine generator components as required.
- F. Provide aluminum stairs, support structures and railing system to allow personnel access to the control panel and generator circuit breaker to maintain all NEC code working space requirements when required.

Site Provisions:

- 1. Lifting: Complete assembly of engine generator, enclosure shall be designed to be lifted into place as a single unit, using spreader bars.

2.9 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

2.10 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.
- B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also

perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

- D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.
- F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.2 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:
- B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
- C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.
- D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.3 TRAINING

- A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.5 SERVICE AND SUPPORT

- A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year.
- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within Massachusetts of the site.
- C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 30 years.

END OF SECTION 263213

SECTION 23 36 13

MANUAL TRANSFER SWITCH (ESL STORMSWITCH)

PART 1 – GENERAL

1.1 SCOPE:

- A. Contractor shall furnish, deliver, install and test the manual transfer switches as specified herein and in accordance with the drawings.

1.2 QUALITY ASSURANCE:

- A. Manual transfer switch shall be UL listed and labeled under the UL 1008 standard.
- B. Manual transfer switch shall be special seismic certified by OSHPD exclusively on the basis of approved shake table testing, and also certified to IBC 2015. Minimum IBC 2015 design parameters shall be as follows: $I_p = 1.5$, $SDS = 2.0g$, $z/h = 1.0$
- C. Manual transfer switch manufacturer shall provide a complete factory assembled, wired and tested manual transfer switch.
- D. Manual transfer switch shall be factory Hi-pot tested for a period of not less than 60 seconds.
- E. Manual transfer switch installation shall meet all applicable NEC standards.

1.3 SUBMITTALS:

- A. Contractor shall submit manufacturer's drawings and data of manual transfer switches for Engineer's approval prior to start of fabrication. Drawings and data shall include, as a minimum, dimensioned general arrangement drawings and wiring diagrams, UL listing information including UL control or file number, OSHPD "OSP" certification number, short circuit rating or withstand rating, component data, mounting provisions, conduit entry locations and installation instructions.
- B. Upon installation of manual transfer switches Contractor shall submit manufacturer's Operating & Maintenance Manual which shall include as a minimum:
 - 1. Certified as-built General Arrangement drawings and Wiring Diagram.
 - 2. Materials / Component List including part numbers.
 - 3. Maintenance and service requirements.
 - 4. Certificate of Compliance and hi-pot test data.

1.4 WARRANTY:

- A. Manual transfer switches shall be covered by manufacturer's warranty for a minimum period of (1) one year after shipment from manufacturer.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All equipment shall be new.
- B. Manual transfer switch manufacturer must have produced and sold UL 1008 Listed manual transfer switches as a standard product for a minimum of (3) years.
- C. Manual transfer switches shall be molded case circuit breaker type; knife switch or fused switches are not acceptable.
- D. See power one-line drawings for additional requirements, but not limited to:
 - 1. AIC rating.
 - 2. 100% rating.
 - 3. Service Entrance (SE) rating.
 - 4. Adjustable trips with LSIG settings.
 - 5. Ground fault monitoring when feed from generator.
 - 6. Arc Fault Reduction maintenance switches.
 - 7. Kirk Key interlocks (not required if unit is mechanically interlocked).
- E. Contractor shall be responsible for the equipment until it has been installed and is finally inspected, tested and accepted in accordance with the requirements of this Specification.
- F. Manual transfer switches shall be StormSwitch as manufactured by ESL Power Systems, Inc. or equal as approved by the Engineer.

2.2 MANUAL TRANSFER SWITCHES:

- A. Manual transfer switch shall consist of (2) two mechanically-interlocked molded case circuit breakers, cam-style male connectors, power distribution block and grounding terminals, all housed within a padlockable enclosure.
- B. Manual transfer switch enclosure shall be Type 3R, constructed of continuous seam-welded, powder coated galvanized steel. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via a hinged lower door for pad mount units. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened. Enclosure shall be powder coated after fabrication; color shall be wrinkle gray RAL 7035.
- C. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. Cam-style male connectors shall be color coded. Cam-style male connectors shall be provided for each phase and for ground, and shall also be provided for neutral if required. Each of the phase cam-style male connectors within the enclosure shall be factory-wired to a molded case circuit breaker. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor.

The neutral cam-style male connectors shall be factory wired to a power distribution block. None of the cam-style male connectors shall be accessible unless both molded case circuit breakers are in the "OFF" position and the main access door is open.

- D. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.
- E. Molded case circuit breakers shall be UL Listed and the short circuit interrupt rating shall be a minimum of 50kAIC at 480VAC. Trip rating of the molded case circuit breakers shall be as shown on the drawings. One molded case circuit breaker shall be fed from the permanent generator; the other molded case circuit breaker shall be fed from the cam-style male connectors to supply power from a portable generator. Both molded case circuit breakers shall include UL Listed door-mounted operating mechanisms, preventing the opening of the main access door unless both breakers are in the "OFF" position. Both molded case circuit breakers shall be mounted behind a deadfront panel. The load-side of the molded case circuit breakers shall not be energizable unless the main access door is closed and one of the molded case circuit breakers is in the "ON" position. The (2) molded case circuit breakers shall be safety interlocked by mechanical means to ensure that only one breaker can be closed at any given time.
- F. Manual transfer switch shall be suitable for use as service equipment in the USA as defined by the NEC.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Prior to installation of manual transfer switches, Contractor shall examine the areas and conditions under which the manual transfer switch is to be installed and notify the Engineer in writing if unsatisfactory conditions exist.
- B. Manual transfer switch shall be installed as shown on the drawings and per the manufacturer's written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association's "Standard of Installation".
- C. Conduit entry into the manual transfer switch shall be by Contractor; Contractor shall furnish and install listed watertight conduit hubs, as manufactured by MYERS or T&B, for each conduit entry on the manual transfer switch. The incoming hub size shall match the conduit size for feeders and ground as shown on the drawings. The outgoing hub size shall match the conduit size for loads and ground as shown on the drawings.
- D. Any conduit penetrations that are above live parts must be properly sealed to prevent moisture intrusion from the conduit. A UL Listed or Classified expanding foam sealant (such as Rainbow Quick Seal 79547), or other sealing product meeting local codes and NEC requirements should be used to seal the interior of the conduit around the cables. The product selected must be able to permanently seal around all wires and the conduit (common "Duct Seal" is not acceptable for this application). The sealing shall be done at the entry into the enclosure so the seal can be

verified and inspected from inside the enclosure. Failure to seal may allow water to drip on live parts and will void warranty. Hubs shall be properly installed and tightened to maintain Type 3R integrity of the manual transfer switch enclosure.

- E. Contractor shall terminate feeder conductors, load conductors and ground per the manufacturer's instructions. All field wiring terminations shall be torqued as required per the instructions on the manual transfer switch's power distribution block, circuit breaker & ground lug.

3.2 FIELD TESTING:

- A. Prior to energizing manual transfer switch, the Contractor shall perform the following checks and tests as a minimum:
 - 1. Verify mounting and connections are complete and secure.
 - 2. Verify internal components and wiring are secure.
 - 3. Perform continuity check of all circuits.
 - 4. Perform 1,000 VDC megger test on feeder, load and ground cables.
 - 5. Verify deadfront is secure.
 - 6. With the manual transfer switch deadfront in place and the main access door closed and properly latched, actuate both Operator Mechanisms; verify only (1) breaker at a time can be turned to the "ON" position.
 - 7. Confirm operation of the manual transfer switch ground receptacle by attaching a plug to the manual transfer switch ground receptacle and then verify that the plug is grounded to the facility ground.
 - 8. Once utility power has been applied, confirm operation of manual transfer switch by following directions on main access door.

END OF SECTION 263613

SECTION 263623

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For manufacturer.
- E. Field quality-control test reports.

- F. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Features and operating sequences, both automatic and manual.
 - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NEMA ICS 1.
- F. Comply with NFPA 70.
- G. Comply with NFPA 99.
- H. Comply with NFPA 110.
- I. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 - 1. Notify Construction Manager or Owner no fewer than five days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's or Owner's written permission.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 WARRANTY:

- A. Automatic transfer switches shall be covered by manufacturer's warranty for a minimum period of (1) one year after shipment from manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Contactor Transfer Switches:
 - a. Onan/Cummins Power Generation; Industrial Business Group.
 - b. Caterpillar; Engine Division.
 - c. Emerson; ASCO Power Technologies, LP.
 - d. GE Zenith Controls.
 - e. Kohler Power Systems; Generator Division.
 - f. Russelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 2. Switch Action: Double throw; mechanically held in both directions.
 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles with overlapping neutral contacts.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
- J. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- K. Battery Charger: For generator starting batteries.
1. Float type rated 10 A.
 2. Ammeter to display charging current.
 3. Fused ac inputs and dc outputs.
- L. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- M. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- N. Enclosures: General-purpose NEMA 250, Type 1 for indoor locations and 3R for outdoor locations, complying with NEMA ICS 6 and UL 508, unless otherwise indicated. Provide accessory heaters when located outdoors.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.
- H. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:
 - 1. Fully automatic make-before-break operation.
 - 2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
 - 3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
 - a. Initiation occurs without active control of generator.
 - b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
 - 4. Failure of power source serving load initiates automatic break-before-make transfer.
- I. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- J. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.
- K. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.
- L. Automatic Transfer-Switch Features:
 - 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Identify components according to Division 26 Section "Identification for Electrical Systems."
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.

- d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
- a. Verify grounding connections and locations and ratings of sensors.

3.4 DEMONSTRATION

- A. The Manufacturer's qualified representative shall conduct a training session for up to five (5) owner's representatives for one (1) normal workdays at a jobsite location determined by the owner. The training program shall consist of the instruction on the operation of the transfer switch and the major components within the assembly.
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263623

SECTION 263623
SE RATED AUTOMATIC TRANSFER SWITCH
(EATON ATS MAGNUM WITH ATC 900 CONTROLLER)

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish and install the low voltage automatic transfer switches having the ratings, features/accessories and enclosures as specified herein and as shown on the contract drawings.

1.2 RELATED SECTIONS

1.3 REFERENCES

- A. The automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA as follows:
 - 1. UL 1008 – Transfer Switches
 - 2. UL 991 - Tests for Safety-Related Controls Employing Solid-State Devices
 - 3. NFPA 70 – National Electrical Code
 - 4. NFPA 99 – Essential Electrical Systems of Health Care Facilities
 - 5. NFPA 110 – Emergency and Standby Power Systems
 - 6. NEMA ICS 10 – AC Transfer Switch Equipment
 - 7. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Front view and plan view of the assembly
 - 2. Schematic diagram
 - 3. Conduit space locations within the assembly.
 - 4. Assembly ratings including:
 - a. Withstand and Closing rating
 - b. Voltage
 - c. Continuous current rating
 - d. Short-Time rating if applicable
 - e. Short-circuit rating if ordered with integral protection
 - 5. Cable terminal sizes
 - 6. Product Data Sheets.
- B. Where applicable, the following additional information shall be submitted to the Engineer:
 - 1. Busway connection
 - 2. Connection details between close-coupled assemblies
 - 3. Composite front view and plan view of close-coupled assemblies

1.5 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in section 1.04
 - 2. Wiring diagrams

3. Certified production test reports
4. Installation information
5. Seismic certification as specified

- B. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.6 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Provide Seismic tested equipment as follows:
 1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC).
 2. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
 3. The IP rating of the equipment shall be 1.5
 4. The Structural Engineer for the Site will evaluate the SDS values published on the Manufacturer's website to ascertain that they are "equal to" or "greater than" those required for the Project Site.
 5. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
 - b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
 - c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.7 REGULATORY REQUIREMENTS

- A. Provide a certificate of compliance with UL 1008 for the transfer switches furnished under this section.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.9 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

1.10 WARRANTY:

- A. SE rated automatic transfer switches shall be covered by manufacturer's warranty for a minimum period of (1) one year after shipment from manufacturer.

PART 2- PRODUCTS

2.1 MANUFACTURERS

- A. Eaton
- B. General Electric
- C. Siemens
- D. Square D
- E. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the engineer ten (10) days prior to bid date.

2.2 CONSTRUCTION

- A. Switches shall be free standing construction utilizing fixed mounted power circuit breakers, Eaton type MAGNUM DS or approved equal.
- B. Ratings shall be per the drawing. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating. Breakers shall be electrically operated.
- C. See power one-line drawings for additional requirements, but not limited to:
 - 1. AIC rating.
 - 2. 100% rating.
 - 3. Service Entrance (SE) rating.
 - 4. Adjustable trips with LSIG settings.
 - 5. Ground fault monitoring when feed from generator.
 - 6. Arc Fault Reduction maintenance switches.
 - 7. Kirk Key interlocks.
- D. All breakers shall be provided with a true, two-step stored energy mechanism providing a maximum of three-cycle closing. All the energy required for closing the breakers shall be completely stored and held in readiness pending a release to close action. The power case switch or breaker shall have high-endurance characteristics being capable of no-load and full-load interruptions at rated current equal to or exceeding the UL endurance ratings for power circuit breakers without maintenance.
- E. Transfer switches shall be open transition and provided with in-phase monitor, which will permit a transfer or re-transfer between two live sources that have a phase angle difference of +/- 8

degrees or less.

- F. Transfer switches applied in service entrance equipment applications provide power circuit breakers with Eaton Digitrip 520MC trip units with maintenance mode trip or approved equal.
 - F. The switching panel shall consist of completely enclosed contact assemblies and a separate control or transformer panel. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.
 - G. Each transfer switch shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources under either automatic or manual operation. Main contacts shall be mechanically locked in position in both normal and emergency positions. A neutral position shall not be possible under normal electrical operation unless a delayed transition accessory is required for switching highly inductive loads.
 - H. Transfer switches shall be capable of being operated manually under full rated load conditions. Manual operation shall be accomplished by a permanently attached manual operator, or by integrally mounted pushbuttons. Removable manual operating handles, and handles that may move in the event of an electrical operation during the manual operation, are not acceptable. Manual operators requiring source or load disconnection prior to manual operation are not acceptable.
 - I. On transfer switches requiring a fourth pole for switching the neutral, the neutral shall be fully rated with equal withstand, closing and interrupting ratings to the power poles. Switched neutral poles which are add-on or overlap, or that are not capable of breaking full rated load current are not acceptable.
 - J. The transfer switch shall have a multi-tap voltage selection plug for ease of voltage adjustment in the field.
 - K. Where shown on the drawings, transfer switches applied as service entrance equipment, shall be provided with over-current trip units and a service entrance label. A key-operated selector switch shall be provided to disconnect the power supplies. Indicators shall be provided to show the availability of each source as well as breakers in a disconnected position. Provide a neutral disconnect link for three-pole solid neutral switches, and a neutral-to-ground main bonding jumper for all switches to meet UL service entrance requirements. Ground fault protection shall be provided for all switches rated 1000 amperes or more applied on 480Y/277 Vac systems in accordance with NEC Article 230-95.
 - L. Where indicated on the drawings, the transfer switches shall be provided with a draw-out mechanism to allow easy access for preventive maintenance, testing or inspection. The draw-out mechanism shall provide visual indicators as to the position of the switch/breaker during the draw-out operation.
 - M. When the transfer switches shall be provided with a draw-out mechanism, shuttered cassettes should be provided for safety purposes
 - N. When the transfer switches shall be provided with a draw-out mechanism and NEMA 1 enclosure, a roof mounted breaker lifting device shall be included.
- 2.3 MICROPROCESSOR LOGIC
- A. The transfer switch shall be equal to an Eaton ATC-900 type microprocessor-based controller. The controller shall be hardened against potential problems from transients and surges. Operation of the transfer switch and monitoring of both sources shall be managed by the

controller.

- B. The automatic transfer switch controllers shall meet or exceed the following standards in addition to the basic switch standards:

1. IEC 61000-4-2 - EMC Testing and Measurement Techniques - Electrostatic Discharge Immunity Test
2. IEC 61000-4-3 - EMC Testing and Measurement Techniques - Radio-frequency, Electromagnetic Field Immunity Test
3. IEC 61000-4-4 - EMC Testing and Measurement Techniques - Electrical Fast Transient/Burst Immunity Test
4. IEC 61000-4-5 - EMC Testing and Measurement Techniques - Surge Immunity Test
5. IEC 61000-4-6 - EMC Testing and Measurement Techniques - Immunity to Conducted Disturbances, Induced by Radio-frequency Fields
6. IEC 61000-4-11 - EMC Testing and Measurement Techniques - Voltage Dips, Short Interrupts and Voltage Variations Immunity Tests
7. CISPR11, Class B - Industrial, Scientific and Medical Radio-frequency Equipment - Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement
8. FCC Part 15, Subpart B, Class B

2.4 ENCLOSURE

- A. Each transfer switch shall be provided in a NEMA 1 enclosure for indoor locations and NEMA 3R enclosure for outdoor locations. Enclosure shall be suitable for use in environments indicated on the drawings.
- B. NEMA 1, 12 or 3R enclosures shall be painted with the manufacturer's standard light gray ANSI 61 paint.

2.5 CONTROLLER DISPLAY AND KEYPAD

- A. The microprocessor-based controller display shall be UV resistant and include a 4.3 inch Color TFT (480x272), backlit display. The controller shall be capable of displaying transfer switch status, parameters, and diagnostic data. All set point parameters shall be password protected and programmable using the controller keypad, USB port, or remotely using serial port access. Limited abbreviations or codes shall be used for transfer switch functions.
- B. The microprocessor-based controller shall include a mimic bus display consisting of six (6) individual LED's (3mm) for indicating the following:
1. Availability status of source 1
 2. Availability status of source 2
 3. Connection status of source 1
 4. Connection status of source 2
 5. Source 1 Preferred
 6. Source 2 Preferred

2.6 VOLTAGE AND FREQUENCY SENSING

- A. The controller shall have a voltage range of 0-790 volts (50/60 Hz) and an accuracy of +/- 1% of the reading and a frequency range of 40-70 Hz and an accuracy of +/- .3 Hz.

- B. Voltage and frequency dropout and pickup parameters are set as a percentage of the nominal voltage as indicated in the table below.

Setpoint	Sources	Dropout	Pickup
Undervoltage	Source1 and 2	70 – 97%	(DO + 2%) - 99%
Overvoltage	Source 1 and 2	105 – 110%	103% - (DO – 2%)
Underfrequency	Source 1 and 2	90 – 97%	(DO + 1Hz) – 99%
Overfrequency	Source 1 and 2	103 – 105%	101% - (DO – 1Hz)
Voltage Unbalance	Source 1 and 2	5 – 20%	(UNBAL DO% - 2) – 3%

- C. The normal and emergency sources shall include phase reversal protection. The preferred rotation is programmable as ABC or CBA.

2.7 TIME DELAYS

- A. A time delay shall be provided on transfer to source 2, adjustable from 0 to 166 minutes.
- B. A time delay shall be provided to override a momentary power outage or voltage fluctuation, adjustable from 0 to 120 seconds.
- C. A time delay shall be provided on retransfer from source 2 to source 1, adjustable from 0 to 166 minutes.
- D. A time delay shall be provided after retransfer that allows the generator to run unloaded prior to shutdown, adjustable form 0 to 166 minutes.
- E. A time delay shall be provided for engine failure to start, adjustable 0- 60 seconds.
- F. All delays shall be field adjustable from the microprocessor-based controller without the use of special tools.

2.8 ADDITIONAL FEATURES

- A. One Form C contact for closure of the source 1 generator start circuit for optional use with a dual generator system. The contacts shall be rated for 5-Amp at 250-Vac and 5-Amp at 30-Vdc.
- B. One Form C contact for closure of the source 2 generator start circuit. The contacts shall be rated for 5-Amp at 250-Vac and 5-Amp at 30-Vdc.
- C. The controller shall include two independently programmable Engine Exercisers, selectable as disabled, 7, 14, or 28 day interval, or by calendar date. Run time shall be adjustable for 0-600 minutes, with or without load. Upon loss of source 2 power, the ATS shall automatically return to source 1. Transfer time delays shall also be independently programmable for test events.

- D. The controller shall include a keypad pushbutton to initiate a system test.
- E. The controller shall include 4 user configurable inputs. Each input provides 50 volts at 10ma and can be user configured to one of the following features:
1. Input to accept a remote contact which closes to initiate a transfer to source 2. This feature shall be failsafe and an automatic retransfer shall occur in the event that source 2 power is lost.
 2. Input to accept a remote contact which closes to initiate a transfer to source 2. This feature shall be failsafe and an automatic retransfer shall occur in the event that source 2 power is lost.
 3. Input to accept a remote contact which opens to inhibit transfer to source 2.
 4. Input to enable monitor mode to disable automatic operation of the transfer switch while continuing to display status. Monitor mode allows set point programming at the controller display.
 5. Input to enable lockout feature to disable automatic operations of the transfer switch following an overcurrent trip of an integral circuit breaker.
 6. Input to enable or disable manual retransfer to source 1.
 7. Input to initiate manual retransfer to source 1.
 8. Input to initiate a remote engine test. The test will run using the programmed engine test set points.
 9. Input to select source 1 or source 2 as the preferred source.
 10. Input to initiate a remote load test.
 11. Input to indicate the bypass transfer switch is closed on a source.
 12. Input to bypass time delays
 13. Input to receive engine start signal from a master controller in a three source application.
- F. The controller shall include 4 user configurable outputs rated for 10-Amp at 250-Vac and 10-Amp at 30-Vdc. Each input can be user configured to one of the following features:
1. Source 1 connected
 2. Source 2 connected
 3. ATS in test
 4. ATS not in automatic mode (Monitor Mode)
 5. General Alarm indication for failure to transfer, mechanical fault, or electrical fault.
 6. Engine Test Aborted
 7. Engine cool down in process
 8. Engine start contact status
 9. Emergency inhibit on
 10. Load sequence – Output used to signal select loads to disconnect prior to transfer and reconnect 0-120 seconds after. Loads are reconnected sequentially.
 11. Selective load shed – Output used to shed low priority loads when the load reaches a programmed threshold value. A load shed and load restore set point (measured in kW) are associated with this feature.
 12. Load bank control – Output to disconnect a load bank during an engine run test if a transfer to a source 2 generator is required.
 13. Pre and/or post transfer signal - A pre and or post transfer time delay output adjustable from 0-120 seconds.
- G. One Form C auxiliary contact to indicate Source 1 position and one Form C contact to indicate source 2 position. The contacts shall be rated for 10-Amp, 1/3-Horsepower at 250-Vac and 10-Amp at 30-Vdc.
- H. One Form C contact for Source 1 Available. The contacts shall be rated for 10-Amp, 1/3-Horsepower at 250-Vac and 10-Amp at 30-Vdc.

- I. One Form C contact for Source 2 Available. The contacts shall be rated for 10-Amp, 1/3-Horsepower at 250-Vac and 10-Amp at 30-Vdc.
- J. Data Logging
 - 1. Historical Data Storage to include:
 - a. Engine Run Time
 - b. Source 1 Available time
 - c. Source 2 Available time
 - d. Source 1 Connected time
 - e. Source 2 Connected time
 - f. Source 1 Engine Run Time
 - g. Source 2 Engine Run Time
 - h. Load Energized Time
 - i. Number of Transfers
 - 2. Event Summary shall include up to 100 date and time stamped events. All metered values are logged for each event. Event summaries include:
 - a. Transfer events
 - b. Alarms
 - c. Changes to the set points
 - d. Changes to the time/date
 - e. Resetting a historical counter
 - f. Engine Run test
 - 3. Event Details shall include up to 350 date and time stamped events. All metered values are logged for each event. Event details include detailed sequence of operations of a transfer event.
 - 4. Event recording shall capture 4 seconds of metered data, stored every 20 msec for certain events. The data is captured 2 seconds before and 2 seconds after the event. Oscillographic data for 10 events is stored and may be downloaded over USB. Events Include:
 - a. Source unavailability actions that initiate a transfer sequence (Undervoltage, Overvoltage, etc.)
 - b. Successful transfers (at the point of breaker/contact closure)
 - c. Unsuccessful transfers (at the point of breaker/contact failure to close or open)

2.9 OPTIONAL ACCESSORIES

- A. Communications Interface to be Modbus 485 and Ethernet TCP/IP.
- B. Where indicated on the drawings, provide a 200KA surge protection device on source 1.
- C. Space heater with thermostat rated for 100 watts for outdoor locations.

PART 3- ADDITIONAL REQUIREMENTS

TABLE 16496A-1: UL 1008 Listed Withstand Ratings				
Ampere Rating	3 cycle rating			30 cycle rating
	240V (kA)	480V (kA)	600V (kA)	
Magnum				
800	100	100	100	85
1000	100	100	100	85
1200	100	100	100	85
1600	100	100	100	85
2000	100	100	100	85
2500	100	100	100	85
3200	100	100	100	85
4000A	100	100	100	85
5000A*	100	100	100	85

* 5000A is UL 891 listed only.

3.1 WITHSTAND AND CLOSING RATINGS

- A. The transfer switch shall have a 3 cycle short circuit withstand and closing rating of 100kA at 240 volts.
- B. The transfer switch shall have a 30 cycle short time withstand and closing rating of 85kA at 240 volts.

PART 4- EXECUTION

4.1 EXAMINATION

4.2 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
 - 1. Insulation check to ensure the integrity of insulation and continuity of the entire system
 - 2. Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards

3. Mechanical tests to verify that the switch's power sections are free of mechanical hindrances
 4. Electrical tests to verify the complete electrical operation of the switch and to set up time delays and voltage sensing settings of the logic
- B. The manufacturer shall provide a certified copy of factory test reports.
 - C. Transfer switch shall include a label indicating order number, catalog number and date
- 4.3 INSTALLATION
- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings
 - B. All necessary hardware to secure the assembly in place shall be provided by the contractor
- 4.4 FIELD QUALITY CONTROL
- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of two (2) working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- 4.5 MANUFACTURER'S CERTIFICATION
- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
 - B. The Contractor shall provide a copy of the manufacturer's representative's certification.
- 4.6 TRAINING
- A. The Manufacturer's qualified representative shall conduct a training session for up to five (5) owner's representatives for one (1) normal workdays at a jobsite location determined by the owner. The training program shall consist of the instruction on the operation of the transfer switch and the major components within the assembly.
- 4.7 FIELD SERVICE ORGANIZATION
- A. The manufacturer of the ATS shall also have a national service organization that is available throughout the contiguous United States and is available on call 24 hours a day, 365 days a year.

END OF SECTION 263623

SECTION 264313

SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surge protective devices (SPD or TVSS Transient Voltage Surge Suppression) for the protection of building electrical and electronic systems from the effects of line and electromagnetically induced transient voltage surges and coupled lightning discharge transients for 120 to 600 V power distribution and control equipment.
- B. Labor, equipment, materials and other costs necessary to complete all SPD or TVSS work indicated on the drawings, herein specified or both.
- C. Related Sections:
 - 1. Division 26 Section "Switchboards" for factory-installed SPD.
 - 2. Division 26 Section "Panelboards" for factory-installed SPD.
 - 3. Division 26 Section "Automatic transfer Switches" for factory Installed SPD.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. SPD: Surge Protection Devices.
- C. SVR: Suppressed voltage rating.
- D. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Wiring and connection diagrams.
- C. Qualification Data: For qualified testing agency.
- D. Product Certificates: For SPD devices, from manufacturer.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For SPD devices to include in emergency, operation, and maintenance manuals.

- G. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- D. Comply with NEMA LS 1.
- E. Comply with UL 1283 and UL 1449.
- F. Comply with NFPA 70.
- G. Comply with UL 96 when interconnecting with lightning protection system.

1.6 PROJECT CONDITIONS

- A. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.7 COORDINATION

- A. Coordinate location of field-mounted SPD devices to allow adequate clearances for maintenance.
- B. Coordinate SPD devices with Division 26 Section "Electrical Power Monitoring and Control."
- C. Coordinate SPD devices with Division 26 Section 264113 on Lightning Protection. SPD must be listed and labeled for lightning protection.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: One of each size and type installed.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Equal approved by Engineer.

- B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, wired-in, or bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. LED indicator lights for power and protection status.
2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

- C. Surge Protection Devices:

1. Comply with UL 1449.
2. Modular design (with field-replaceable modules).
3. Fuses, rated at 200-kA interrupting capacity.
4. Fabrication using bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. Redundant replaceable modules.
8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Four-digit transient-event counter set to totalize transient surges.

- D. Peak Single-Impulse Surge Current Rating: 240 kA per mode/480 kA per phase.

- E. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- F. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2
 - 1. Line to Neutral: 70,000 A.
 - 2. Line to Ground: 70,000 A.
 - 3. Neutral to Ground: 50,000 A.
- G. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 V or 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:
 - 1. Line to Neutral: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
 - 2. Line to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
 - 3. Neutral to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
- H. Protection modes and UL 1449 SVR for 240/120 V, single-phase, 3-wire circuits shall be as follows:
 - 1. Line to Neutral: 400 V.
 - 2. Line to Ground: 400 V.
 - 3. Neutral to Ground: 400 V.
- I. Protection modes and UL 1449 SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
 - 1. Line to Neutral: 400 V, 800 V from high leg.
 - 2. Line to Ground: 400 V.
 - 3. Neutral to Ground: 400 V.
- J. Protection modes and UL 1449 SVR for 240 V or 480 V, 3-phase, 3-wire, delta circuits shall be as follows:
 - 1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
 - 2. Line to Ground: 1500 V for 480 V, 800 V for 240 V.

2.2 PANELBOARD SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Surge Protection Devices:
 - 1. Non-modular.
 - 2. LED indicator lights for power and protection status.
 - 3. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Surge Protection Devices:

1. Comply with UL 1449.
2. Modular design (with field-replaceable modules).
3. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
4. Fuses, rated at 200-kA interrupting capacity.
5. Fabrication using bolted compression lugs for internal wiring.
6. Integral disconnect switch.
7. Redundant suppression circuits.
8. Redundant replaceable modules.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Four-digit transient-event counter set to totalize transient surges.

D. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase for distribution panelboards and 80 kA per mode/160 kA per phase for branch panelboards.

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 V or 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
2. Line to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
3. Neutral to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.

F. Protection modes and UL 1449 SVR for 240/120 V, single-phase, 3-wire circuits shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

G. Protection modes and UL 1449 SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

H. Protection modes and UL 1449 SVR for 240 V or 480 V, 3-phase, 3-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
2. Line to Ground: 1500 V for 480 V, 800 V for 240 V.

- I. Grounding conductors: Grounding and bonding components shall not be aluminum.

2.3 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install SPD devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install SPD devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multiple pole, 60-A-3P circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated. Provide wiring consisting of 4#6 + 1#10G, 1"C or per the manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
 - 2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Complete startup checks according to manufacturer's written instructions.
- B. SPD device will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Do not energize or connect service entrance equipment, panelboards, control terminals, or data terminals to their sources until required SPD devices are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 DEMONSTRATION

- A. Contractor to train Owner's maintenance personnel to maintain SPD devices.

END OF SECTION 264313

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures with LED sources.
2. Lighting fixtures mounted on exterior building surfaces with LED sources.
3. Accessories, plaster rings, fasteners, etc.

1.2 RELATED DOCUMENTS:

- A.** AIA A201 and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all INTERIOR LIGHTING work indicated on the drawings, herein specified or both.
- B.** The applicable portions of section 260000 GENERAL are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

- A.** Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, and finishes.
- B.** Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C.** Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A.** Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B.** Comply with NFPA 70.
- C.** FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.5 WARRANTY:

- A.** Manual transfer switches shall be covered by manufacturer's warranty for a minimum period of (1) one year after shipment from manufacturer.

1.6 EXTRA MATERIALS:

- A. Provide 3% of extra LED drivers and applicable lenses, but the quantity shall not be less than two per fixture type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 LIGHTING LUMINAIRES

- A. See schedules on drawings.
- B. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category as currently defined by the DLC Premium qualification requirements at the time of bid.
- C. Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
- D. Color Consistency: LED manufacturer shall use a maximum 2-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 3-step MacAdam Ellipse binning process.
- E. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- F. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- G. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
- H. Luminaire shall maintain 70% lumen output (L70) for a minimum of 100,000 hours.
- I. Driver shall have a rated life of 50,000 hours, minimum.
- J. Lumen output shall not depreciate more than 5% after 10,000 hours of use.
- K. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
- L. Luminaire Color Rendering Index (CRI) shall be a minimum of 90 for interior luminaires, and a minimum of 80 for exterior luminaires.
- M. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).

- N. LED driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
- O. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- P. Luminaire shall have a maximum Total Harmonic Distortion (THD) of 10% at full input power and across specified voltage range.
- Q. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
- R. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
- S. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
- T. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
- U. Provide all of the following data on submittals:
 - 1. Delivered lumens
 - 2. Input watts
 - 3. Efficacy
 - 4. Color rendering index.
- V. The failure of one LED shall not affect the operation of the remaining LEDs.
- W. Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.
- X. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.
- Y. LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire.

2.3 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "HANGERS AND SUPPORTS" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture).
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage 2.68 mm.
- E. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
 - 2. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
 - 3. Provide additional support, independent of ceiling grid for all fixtures (including incandescent) by use of jack chain having breaking strength of 3 times the weight of the fixture (minimum of #12). Fixtures over one foot in length shall be supported at all four corners.
 - 4. See section 260548, "Vibration and Seismic Controls for Electrical Systems" for additional requirements.
- C. Suspended Fixture Support: As follows:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows (stem mounted): Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 4. Continuous Rows (cable mounted): Suspend from cable.
 - 5. Support: Per NEC 410-16.
- D. Adjust aimable fixtures to provide required light intensities. Adjust all fixtures to the satisfaction of the Engineer. Adjustments required at night shall be done at no additional charge. Provide all equipment needed including scaffolding, if required.
- E. Provide start-up, testing and commissioning of the new lighting and associated lighting controls.

END OF SECTION 265100

SECTION 265200
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaires and accessories
- B. Poles
- C. Pole foundations
- D. Grounding
- E. Conduit and wiring
- F. Lighting controls

1.2 QUALITY ASSURANCE

- A. Comply with the following codes and standards:
 - 1. *National Electrical Code* (NEC) for components and installation.
 - 2. International Building Code
 - 3. ASCE-7, Minimum Design Loads for Buildings and Other Structures
 - 4. The national Energy Policy Act and Energy Star requirements for lighting products.
- B. Provide luminaires listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environments in which installed.
- C. Use manufacturers that are experienced in manufacturing poles, luminaires, lamps and ballasts similar to those indicated for this Project and have a record of successful in-service performance.

1.3 SERVICE CONDITIONS

- A. Elevation: 7500 feet above sea level.
- B. International Building Code, RIBC and ASCE 7 design wind conditions:
 - 1. Basic Wind Speed: 150 mph (3-second gust at 30 ft above ground, mean recurrence interval of 50 years)
 - 2. Importance Factor: 1.00.
- C. Ambient temperatures, deg C (deg F):
 - 1. Annual averages: 2.1 (35.8) minimum, 15.6 (60.0) maximum, 8.8 (47.9) average
 - 2. Annual nighttime average: 5.4 (41.7)
 - 3. Annual extremes: -15.0 (5.0) minimum, 31.7 (89.0) maximum
 - 4. Annual warmest day 24-hour average: 20.7 (69.3)
 - 5. Annual warmest day nighttime average: 16.4 (61.6).

- D. Maximum solar heat gain: 110 W/sq ft.
- E. Lightning flash density: 8 flashes to ground per square km per year.

1.4 DEFINITIONS

- A. Unless otherwise specified or indicated, terms used in this Section are as defined in the National Electrical Code or the IESNA Lighting Handbook.

1.5 SUBMITTALS

- A. Submit the following in accordance with Project submittal procedures.
 - 1. Catalog Data: Submit catalog data describing poles, luminaires, lamps, ballasts, and pole and luminaire finishes. Include data substantiating that materials comply with specified requirements. Arrange data for luminaires in the order of luminaire designation.
 - 2. Performance Curves/Data: Submit certified photometric data for each type of luminaire.
 - 3. Shop Drawings: Submit manufacturer's drawings for non-standard luminaires.
 - 4. Maintenance Data: Submit maintenance instructions for inclusion in the operations and maintenance manuals.

1.6 EXTRA MATERIALS

- A. Furnish the following extra materials matching products installed. Package with protective covering for storage and identify with labels describing contents.
 - 1. Drivers: 10 percent of quantity of ballasts of each type, but not less than one of each type.
 - 2. Lenses, Diffusers, Covers, Globes, and Guards: 10 percent of quantity of each type, but not less than one of each type.
 - 3. Fuses: 10 percent of quantity of fuse of each type, but not less than two of each type.

1.7 RECEIVING, STORING AND PROTECTING

- A. Receive, inspect, handle, and store products according to the manufacturer's written instructions and NECA/IESNA 501, Recommended Practice for Installing Exterior Lighting Systems.

1.8 WARRANTY:

- A. All exterior light fixtures shall be covered by manufacturer's warranty for a minimum period of (1) one year after shipment from manufacturer.

PART 2 - PRODUCTS

2.1 FINISHES

- A. Furnish luminaires, poles, and accessories with finishes as scheduled that are resistant to fading, chalking, and other changes due to aging and exposure to heat and ultraviolet light. Acceptable finishes for metals are:
 - 1. Hot-dipped galvanized steel: ASTM A 123/A 123M.
 - 2. Brushed natural aluminum
 - 3. Anodized aluminum: AAMA 611, *Anodized Architectural Aluminum*, Class I.

Powder coated aluminum: Fluorocarbon polymer powder coating per AAMA 2605, *Superior Performing Organic Coatings* over chrome phosphate conversion coated aluminum.

- B. Reject luminaires, poles, and accessories with finish having runs, streaks, stains, holidays and defects.
- C. Replace luminaires, poles, and accessories showing evidence of yellowing, fading, chalking, and other changes indicating failure during warranty period.
- D. Use stainless steel for exposed hardware.

2.2 EXTERIOR LUMINAIRES - GENERAL

- A. Furnish exterior luminaires that comply with requirements specified in this Section and in the luminaire schedule on the Drawings.
- B. Luminaires shall be NRTL-listed as conforming to UL 1598 - *Luminaires*.
- C. Luminaire photometric characteristics shall be based on IESNA approved methods for photometric measurements performed by a recognized photometric laboratory.
- D. Luminaire housing shall be primarily metal.
 - 1. Metal parts shall be free from burrs and sharp corners and edges.
 - 2. Sheet metal components shall be fabricated from corrosion-resistant aluminum, formed and supported to prevent sagging and warping.
 - 3. Exposed fasteners shall be stainless steel.
- E. Doors and frames shall be smooth operating and free from light leakage under operating conditions.
 - 1. Relamping shall be possible without the use of special tools.
 - 2. Doors, frames, lenses and diffusers shall be designed to prevent accidental falling during relamping and when secured in the operating position.
 - 3. Door shall be removable for cleaning or replacing lens.
- F. Luminaires shall have minimum reflecting surface reflectance as follows unless scheduled otherwise:
 - 1. White surfaces: 85 percent
 - 2. Specular surfaces: 83 percent
 - 3. Diffusing specular surfaces: 75 percent
- G. Provide lenses, diffusers, covers and globes as scheduled on the Drawings fabricated from materials that are UV stabilized to be resistant to yellowing and other changes due to aging or exposure to heat and ultraviolet radiation.
- H. Doors shall have resilient gaskets that are heat-resistant and aging-resistant to seal and cushion lens and refractor.

2.3 LED LUMINAIRES

- A. LED luminaires shall conform to UL 1598 and to UL 8250 – *Safety Standard for Light-Emitting Diode (LED) Light Sources for Use in Lighting Products*.

- B. Products shall be lead and mercury free.
- C. Photometric characteristics shall be established using IESNA LM-79-08, *IESNA Approved Method for the Electrical and Photometric Measurement of Solid-State Lighting Products*.
- D. Ingress protection for optical assembly shall be IP65 or better in accordance with ANSI/IEC 60529 - *Degrees of Protection Provided by Enclosures*.
- E. Color characteristics of LED luminaires shall be as follows in accordance with ANSI C78.377 – *Specifications for the Chromaticity of Solid State Lighting Products*:
 - 1. Color temperature (deg K): 3000
 - 2. Color rendering index: not less than 80
- F. LED and driver cooling system shall be passive and shall resist the buildup of debris.
- G. LED luminaire output after 50,000 hours of operation shall be not less than 70 percent of the initial lumen output when determined in accordance with IESNA LM-80-08 – *IESNA approved Method for Measuring Lumen Maintenance of LED Lighting Sources*.
- H. LED luminaire electrical characteristics:
 - 1. Supply voltage: 120 V, 208 V, 240 V, 277 V, or 480 V as indicated on the Drawings. Provide step-down transformers if required to match driver input voltage rating.
 - 2. Total harmonic distortion (current): Not more than 10 percent
 - 3. Power factor: Not less than 90%
 - 4. RF interference: Meet FCC 47 CFR Part 15/18
 - 5. Transient protection: IEEE C62.41 Class A.
- I. Warranty:
 - 1. Manufacturer shall replace any luminaires that fail to operate properly within 60 months of the date of LANL acceptance of the installation. Lens yellowing or hazing will be considered a failure.
 - 2. Manufacturer shall replace any luminaires that experience housing or finish failure within 5 years of the date of acceptance of the installation.
- J. Manufacturers: Subject to compliance with requirements, provide products as scheduled or specified on the Drawings.

2.4 POLES AND ACCESSORIES

- A. Furnish poles and accessories that comply with requirements specified in this Section and the luminaire schedule on the Drawings.
- B. Pole, base, and anchorage shall carry the luminaires, supports, and appurtenances at the indicated height above grade without deflection or whipping.
- C. Mountings, fastenings and other appurtenances shall be fabricated from corrosion-resistant materials that are compatible with poles and luminaires and will not cause galvanic action at contact points. Mountings shall correctly position luminaires to provide scheduled light distribution.
- D. A reinforced access handhole shall be located in the wall of each metal pole.

- E. A welded 1/2 inch grounding lug shall be accessible through the handhole of each metal pole. Grounding connection shall be designed to prevent electrolysis when used with copper ground wire.
- F. Metal poles shall have anchor type bases and galvanized steel anchor bolts and leveling nuts.
- G. Metal poles shall have a metal base cover that covers the entire base plate and anchorage.
- H. Protect painted, anodized, or brushed pole finishes during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.
- I. Aluminum poles shall be fabricated from corrosion resistant aluminum Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys or Alloy 356-T4 for cast alloys.
 - 1. Poles shall be square or round, tapered or straight as indicated on the Drawings.
 - 2. Aluminum poles over 30 feet tall shall include factory-installed vibration dampers.
 - 3. Poles shall be seamless extruded or spun seamless type with minimum 0.188 inch wall thickness.
 - 4. Tops of shafts shall be fitted with a round or tapered cover.
 - 5. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M, *Standard Specification for Aluminum-Alloy Permanent Mold Castings* and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded.
 - 6. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.
- J. Anchor bolts shall be steel rod having minimum yield strength of 50,000 psi. The top 12 inches of the anchor bolt shall be galvanized in accordance with ASTM A153/A153M.
- K. Manufacturers: Subject to compliance with requirements, provide products as scheduled or specified on the Drawings.

2.5 LIGHTING CONTROL EQUIPMENT

- A. Furnish photoelectric relays to control exterior lighting as indicated on the Drawings.
- B. Furnish one or more time switches to control exterior lighting as indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned exterior luminaires as indicated on the Drawings.
- B. Disconnect and remove abandoned luminaire poles and associated foundations as indicated on the Drawings
- C. Maintain electrical circuit to existing exterior luminaires that are to remain active.
- D. Clean and repair existing exterior luminaires that are to remain or be reinstalled.

3.2 EXAMINATION

- A. Examine areas, spaces, and surfaces to receive exterior luminaire (s) or poles for compliance with installation tolerances and other conditions affecting performance of the product. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions, NECA/IESNA 501, and approved shop drawings.
- B. Locations of luminaires and poles shown on the Drawings are diagrammatic. Coordinate luminaire locations with building finishes, building structure, paving and striping, utility piping, security fences, and existing trees. Obtain approval for location changes through LANL Subcontract Technical Representative (STR).
- C. Set poles and luminaires plumb, square, level and secure.
- D. Install surface mounted luminaires directly to an outlet box which is supported from structure.
- E. Install in-grade luminaires flush with surrounding surface. Coordinate pitch or grading of surface with General Contractor to allow drainage away from fixture.
- F. Install lamps in luminaires in accordance with manufacturer's instructions.

3.4 CONCRETE FOUNDATIONS

- A. Construct concrete foundations with exterior 4000 psi concrete and reinforcing conforming to Section 033000 Cast-In-Place Concrete.
- B. Comply with details on the Drawings and manufacturer's recommendations for foundation dimensions, reinforcing, anchor bolts, nuts and washers.
- C. Position power conduits and ground rod to terminate within the pole shaft area and one inch above the top of the foundation.
- D. Cure concrete foundations for 7 full curing days before erecting poles.

3.5 POLE ERECTION

- A. Do not install poles without luminaires.
- B. Use fabric web slings to raise and set poles.
- C. Use leveling nuts or shims to make poles plumb. When leveling nuts are used, set the lower nuts not more than 1 inch from the concrete foundation.
- D. Tighten anchor bolt nuts and other pole hardware to torque recommended by manufacturer.
- E. After pole is leveled, pack non-shrink grout between anchor base and concrete foundation to provide a full bearing surface. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout; arrange to drain condensation from interior of pole.

- F. Set embedded poles to depth indicated on the Drawings, but not less than 1/6 of pole length below finish grade.
 - 1. Auger holes large enough to permit the use of tampers the full depth of the hole.
 - 2. Backfill in 6 inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of the undisturbed earth.

3.6 GROUNDING

- A. Install grounding for exterior lighting using materials and methods specified in Section 26 0526, *Grounding and Bonding for Electrical Systems*.
- B. Connect ground lug of metal pole to circuit equipment grounding conductor.

3.7 RACEWAYS AND BOXES

- A. Install conduit system for exterior lighting using materials and methods specified in Section 26 0533, *Raceways and Boxes for Electrical Systems*.

3.8 FIELD QUALITY CONTROL

- A. Inspect each installed lighting unit for damage. Replace damaged luminaires, poles, and components.
- B. Test installed luminaires for proper operation.
 - 1. Provide instruments to make and record test results.
 - 2. Replace or repair malfunctioning luminaires and components then re-test.
 - 3. Repeat procedure until all luminaires operate properly.
- C. Replace inoperative lamps.
- D. Check poles for signs of vibration induced by 10 to 30 mph wind: visible swaying, loosened anchor bolt nuts, vibration perceptible by touch, or wires rattling inside pole. Notify the Engineer or Architect and the pole manufacturer – vibration mitigation devices may be required.

3.9 ADJUSTING AND CLEANING

- A. Clean each luminaire inside and out, including plastics and glassware. Use methods and materials recommended by manufacturer.

END OF SECTION 265200

SECTION 28 31 11

FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 1 Specification Sections, apply to this Section.
- B. This specification is being reviewed by a fire alarm vendor. The intent is to provide a fire alarm system with voice evacuation as indicated on the drawings. This specification will be revised.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Smoke/carbon monoxide detectors.
 - 5. Heat detectors.
 - 6. Addressable Notification appliances.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Radio Master Box.

1.3 SYSTEM DESCRIPTION

- A. Non-coded, UL Listed intelligent analog addressable fire alarm system with multiplexed signal transmission.
- B. The complete system shall be as manufactured by Autocall. (Contact: NSG Life Safety, 865 Waterman Avenue, East Providence, RI. Tel. 774-338-1839). Approved manufacturers are Edwards and Notifier.
- C. The System supplied under this specification utilizes independently addressed, input/output modules, power supply(s) as described in this specification. The system contains fire alarm control panels, remote annunciator(s), Remote Transponder(s) and Addressable Notification Appliances. Alternate systems shall support all self-testing operations specified herein (no exceptions).

1.4 SUBMITTALS

- A. The Contractor shall purchase no equipment for the system specified herein until the engineer has approved the project submittals in their entirety and has returned them to the contractor. It is the responsibility of the contractor to meet the entire intent and functional performance detailed in these specifications. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications.
- B. Each submittal shall include a cover letter providing a list of each variation that the submittal may have from the requirements of the Contract Documents. In addition, the Contractor shall provide specific notation on each Shop Drawing, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Architect.
 - 2. Shop Drawings shall be prepared by persons with the following qualifications: a. Trained and certified by manufacturer in fire-alarm system design and be NICET III certified. Submittals shall be reviewed, signed and dated by a NICET IV.

- C. Product Data: Product Data sheets with the printed logo or trademark of the manufacturer of all equipment. Indicated in the documentation shall be the type, size, rating, style, and catalog number for all items proposed to meet the system performance detailed in this specification. The proposed equipment shall be subject to the approval of the Owner.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
- E. Operation and Maintenance Data: For fire-alarm systems and components to be included in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data, include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.
 - 2. Provide "Record of Completion Documents" according to NFPA72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 - 3. Record copy of site-specific software database file, hardcopy print-out and CD, with password for delivery to the owner.
 - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA72 article of the same name and include the following:
 - 5. Manufacturer's required maintenance related to system warranty requirements.
 - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 - 7. Copy of NFPA72.
- F. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application.
 - 5. CD of site-specific software database file with password, and electronic product data sheets. Provide hard copy print-out of the software program. Provide a complete system comparison report for each change implemented during the warranty period.
 - 6. Provide a list of global system settings
 - 7. Provide a list of the contents of each system cabinet and their settings
 - 8. Provide a list of all addressable devices with their addresses and settings

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, by a qualified testing agency, and marked for intended location and application.

1.6 WARRANTY AND SOFTWARE SERVICE AGREEMENT

- A. The contractor shall warranty all materials, installation and workmanship for one (1) year from date of acceptance, unless otherwise specified. A copy of the manufacturers' warranty shall be provided with closeout documentation and included with the operation and installation manuals.
- B. The System Supplier shall maintain a service organization with adequate spare parts stocked within 50 miles of the installation.
- C. Detector Sensitivity Testing: During the warranty period, each year the contractor is to perform detector sensitivity testing and provide report to the Owner. Unless, the system is UL Listed to perform automatic sensitivity testing without any manual intervention and should detector fall outside of sensitivity window, the system will automatically indicate a device trouble. A copy of UL letter is to be provided as proof of system operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling fire alarm system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- B. The Contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these Specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.
- C. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building Owner. All specified operational features must be met without exception.
- D. All control panel assemblies and connected (new) field appliances shall be provided by the same System Supplier, and shall be designed and tested to ensure that the system operates as specified. All equipment and components shall be installed in strict compliance with the manufacturer's recommendations.
- E. Upon completion of the project the Owner shall be provided with a hard copy printout of the system software database and an electronic version of the system program and database with all required passwords.
- F. That equipment proposed to be supplied will be considered only if it meets all sections of the performance specification. Any deviations of system performance outlined in this specification will only be considered when the following requirements have been met:
 - 1. A complete description of proposed alternate system performance methods with three (3) copies of working drawings thereof for approval by the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.
 - 2. The supplier of alternate equipment shall furnish evidence that the proposed alternate system performance is equal to or superior than the system operation stated in the specification. Such evidence shall be submitted to the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.
 - 3. The supplier shall submit a point-by-point statement of compliance for all sections in this specification. The statement of compliance shall consist of a list of all paragraphs within these sections. Where the proposed system complies fully with the paragraph as written, placing the word "comply" opposite the paragraph number shall indicate such. Where the proposed system does not comply with the paragraph as written, and the supplier feels the proposed system will accomplish the intent of the paragraph, a full description of the function as

well as a full narrative description of how its proposal will meet its intent shall be provided. Any submission that does not include a point-by-point statement of compliance as described herein shall be disqualified. Where a full description is not provided, it shall be assumed that the proposed system does not comply.

4. The supplier of alternate equipment shall submit a list from the alternate manufacture on the manufacture's letterhead indicating the names and addresses of all authorized suppliers in the area.
 5. The acceptability of any alternate proposed system shall be the sole decision of the Owner or his authorized representative.
- G. Approved Products: All panels and peripheral devices shall be of the standard product of single manufacturer and shall display the manufacturer's name of each component.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors without sounder bases.
 4. Automatic sprinkler system water flow.
 5. Fire standpipe system.
 6. Duct smoke detectors.
- B. Fire-alarm signal shall initiate the following actions:
1. Selectively Activate the audible and visual notification appliance or appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 7. Activate emergency shutoffs for gas and fuel supplies.
 8. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Low-air-pressure switch of a dry-pipe sprinkler system.
 3. Elevator shunt-trip supervision.
 4. Duct smoke detectors (shutdown local fan).
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
 10. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system.

- E. System Trouble and Supervisory Signal Actions: Annunciate at fire-alarm control unit and remote annunciators.

2.3 FIRE-ALARM CONTROL UNIT (FACU)

- A. Provide and install Autocall 4100ES series Fire Alarm Control System. The system shall consist of the required Fire Alarm control or transponder panels, each sized to support 500 analog detectors, expandable to 2500. The system shall support peer-to-peer network communications consisting of up to 99 nodes. Each network panel shall provide the following functions:
 - B. Monitor all initiating devices, report the event to the fire alarm network [and Security Management System (SMS)], annunciate the alarmed device and its location, conduct smoke control functions, and initiate the audio/visual evacuation signaling and control sequences as described herein.
 - C. Conduct off-site or municipal reporting as described herein.
 - D. Initiating devices shall respond with their condition. Control relays shall be individually addressable by the system to respond automatically in the event of an alarm of related sensors. Manual override of control relays shall be individually addressable by the operator.
- E. Control Configuration: All fire alarm control portions of the system shall be housed in red locking, semi flush mounted enclosures. All panel initiating and control status indicators shall be visible through a clear Lexan window. Access to the control panel shall be by keys issued to the Fire Department and authorized personnel. Each panel shall incorporate an operator interface, CPU, addressable loop interface cards, audio control/microphone, amplifiers, power supply and batteries to perform the system operation as described herein.
- F. Primary Operator Control: The FACP shall provide an operator interface module consisting of an 80 character backlit LCD display to present all system alarm, trouble and supervisory conditions, and shall provide control switches for status message scrolling, event acknowledgment, System Reset and Alarm Silence, as well as program function switches, 3 programmable status LEDs and 5 additional user-programmable function switches. The display shall have LEDs to indicate Power On, Fire Alarm, Priority 2 Alarm, Supervisory, Trouble and Alarm Silenced status.
- G. Addressable Loop Interface: Provide an IDNET addressable loop interface card for each addressable signaling line circuit. Each card shall support four isolated circuit loops (quad isolator) and digital communications with up to 250 addressable field detectors, and total wiring distances up to 10,000 ft.
- H. Auxiliary Control / Annunciation: Provide the required auxiliary switch and LED modules for discreet LED annunciation, zone disconnect, HVAC override, or related monitoring and control functions integral to the primary FACP. As a minimum, provide [16 32 64] discreet, programmable auxiliary switches with corresponding status LEDs and [8 16 24] HOA switches with status LEDs, for auxiliary control functions. These are intended for use by the Fire Department during an event or by authorized personnel during testing periods. Keypad entered commands for these functions shall not be an acceptable substitute.
- I. System Power Supplies: Integral system power supplies shall provide 24VDC operating and emergency power to each system panel (18 amps minimum). It is the design intent that all system power supplies be derived from network panels, and each power supply module shall have dedicated NAC outputs and a charging circuit that will support up to 110AH batteries. Field-located addressable NAC modules or remote auxiliary power supplies will not be allowed, except where specifically shown on the contract drawings. The following system power supply analog values shall be available for viewing through the primary operator interface display:
 - 1. Battery voltage
 - 2. Battery charger voltage and current draw

3. Main output voltage and current draw
4. Individual NAC current draw
- J. Voice Communications Control: Provide complete analog voice communication control capabilities to include the necessary Audio Controller Board, one-way paging microphone integral to the network panel at the designated Fire Command location(s). The Audio Control Board will provide pre-amplification of evacuation tones and voice messages as well as routing of audio signals to the appropriate audio output circuits. Voice communications shall consist of a paging microphone, dual channel audio amplifiers and audio control select switches for selective paging on a per floor/zone and All Call basis.
- K. Audio Control/Amplifiers: Provide power-limited audio amplifiers to provide 35, 50 or 100 watts of 70Vrms audio power to voice evacuation circuits. Each amplifier module shall provide three on-board audio NAC outputs, with a default temporal code 3 tone generator and automatic backup in the event of a channel input failure. Provide a one-to-one backup amplifier for each primary amplifier. Provide a minimum of 6 audio and six NAC circuits at each panel shown on drawings.
- L. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
 1. Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
 2. Programmable tone and message sequence selection.
 3. Standard digitally recorded messages for "Evacuation" and "All Clear."
 4. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.
- M. Digital Alarm Communicator/Transmitter (DAC/T): An integral serial DAC/T shall be provided for point reporting of system events to a Central Monitoring Station.

2.4 REMOTE ANNUNCIATOR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Autocall
- C. General Characteristics
- D. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, speaker circuit selection and testing.
- E. Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.5 INTELLIGENT SYSTEM DEVICES

- A. Intelligent System Devices: Provide intelligent analog devices where shown and required. All devices shall utilize red LED indicator which will flash to denote normal active communication and light steadily to denote an alarm condition. Devices shall be interchangeable with twist-lock bases, which will support a remote LED output, fault isolation circuitry, auxiliary relay contact, or a sounder base with integral programmable piezo horn. Devices shall support physical address setting integral to the device base. Devices which require special programming tools to set operating parameters or extract device history data will not be allowed.
 1. Multi-sensing Smoke Detector: Provide multi-sensing analog smoke detectors where shown and required. Multi-sensing detectors shall employ photoelectric and thermal sensing principles and shall be capable of being programmed to operate in a distinct fashion depending upon whether the thermal or photoelectric

- element has responded.
2. Photoelectric Smoke Detector: Provide analog photoelectric smoke detectors where shown and required.
 3. Analog Heat Detectors: Provide Analog Heat Detectors. Analog heat detectors shall be field selectable for a fixed temperature rating of 135 or 155 degrees, or a rate of rise operation of 15 or 20 degrees/minute operation. Heat Detectors shall also be programmable for low temperature warning. Where otherwise required, provide conventional fixed temperature or weatherproof heat detectors in lieu of analog heat detectors. Conventional devices shall be individually addressable via an intelligent addressable module which shall be installed in a heated, ventilated location.
 4. Analog Duct Smoke Detector: Provide analog photoelectric duct-mounted smoke detectors mounted in air ducts where shown and required. Each detector shall be supplied with duct-mount housing, remote indicator/test station and sampling tubes sized according to duct width. Provide the required programmable auxiliary relay outputs or addressable relay control modules with each detector in order to accomplish the required HVAC control and override functions.
 5. Manual Pull Stations: Provide addressable manual stations where shown. The station shall be double action type with screw terminals, toggle switch, and integral addressable electronics. The station shall be constructed of red Lexan with white raised letters and a key reset switch. The station shall be keyed alike to the FACP. Where ambient conditions preclude the use of addressable devices, conventional weatherproof pull stations shall be used. Conventional devices shall be individually addressable via an intelligent addressable module which shall be installed in an appropriately heated, ventilated location.
 6. Monitor Module: Provide Individual Addressable Modules for supervised input points to monitor related systems or integrate conventional initiating devices onto the IDNET addressable loop.
 7. Control Module: Provide Relay Individual Addressable Modules (Relay IAM) to provide supervised outputs and control conventional devices (indicating circuits, AHUs, door holders, etc.) via the IDNET addressable loop. RIAMs shall provide a supervised output rated for 2 amps @ 24VDC or .5 amps at 120VAC, and corresponding supervised contact input point.
 8. Isolation Modules: Provide Zone Addressable Isolator Modules to protect signaling line circuit integrity in the event of a wiring fault, to ensure Style 6 wiring conventions. Provide a minimum of one isolation module per floor or evacuation zone, or one per 25 devices; whichever is greater.

2.6 ADDRESSABLE NOTIFICATION APPLIANCES (SPEAKER/STROBES)

- A. Monitoring: The FACU shall monitor individual addressable notification appliances for status, condition, type of appliance, and configured appliance settings. A fault in any individual appliance shall automatically report a trouble condition on the FACU. Paging zones shall be programmable from the FACP and shall not be reliant on circuit wiring. There shall be no limit to the quantity and configuration of paging zones.
- B. Individual Appliance Custom Label: Each addressable appliance shall have its own 40-character custom label to identify the location of the appliance and to aid in troubleshooting fault conditions.
- C. Individual Appliance Information Display:
- D. The FACU shall be capable of calling up detailed information for each addressable appliance including the appliance location, status, condition, type of appliance, and configured appliance settings.
 1. Notification appliances that are not capable of communicating and reporting their individual location, status, condition, type of appliance, and configured appliance

- settings to the FACU shall not be accepted.
2. Programmable Appliance Settings:
- E. The selectable operation of each addressable notification appliance shall be capable of being configured by the FACU without having to replace or remove the appliance from the wall or ceiling.
 - F. Programmable appliance settings for applicable addressable notification appliances shall include:
 - 1) Operation:
 - a) General Evac
 - b) Alert
 - c) User Defined
 - 2) Style:
 - a) Indoor
 - b) UL Weatherproof
 - 3) Candela Selections:
 - a) Indoor: 15, 30, 75, 110, 135, or 185 cd (per UL1971)
 - b) UL Weatherproof: 15 or 75 cd (per UL1971), and 75 or 185 cd (per UL1638)
 - b. Systems that require replacement or removal of the appliances from the wall or ceiling to change their applicable operation or settings shall include changes at no additional cost for the entire warranty period
 - G. Programmable Notification Zones:
 - H. Changing the notification zone assigned to a notification appliance shall be configurable by the FACU and shall not require additional circuits or wiring.
 - I. Systems that require additional circuits and wiring to change the notification zone assigned to a notification appliance shall be considered unacceptable.
 - J. Addressable Notification Appliance Automated Self-Test:
 - K. The fire alarm control unit shall be capable of performing an automated functional self-test of all self-test notification appliances and meet the requirements in NFPA 72, 2013 Edition, 14.2.8 Automated Testing and Table 14.4.3.2 testing requirements.
 - a. Test results for each self-test notification appliance shall be stored in non-volatile memory at the fire alarm control unit.
 - b. The fire alarm control unit shall be capable of running a functional automated test for all self-test notification appliances in a general alarm group or for all self-test appliances within a specific notification zone.
 - c. The duration required to complete the automated functional test for all self-test notification appliances shall be accomplished in 2 minutes or less.
 - d. The automated test results for all self-test notification appliances shall be available from the fire alarm control unit within 4 minutes from the start of the test.
 - e. If any notification appliance fails its automated functional self-test an audible and visual trouble signal shall be annunciated at the fire alarm control unit.
 - f. The self-test trouble signal shall be a latching trouble signal which requires manual restoration to normal.
 - L. Addressable Notification Appliance Reports:
 - M. The fire alarm control unit shall maintain configuration and test data for each self-test addressable notification appliance.
 - N. The fire alarm control unit shall be capable of generating configuration, self-test, and deficiency reports, that can be viewed through the fire alarm control unit user interface or printed via the fire alarm control unit service port.
 - O. At minimum, the configuration report shall include the following information applicable for each addressable notification appliance:

- a. Point ID
 - b. Custom Label
 - c. Device Type
 - d. Candela Setting
 - e. Network Synchronization of Notification Appliances
- P. The fire alarm and emergency communications network shall be capable of providing UL Listed synchronization across all the notification appliance circuits for all panels on a network loop in accordance with the requirements of UL 1971.
- Q. Systems that require all notification appliances to be connected to a single panel for synchronization thus creating a potential single point of failure shall not be acceptable.
- R. Up to 99 panels on a network loop shall be capable of UL Listed synchronization of all notification appliance circuits across the network loop in accordance with the requirements of UL 1971.
- S. Should network communications be disrupted, re-synchronization shall occur across all nodes that continue to communicate together after network re-initialization is completed and restored to affected nodes.
- T. Addressable Speaker: Addressable Speaker notification appliances shall be listed to UL 1480. Individual device level supervision and activation control shall be provided by the fire alarm control unit.
- U. Speakers shall be individually powered, addressed, and controlled from a compatible fire alarm control unit Signaling Line Circuit (SLC) using Unshielded Twisted Pair (UTP) cable
- V. Speakers shall provide for Fire Alarm and General Signaling functionality in a single unit, eliminating additional devices. Device "Self-Test" shall be supported by a compatible fire alarm control unit and shall be UL listed and NFPA 72 compliant. Speakers shall be UL listed to provide a 520Hz audio tone in compliance with NFPA 72 for sleeping areas.
- W. The speaker audio shall be provided by a standard 25VRMS or 70.7VRMS audio circuit using Unshielded Twisted Pair (UTP) cable and T-taps shall be allowed for Class B installation reducing wiring costs and wiring distances.
- X. Speaker power taps shall be at a minimum of 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker shall have a minimum UL rated sound pressure level of 86dBA at 10 feet for the Standard Output version and 84dBA at 10 feet for the High Fidelity version.
- Y. Speakers shall be available in either "Standard Output" with a minimum frequency response of 400 to 4000 Hz or in "High Fidelity Output" with a minimum frequency response of 200 to 10,000 Hz. Standard Output speakers shall use a multi-tapped speaker for audio/tone notification.
- Z. Wall mount appliances shall be available in White and Red and ceiling mount appliances shall be available in White, Red, and Black. Labeling shall be available as either "FIRE", "ALERT" or no labeling.
- AA. The speaker shall install directly to a 4" square, 2 1/8" deep electrical box. Extensions for these boxes shall not be required.
- BB. Addressable Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker shall operate on a 25VRMS or 70.7VRMS NAC.
- CC. Operational functions and features of Addressable Speaker above shall apply to this section. Operational functions and features of Addressable Strobe above shall apply to this section.
- DD. Wall mount appliances shall be available in White and Red and ceiling mount appliances shall be available in White, Red, and Black. Labeling shall be available as either "FIRE", "ALERT" or no labeling.
- EE. The speaker shall install directly to a 4" square, 2 1/8" deep electrical box. Extensions for these boxes shall not be required. Units shall be modular in design to allow for easy installation and for easy changing of device color and labeling

2.7 MUNICIPAL MASTER BOX

- A. Provide new Radio Master Box per the local Fire Department requirements (SIGCOM, DTX Series Long Range Radio Alarm Transceiver).
- B. Provide DACT to transmit supervisory signals to the owner's security system's supervising station.

2.8 WIRE AND CABLE

- A. Signaling Line Circuits – Annunciator Data (RUI): Twisted pair, not less than No. 18 AWG or as recommended by the manufacturer.
- B. Signaling Line Circuits – Intelligent Loop (IDNET): Unshielded Twisted pair, not less than No. 16 AWG or as recommended by the manufacturer.
- C. Circuit Integrity Cable: Provide as required to meet NFPA or Local Code requirements. CI Cable shall meet National Electrical Code, power limited fire alarm service.
- D. Addressable Notification Appliance Circuits (IDNAC): No. 12 or 14 AWG Unshielded Twisted Pair, THHN or FPLP as recommended by the manufacturer. Cable must have a capacitive rating of less than 60pf/ft with 3 twists per foot.
- E. Existing wiring may be reused as long as it is in good shape, free of electrical noise, and meets the requirements of National Electrical Code and local AHJ.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA72 and RI Fire Safety Code for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
- C. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to NFPA 72.
 - 5. HVAC: Locate smoke detectors not closer than 3 feet from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA72 and NFPA90A. Install sampling tubes so they extend the full width of duct.
- E. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- F. Notification Appliance Devices: Install bottom of strobe 80 inches above finished floor.
- G. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- H. Annunciator: Install with top of panel not more than 56 inches above the finished floor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 8 Section "Door Hardware."
 - 1. Connect hardware and devices to fire-alarm system.
 - 2. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to activate emergency lighting control.
 - 3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 4. Supervisory connections at valve supervisory switches.
 - 5. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
- 3.3 IDENTIFICATION
 - A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."
- 3.4 GROUNDING
 - A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- 3.5 FIELD QUALITY CONTROL
 - A. Field tests shall be witnessed by Architect, Engineer and authorities having jurisdiction.
 - B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
 - C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - D. Tests and Inspections:
 - 1. Visual Inspection:
 - E. Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - F. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 1. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.
 - 2. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.4
 - 3. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 4. Test visible appliances for the public operating mode according to manufacturer's written instructions. 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.
 - G. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
 - H. Fire-alarm system will be considered defective if it does not pass tests and inspections.

- I. Prepare test and inspection reports.
- J. Maintenance Test and Inspection: Include, as part of this Contract, the four quarterly tests following the final acceptance test. Provide quarterly testing in conformance with the latest codes, latest edition Annual Test and Inspection: During the warranty period, each year test fire-alarm system complying with visual and testing inspection requirements in NFPA72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 31 11

SECTION 28 31 11

FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including AIA A201 and Division 1 Specification Sections, apply to this Section.
- B. This specification is being reviewed by a fire alarm vendor. The intent is to provide a fire alarm system with voice evacuation as indicated on the drawings. This specification will be revised.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Smoke/carbon monoxide detectors.
 - 5. Heat detectors.
 - 6. Addressable Notification appliances.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Radio Master Box.

1.3 SYSTEM DESCRIPTION

- A. Non-coded, UL Listed intelligent analog addressable fire alarm system with multiplexed signal transmission.
- B. The complete system shall be as manufactured by Autocall. (Contact: NSG Life Safety, 865 Waterman Avenue, East Providence, RI. Tel. 774-338-1839). Approved manufacturers are Edwards and Notifier.
- C. The System supplied under this specification utilizes independently addressed, input/output modules, power supply(s) as described in this specification. The system contains fire alarm control panels, remote annunciator(s), Remote Transponder(s) and Addressable Notification Appliances. Alternate systems shall support all self-testing operations specified herein (no exceptions).

1.4 SUBMITTALS

- A. The Contractor shall purchase no equipment for the system specified herein until the engineer has approved the project submittals in their entirety and has returned them to the contractor. It is the responsibility of the contractor to meet the entire intent and functional performance detailed in these specifications. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications.
- B. Each submittal shall include a cover letter providing a list of each variation that the submittal may have from the requirements of the Contract Documents. In addition, the Contractor shall provide specific notation on each Shop Drawing, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Architect.
 - 2. Shop Drawings shall be prepared by persons with the following qualifications: a. Trained and certified by manufacturer in fire-alarm system design and be NICET III certified. Submittals shall be reviewed, signed and dated by a NICET IV.

- C. Product Data: Product Data sheets with the printed logo or trademark of the manufacturer of all equipment. Indicated in the documentation shall be the type, size, rating, style, and catalog number for all items proposed to meet the system performance detailed in this specification. The proposed equipment shall be subject to the approval of the Owner.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
- E. Operation and Maintenance Data: For fire-alarm systems and components to be included in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data, include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.
 - 2. Provide "Record of Completion Documents" according to NFPA72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 - 3. Record copy of site-specific software database file, hardcopy print-out and CD, with password for delivery to the owner.
 - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA72 article of the same name and include the following:
 - 5. Manufacturer's required maintenance related to system warranty requirements.
 - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 - 7. Copy of NFPA72.
- F. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application.
 - 5. CD of site-specific software database file with password, and electronic product data sheets. Provide hard copy print-out of the software program. Provide a complete system comparison report for each change implemented during the warranty period.
 - 6. Provide a list of global system settings
 - 7. Provide a list of the contents of each system cabinet and their settings
 - 8. Provide a list of all addressable devices with their addresses and settings

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, by a qualified testing agency, and marked for intended location and application.

1.6 WARRANTY AND SOFTWARE SERVICE AGREEMENT

- A. The contractor shall warranty all materials, installation and workmanship for one (1) year from date of acceptance, unless otherwise specified. A copy of the manufacturers' warranty shall be provided with closeout documentation and included with the operation and installation manuals.
- B. The System Supplier shall maintain a service organization with adequate spare parts stocked within 50 miles of the installation.
- C. Detector Sensitivity Testing: During the warranty period, each year the contractor is to perform detector sensitivity testing and provide report to the Owner. Unless, the system is UL Listed to perform automatic sensitivity testing without any manual intervention and should detector fall outside of sensitivity window, the system will automatically indicate a device trouble. A copy of UL letter is to be provided as proof of system operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling fire alarm system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- B. The Contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these Specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.
- C. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building Owner. All specified operational features must be met without exception.
- D. All control panel assemblies and connected (new) field appliances shall be provided by the same System Supplier, and shall be designed and tested to ensure that the system operates as specified. All equipment and components shall be installed in strict compliance with the manufacturer's recommendations.
- E. Upon completion of the project the Owner shall be provided with a hard copy printout of the system software database and an electronic version of the system program and database with all required passwords.
- F. That equipment proposed to be supplied will be considered only if it meets all sections of the performance specification. Any deviations of system performance outlined in this specification will only be considered when the following requirements have been met:
 - 1. A complete description of proposed alternate system performance methods with three (3) copies of working drawings thereof for approval by the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.
 - 2. The supplier of alternate equipment shall furnish evidence that the proposed alternate system performance is equal to or superior than the system operation stated in the specification. Such evidence shall be submitted to the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.
 - 3. The supplier shall submit a point-by-point statement of compliance for all sections in this specification. The statement of compliance shall consist of a list of all paragraphs within these sections. Where the proposed system complies fully with the paragraph as written, placing the word "comply" opposite the paragraph number shall indicate such. Where the proposed system does not comply with the paragraph as written, and the supplier feels the proposed system will accomplish the intent of the paragraph, a full description of the function as

well as a full narrative description of how its proposal will meet its intent shall be provided. Any submission that does not include a point-by-point statement of compliance as described herein shall be disqualified. Where a full description is not provided, it shall be assumed that the proposed system does not comply.

4. The supplier of alternate equipment shall submit a list from the alternate manufacture on the manufacture's letterhead indicating the names and addresses of all authorized suppliers in the area.
 5. The acceptability of any alternate proposed system shall be the sole decision of the Owner or his authorized representative.
- G. Approved Products: All panels and peripheral devices shall be of the standard product of single manufacturer and shall display the manufacturer's name of each component.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors without sounder bases.
 4. Automatic sprinkler system water flow.
 5. Fire standpipe system.
 6. Duct smoke detectors.
- B. Fire-alarm signal shall initiate the following actions:
1. Selectively Activate the audible and visual notification appliance or appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 7. Activate emergency shutoffs for gas and fuel supplies.
 8. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Low-air-pressure switch of a dry-pipe sprinkler system.
 3. Elevator shunt-trip supervision.
 4. Duct smoke detectors (shutdown local fan).
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
 10. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system.

- E. System Trouble and Supervisory Signal Actions: Annunciate at fire-alarm control unit and remote annunciators.

2.3 FIRE-ALARM CONTROL UNIT (FACU)

- A. Provide and install Autocall 4100ES series Fire Alarm Control System. The system shall consist of the required Fire Alarm control or transponder panels, each sized to support 500 analog detectors, expandable to 2500. The system shall support peer-to-peer network communications consisting of up to 99 nodes. Each network panel shall provide the following functions:
 - B. Monitor all initiating devices, report the event to the fire alarm network [and Security Management System (SMS)], annunciate the alarmed device and its location, conduct smoke control functions, and initiate the audio/visual evacuation signaling and control sequences as described herein.
 - C. Conduct off-site or municipal reporting as described herein.
 - D. Initiating devices shall respond with their condition. Control relays shall be individually addressable by the system to respond automatically in the event of an alarm of related sensors. Manual override of control relays shall be individually addressable by the operator.
- E. Control Configuration: All fire alarm control portions of the system shall be housed in red locking, semi flush mounted enclosures. All panel initiating and control status indicators shall be visible through a clear Lexan window. Access to the control panel shall be by keys issued to the Fire Department and authorized personnel. Each panel shall incorporate an operator interface, CPU, addressable loop interface cards, audio control/microphone, amplifiers, power supply and batteries to perform the system operation as described herein.
- F. Primary Operator Control: The FACP shall provide an operator interface module consisting of an 80 character backlit LCD display to present all system alarm, trouble and supervisory conditions, and shall provide control switches for status message scrolling, event acknowledgment, System Reset and Alarm Silence, as well as program function switches, 3 programmable status LEDs and 5 additional user-programmable function switches. The display shall have LEDs to indicate Power On, Fire Alarm, Priority 2 Alarm, Supervisory, Trouble and Alarm Silenced status.
- G. Addressable Loop Interface: Provide an IDNET addressable loop interface card for each addressable signaling line circuit. Each card shall support four isolated circuit loops (quad isolator) and digital communications with up to 250 addressable field detectors, and total wiring distances up to 10,000 ft.
- H. Auxiliary Control / Annunciation: Provide the required auxiliary switch and LED modules for discreet LED annunciation, zone disconnect, HVAC override, or related monitoring and control functions integral to the primary FACP. As a minimum, provide [16 32 64] discreet, programmable auxiliary switches with corresponding status LEDs and [8 16 24] HOA switches with status LEDs, for auxiliary control functions. These are intended for use by the Fire Department during an event or by authorized personnel during testing periods. Keypad entered commands for these functions shall not be an acceptable substitute.
- I. System Power Supplies: Integral system power supplies shall provide 24VDC operating and emergency power to each system panel (18 amps minimum). It is the design intent that all system power supplies be derived from network panels, and each power supply module shall have dedicated NAC outputs and a charging circuit that will support up to 110AH batteries. Field-located addressable NAC modules or remote auxiliary power supplies will not be allowed, except where specifically shown on the contract drawings. The following system power supply analog values shall be available for viewing through the primary operator interface display:
 - 1. Battery voltage
 - 2. Battery charger voltage and current draw

3. Main output voltage and current draw
4. Individual NAC current draw
- J. Voice Communications Control: Provide complete analog voice communication control capabilities to include the necessary Audio Controller Board, one-way paging microphone integral to the network panel at the designated Fire Command location(s). The Audio Control Board will provide pre-amplification of evacuation tones and voice messages as well as routing of audio signals to the appropriate audio output circuits. Voice communications shall consist of a paging microphone, dual channel audio amplifiers and audio control select switches for selective paging on a per floor/zone and All Call basis.
- K. Audio Control/Amplifiers: Provide power-limited audio amplifiers to provide 35, 50 or 100 watts of 70Vrms audio power to voice evacuation circuits. Each amplifier module shall provide three on-board audio NAC outputs, with a default temporal code 3 tone generator and automatic backup in the event of a channel input failure. Provide a one-to-one backup amplifier for each primary amplifier. Provide a minimum of 6 audio and six NAC circuits at each panel shown on drawings.
- L. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
 1. Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
 2. Programmable tone and message sequence selection.
 3. Standard digitally recorded messages for "Evacuation" and "All Clear."
 4. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.
- M. Digital Alarm Communicator/Transmitter (DAC/T): An integral serial DAC/T shall be provided for point reporting of system events to a Central Monitoring Station.

2.4 REMOTE ANNUNCIATOR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Autocall
- C. General Characteristics
- D. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, speaker circuit selection and testing.
- E. Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.5 INTELLIGENT SYSTEM DEVICES

- A. Intelligent System Devices: Provide intelligent analog devices where shown and required. All devices shall utilize red LED indicator which will flash to denote normal active communication and light steadily to denote an alarm condition. Devices shall be interchangeable with twist-lock bases, which will support a remote LED output, fault isolation circuitry, auxiliary relay contact, or a sounder base with integral programmable piezo horn. Devices shall support physical address setting integral to the device base. Devices which require special programming tools to set operating parameters or extract device history data will not be allowed.
 1. Multi-sensing Smoke Detector: Provide multi-sensing analog smoke detectors where shown and required. Multi-sensing detectors shall employ photoelectric and thermal sensing principles and shall be capable of being programmed to operate in a distinct fashion depending upon whether the thermal or photoelectric

- element has responded.
2. Photoelectric Smoke Detector: Provide analog photoelectric smoke detectors where shown and required.
 3. Analog Heat Detectors: Provide Analog Heat Detectors. Analog heat detectors shall be field selectable for a fixed temperature rating of 135 or 155 degrees, or a rate of rise operation of 15 or 20 degrees/minute operation. Heat Detectors shall also be programmable for low temperature warning. Where otherwise required, provide conventional fixed temperature or weatherproof heat detectors in lieu of analog heat detectors. Conventional devices shall be individually addressable via an intelligent addressable module which shall be installed in a heated, ventilated location.
 4. Analog Duct Smoke Detector: Provide analog photoelectric duct-mounted smoke detectors mounted in air ducts where shown and required. Each detector shall be supplied with duct-mount housing, remote indicator/test station and sampling tubes sized according to duct width. Provide the required programmable auxiliary relay outputs or addressable relay control modules with each detector in order to accomplish the required HVAC control and override functions.
 5. Manual Pull Stations: Provide addressable manual stations where shown. The station shall be double action type with screw terminals, toggle switch, and integral addressable electronics. The station shall be constructed of red Lexan with white raised letters and a key reset switch. The station shall be keyed alike to the FACP. Where ambient conditions preclude the use of addressable devices, conventional weatherproof pull stations shall be used. Conventional devices shall be individually addressable via an intelligent addressable module which shall be installed in an appropriately heated, ventilated location.
 6. Monitor Module: Provide Individual Addressable Modules for supervised input points to monitor related systems or integrate conventional initiating devices onto the IDNET addressable loop.
 7. Control Module: Provide Relay Individual Addressable Modules (Relay IAM) to provide supervised outputs and control conventional devices (indicating circuits, AHUs, door holders, etc.) via the IDNET addressable loop. RIAMs shall provide a supervised output rated for 2 amps @ 24VDC or .5 amps at 120VAC, and corresponding supervised contact input point.
 8. Isolation Modules: Provide Zone Addressable Isolator Modules to protect signaling line circuit integrity in the event of a wiring fault, to ensure Style 6 wiring conventions. Provide a minimum of one isolation module per floor or evacuation zone, or one per 25 devices; whichever is greater.

2.6 ADDRESSABLE NOTIFICATION APPLIANCES (SPEAKER/STROBES)

- A. Monitoring: The FACU shall monitor individual addressable notification appliances for status, condition, type of appliance, and configured appliance settings. A fault in any individual appliance shall automatically report a trouble condition on the FACU. Paging zones shall be programmable from the FACP and shall not be reliant on circuit wiring. There shall be no limit to the quantity and configuration of paging zones.
- B. Individual Appliance Custom Label: Each addressable appliance shall have its own 40-character custom label to identify the location of the appliance and to aid in troubleshooting fault conditions.
- C. Individual Appliance Information Display:
- D. The FACU shall be capable of calling up detailed information for each addressable appliance including the appliance location, status, condition, type of appliance, and configured appliance settings.
 1. Notification appliances that are not capable of communicating and reporting their individual location, status, condition, type of appliance, and configured appliance

- settings to the FACU shall not be accepted.
2. Programmable Appliance Settings:
- E. The selectable operation of each addressable notification appliance shall be capable of being configured by the FACU without having to replace or remove the appliance from the wall or ceiling.
- F. Programmable appliance settings for applicable addressable notification appliances shall include:
- 1) Operation:
 - a) General Evac
 - b) Alert
 - c) User Defined
 - 2) Style:
 - a) Indoor
 - b) UL Weatherproof
 - 3) Candela Selections:
 - a) Indoor: 15, 30, 75, 110, 135, or 185 cd (per UL1971)
 - b) UL Weatherproof: 15 or 75 cd (per UL1971), and 75 or 185 cd (per UL1638)
- b. Systems that require replacement or removal of the appliances from the wall or ceiling to change their applicable operation or settings shall include changes at no additional cost for the entire warranty period
- G. Programmable Notification Zones:
- H. Changing the notification zone assigned to a notification appliance shall be configurable by the FACU and shall not require additional circuits or wiring.
- I. Systems that require additional circuits and wiring to change the notification zone assigned to a notification appliance shall be considered unacceptable.
- J. Addressable Notification Appliance Automated Self-Test:
- K. The fire alarm control unit shall be capable of performing an automated functional self-test of all self-test notification appliances and meet the requirements in NFPA 72, 2013 Edition, 14.2.8 Automated Testing and Table 14.4.3.2 testing requirements.
- a. Test results for each self-test notification appliance shall be stored in non-volatile memory at the fire alarm control unit.
 - b. The fire alarm control unit shall be capable of running a functional automated test for all self-test notification appliances in a general alarm group or for all self-test appliances within a specific notification zone.
 - c. The duration required to complete the automated functional test for all self-test notification appliances shall be accomplished in 2 minutes or less.
 - d. The automated test results for all self-test notification appliances shall be available from the fire alarm control unit within 4 minutes from the start of the test.
 - e. If any notification appliance fails its automated functional self-test an audible and visual trouble signal shall be annunciated at the fire alarm control unit.
 - f. The self-test trouble signal shall be a latching trouble signal which requires manual restoration to normal.
- L. Addressable Notification Appliance Reports:
- M. The fire alarm control unit shall maintain configuration and test data for each self-test addressable notification appliance.
- N. The fire alarm control unit shall be capable of generating configuration, self-test, and deficiency reports, that can be viewed through the fire alarm control unit user interface or printed via the fire alarm control unit service port.
- O. At minimum, the configuration report shall include the following information applicable for each addressable notification appliance:

- a. Point ID
 - b. Custom Label
 - c. Device Type
 - d. Candela Setting
 - e. Network Synchronization of Notification Appliances
- P. The fire alarm and emergency communications network shall be capable of providing UL Listed synchronization across all the notification appliance circuits for all panels on a network loop in accordance with the requirements of UL 1971.
- Q. Systems that require all notification appliances to be connected to a single panel for synchronization thus creating a potential single point of failure shall not be acceptable.
- R. Up to 99 panels on a network loop shall be capable of UL Listed synchronization of all notification appliance circuits across the network loop in accordance with the requirements of UL 1971.
- S. Should network communications be disrupted, re-synchronization shall occur across all nodes that continue to communicate together after network re-initialization is completed and restored to affected nodes.
- T. Addressable Speaker: Addressable Speaker notification appliances shall be listed to UL 1480. Individual device level supervision and activation control shall be provided by the fire alarm control unit.
- U. Speakers shall be individually powered, addressed, and controlled from a compatible fire alarm control unit Signaling Line Circuit (SLC) using Unshielded Twisted Pair (UTP) cable
- V. Speakers shall provide for Fire Alarm and General Signaling functionality in a single unit, eliminating additional devices. Device "Self-Test" shall be supported by a compatible fire alarm control unit and shall be UL listed and NFPA 72 compliant. Speakers shall be UL listed to provide a 520Hz audio tone in compliance with NFPA 72 for sleeping areas.
- W. The speaker audio shall be provided by a standard 25VRMS or 70.7VRMS audio circuit using Unshielded Twisted Pair (UTP) cable and T-taps shall be allowed for Class B installation reducing wiring costs and wiring distances.
- X. Speaker power taps shall be at a minimum of 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker shall have a minimum UL rated sound pressure level of 86dBA at 10 feet for the Standard Output version and 84dBA at 10 feet for the High Fidelity version.
- Y. Speakers shall be available in either "Standard Output" with a minimum frequency response of 400 to 4000 Hz or in "High Fidelity Output" with a minimum frequency response of 200 to 10,000 Hz. Standard Output speakers shall use a multi-tapped speaker for audio/tone notification.
- Z. Wall mount appliances shall be available in White and Red and ceiling mount appliances shall be available in White, Red, and Black. Labeling shall be available as either "FIRE", "ALERT" or no labeling.
- AA. The speaker shall install directly to a 4" square, 2 1/8" deep electrical box. Extensions for these boxes shall not be required.
- BB. Addressable Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker shall operate on a 25VRMS or 70.7VRMS NAC.
- CC. Operational functions and features of Addressable Speaker above shall apply to this section. Operational functions and features of Addressable Strobe above shall apply to this section.
- DD. Wall mount appliances shall be available in White and Red and ceiling mount appliances shall be available in White, Red, and Black. Labeling shall be available as either "FIRE", "ALERT" or no labeling.
- EE. The speaker shall install directly to a 4" square, 2 1/8" deep electrical box. Extensions for these boxes shall not be required. Units shall be modular in design to allow for easy installation and for easy changing of device color and labeling

2.7 MUNICIPAL MASTER BOX

- A. Provide new Radio Master Box per the local Fire Department requirements (SIGCOM, DTX Series Long Range Radio Alarm Transceiver).
- B. Provide DACT to transmit supervisory signals to the owner's security system's supervising station.

2.8 WIRE AND CABLE

- A. Signaling Line Circuits – Annunciator Data (RUI): Twisted pair, not less than No. 18 AWG or as recommended by the manufacturer.
- B. Signaling Line Circuits – Intelligent Loop (IDNET): Unshielded Twisted pair, not less than No. 16 AWG or as recommended by the manufacturer.
- C. Circuit Integrity Cable: Provide as required to meet NFPA or Local Code requirements. CI Cable shall meet National Electrical Code, power limited fire alarm service.
- D. Addressable Notification Appliance Circuits (IDNAC): No. 12 or 14 AWG Unshielded Twisted Pair, THHN or FPLP as recommended by the manufacturer. Cable must have a capacitive rating of less than 60pf/ft with 3 twists per foot.
- E. Existing wiring may be reused as long as it is in good shape, free of electrical noise, and meets the requirements of National Electrical Code and local AHJ.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA72 and RI Fire Safety Code for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
- C. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to NFPA 72.
 - 5. HVAC: Locate smoke detectors not closer than 3 feet from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA72 and NFPA90A. Install sampling tubes so they extend the full width of duct.
- E. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- F. Notification Appliance Devices: Install bottom of strobe 80 inches above finished floor.
- G. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- H. Annunciator: Install with top of panel not more than 56 inches above the finished floor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 8 Section "Door Hardware."
 - 1. Connect hardware and devices to fire-alarm system.
 - 2. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to activate emergency lighting control.
 - 3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 4. Supervisory connections at valve supervisory switches.
 - 5. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
- 3.3 IDENTIFICATION
 - A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."
- 3.4 GROUNDING
 - A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- 3.5 FIELD QUALITY CONTROL
 - A. Field tests shall be witnessed by Architect, Engineer and authorities having jurisdiction.
 - B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
 - C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - D. Tests and Inspections:
 - 1. Visual Inspection:
 - E. Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - F. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 1. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.
 - 2. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.4
 - 3. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 4. Test visible appliances for the public operating mode according to manufacturer's written instructions. 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.
 - G. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
 - H. Fire-alarm system will be considered defective if it does not pass tests and inspections.

- I. Prepare test and inspection reports.
- J. Maintenance Test and Inspection: Include, as part of this Contract, the four quarterly tests following the final acceptance test. Provide quarterly testing in conformance with the latest codes, latest edition Annual Test and Inspection: During the warranty period, each year test fire-alarm system complying with visual and testing inspection requirements in NFPA72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 31 11

SECTION 310000

EARTHWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.
- C. "Geotechnical Design Basis Report" for the New Community Center in East Providence prepared by Pare Corporation, Inc. of Foxboro, MA dated September 2024.

1.03 SUMMARY

- A. This Section includes all excavation including, but not limited to, the following:
 - 1. Excavating and backfilling for demolition of buildings and structures.
 - 2. Excavating and backfilling for utility trenches.
 - 3. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
 - 4. Bioretention areas.
 - 5. Geotextiles.
- B. Related Sections include:
 - 1. Section 315000 Excavation Support and Protection
 - 2. Section 312319 Dewatering

1.04 SUBMITTALS

- A. Geotextiles:
 - 1. Technical properties including but not limited to tensile strength, puncture strength, mullen burst, elongation, equivalent opening, permittivity, and water flow rate.
 - 2. Provide a 12-by-12-inch sample of geotextiles and the manufacturer's recommended installation procedure.
- B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with the following requirements indicated:
 - 1. Gradation Test Results for each on-site and imported soil material proposed for fill and backfill.
 - 2. Laboratory compaction curve according to ASTM D6938 and ASTM D1557 for each on-site and imported soil material proposed for fill and backfill.
 - 3. Each submittal shall include the intended use for the material with the appropriate specification section and material name corresponding to the Contract Documents to facilitate review.
 - 4. Bioretention Area soil mix organic content and PH levels.

- C. Copies of permits obtained for excavations that are required by state and local governing authorities and local utility companies shall be submitted to the owner's representative.

1.05 SITE INFORMATION

- A. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.
- B. Plans, surveys, measurements and dimensions, under which the work is to be performed, are believed to be correct to the best of the Engineer's knowledge, but the Contractor shall have examined them for himself during the bidding period, as no allowance will be made for any errors or inaccuracies that may be found herein.
- C. Data on indicated subsurface conditions are not intended as representations or warrants of continuity of such conditions between soil borings. It is expressly understood that the Owner and Engineer will not be responsible for interpretations or conclusions drawn therefrom by the Contractor.
- D. The Contractor may request to perform additional test borings and other explorations at no cost to the Owner.
- E. Soil borings and test pits have been made by qualified Contractors prior to this Contract. This information shall be made available to bidders as specified under other Sections. The Contractor is responsible for employing qualified personnel capable of interpreting geotechnical information, test pit logs, and boring logs. The results of these subsurface explorations and recommendations for work were prepared by the Engineer, consulting geotechnical engineers, and are hereby attached to this specification for information only. Procedures for dewatering, areas to receive special fill and other methods and procedures specified herein shall be supplemented by this information. For the purposes of this specification, this information will be referred to as the Geotechnical Report. Where procedures within the report vary from procedures as specified herein, this specification shall override. The Geotechnical Report is available as a separate document.
- F. The Geotechnical Report states that rock is present on the site. The costs of additional rock excavation resulting from changes in the work shall be paid for as outlined in the measurement and payment section of this specification.
- G. The Geotechnical Report states that groundwater is present on the site. The Contractor is made aware of this condition and will not be eligible to receive additional compensation for dewatering exceeding the Contractor's initial bid.
- H. The Geotechnical Report states that some of the materials present on site contain quantities of silt beyond the limit deemed acceptable for re-use by this specification. The Contractor is made aware of this condition and will not be eligible to receive additional compensation for imported material exceeding the Contractor's initial bid.
- I. It is the responsibility of the Contractor under this Contract to do the necessary excavation, filling, grading, and rough grading to bring the existing grades to subgrade and parallel to finished grades as specified herein and as shown on the Drawings for this Work. The Contractor shall visit the site prior to submitting a bid to become familiar with the extent of the work to be done under this Contract. The Contractor shall be responsible for determining the quantities of earth materials that must be imported or hauled off the site necessary to complete the work under this Section. All imported earth materials required to construct the project shall be included in the Contractor's base bid.
- J. The Contractor is allowed to re-use excavated On-Site Common Borrow as fill in accordance with this specification. All On-Site Common Borrow used as backfill shall be compacted to

the required percentage of maximum dry density included in the Minimum Compaction Requirements Table below.

1. The Contractor is made aware that On-Site Common Borrow may contain large amounts of silt. Additional efforts required to reuse On-Site Common Borrow are the responsibility of the Contractor and shall result in no additional expense to the Owner or a request for additional time for delays caused by its usage.
 2. The Contractor agrees to use this material at his own risk and is responsible for any additional work required to install this material in accordance with the specifications.
 3. If project delays will result from the additional time required to re-work On-Site Common Borrow, placed as fill in accordance with the specifications, the Contractor shall remove material that does not meet the compaction requirements and provide imported fill meeting the specifications. This imported material shall be provided at no additional expense to the Owner.
 4. Any project delays resulting from additional time required to work this material are the responsibility of the Contractor and shall be made up elsewhere on the project.
- K. The Contractor shall use suitable on-site soils and fill, and soil from off-site sources, as needed. Please note that not all on-site materials will be suitable for reuse, nor will all required material gradations be present on the site. Imported materials are anticipated for this project.
- L. Contractor shall protect and adjust moisture condition of all on-site and imported materials for proper installation, compaction, and use. This includes covering, drying, and adding moisture as required to maintain suitable workability of the soil materials. Please note onsite and imported materials will not necessarily be encountered, or delivered in a suitable condition as environmental factors prevalent at the time of construction will impact soil materials.

1.06 UNIT PRICES

- A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the limits specified in PART 3 – EXECUTION.
- B. Unit prices for rock excavation include all labor, equipment, and materials required for removal of rock and hauling of rock off-site. Unit prices for rock excavation also include all labor, equipment, and materials required for replacement of rock excavation with approved materials where the rock excavation extends beyond the specified excavation limits. Any excavation beyond the specified excavation limits must be approved by the Owner's representative prior to removal. Specified excavation limits for rock are specified in Section 3.04 - ROCK EXCAVATION.

1.07 DEFINITIONS

- A. Backfill: Soil material used for fill and excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subbase course and asphalt paving.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Satisfactory soil for use as fill or backfill.
- E. Boulder: A soil particle with a minimum dimension of 12 inches.
- F. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated on the Drawings.
1. Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner's Representative. Additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 2. Bulk Excavation: Excavation more than 6 feet in width and more than 10 feet in length for the installation of utilities, foundations, and footings.
 3. Trench Excavation: Excavation 6 feet in width or less for the installation of utilities, foundations, and footings
 4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner's Representative. Unauthorized excavation, as well as remedial work directed by Owner's Representative, shall be without additional compensation.
- H. Fill: Soil materials used to raise existing grades.
- I. Imported Material: Material obtained by the Contractor from sources off the site.
- J. Influence Area: The area within planes sloped downward and outward at an angle of 60 degrees from the horizontal from (a) 1 foot outside the outermost edge at the base of foundations or slabs; or (b) 1 foot outside the outermost edge at the surface of roadways or shoulder; or (c) 0.5 foot outside the exterior edge at the spring line of pipes and culverts.
- K. Optimum Moisture Content: Determined by the ASTM standard specified to determine the maximum dry density for relative compaction.
- L. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D1557. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Owner's Representative.
- M. Relative Density: As defined by ASTM D4253 or D4254.
- N. Rock: Material in beds, ledges, unstratified masses, conglomerate deposits that cannot be removed, in the opinion of the Engineer, without systematic drilling, ram hammering, blasting, or ripping. Weathered Rock that can be removed by an excavator without hammering or other mechanical means shall not meet the definition of rock.
- O. Rock also includes boulders of rock material that exceed 2 cu. yd. for bulk excavation or 1 cu. yd. diameter for footing, trench, and pit excavation.
1. Bulk Rock Excavation: Rock encountered within bulk excavation as defined above.
 2. Trench Rock Excavation: Rock encountered within trench excavation as defined above.
- P. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- Q. Subbase Course: Course placed between the subgrade and base course for asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or asphalt walk.
- R. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- S. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel,

and other objects more than 1 inch in diameter; and free of weeds, roots, and toxic and other non-soil materials.

- T. Unsuitable Soils: Existing soils that, in the opinion of the Engineer and Owner's Representative, are unsuitable to remain in their existing location that are deposited outside the excavation limits. This does not include topsoil, subsoil, and silty-sand materials.
 - 1. Anticipated unsuitable soils: Unsuitable soils identified in the geotechnical report, drawings, specifications, test pit logs, or boring logs provided as part of the project manual.
 - 2. Unanticipated unsuitable soils: Unsuitable soils not identified in either the geotechnical report, test pits, or boring logs provided as part of the project manual.
- U. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- V. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes. Well-graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters. Well-graded is used to define a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.08 IMPORTED MATERIAL ACCEPTANCE

- A. All imported earth materials specified in this section are subject to the following requirements:
 - 1. Materials imported to the site by the Contractor for on-site use shall not contain oil and/or hazardous materials.
 - 2. All tests necessary for the Contractor to locate acceptable sources of imported material shall be made by the Contractor. Certification that the material conforms to the Specification requirements along with copies of the test results from a qualified commercial testing laboratory shall be submitted to the Engineer for approval at least 5 calendar days before the material is required for use. All material samples shall be a minimum of 40 pounds and furnished by the Contractor at the Contractor's sole expense. Samples shall be representative and be clearly marked to show the source of the material and the intended use on the project. The sampling of the material source shall be done by the Contractor in accordance with ASTM D75. Tentative acceptance of the material shall be based on an inspection of the source by the Engineer and/or the certified test results submitted by the Contractor to the Engineer at the Engineer's discretion. No imported materials shall be delivered to the site until the proposed source and the Engineer has tentatively accepted materials tests in writing. Final acceptance will be based on Quality Control and Quality Assurance tests made on samples of material taken from the completed and compacted course.
 - 3. Gradation tests by the Contractor shall be made on samples taken at the place of production prior to shipment. Samples of the finished product for gradation testing shall be taken as specified in 03.16 FIELD QUALITY CONTROL, or more often as directed by the Owner's Representative if variation in gradation is occurring, or if the material appears to depart from the Specifications. Test results shall be forwarded to the Engineer within 48 hours of testing.
 - 4. If tests conducted by the Contractor or the Engineer indicate that the material does not meet Specification requirements, material placement will be terminated until corrective measures are taken. Material that does not conform to the Specification requirements and is placed in the work shall be removed and replaced at the Contractor's sole expense. Retesting of material that does not meet specification requirements shall be performed at the Contractor's sole expense.
- B. All imported earth materials specified in this Section are subject to the following requirements:
 - 1. Materials imported to the site by the Contractor for on-site use shall meet the following:
 - a. Within any proposed Building Footprint: Materials shall have no detectable concentrations of petroleum or volatile organic compounds. Concentrations of

- all other hazardous materials shall be below the RI Department of Environmental Management Residential Direct Exposure Criteria.
- b. Outside any proposed Building Footprint: Concentrations of oil or hazardous materials shall be below the Rhode Island Department of Environmental Management Residential Direct Exposure Criteria.
 - c. The Contractor shall be solely responsible for all costs associated with permitting and/or coordination required with RIDEM for the earthwork materials proposed to be imported to the project site.
2. Imported materials shall be tested in accordance with the following requirements. Any proposed modifications to these testing requirements shall be approved by the project Environmental Engineer.
 - a. Imported earth materials to be used for backfilling and/or restoration activities shall be sampled, analyzed, and approved prior to delivery to the Site. The material is not limited to one specific type of material, and may be topsoil, stone dust, gravel, etc. as required per the proposed Drawings and Specifications. Each type of material shall be sampled, analyzed, and approved by the project Environmental Engineer prior to delivery to the Site. Imported material shall be sampled at a frequency of one (1) sample per 1,000 cubic yards delivered to the Site, with no fewer than 2 samples per material type and no fewer than 2 samples per material source. Samples shall be analyzed for the following parameters:
 - Total Petroleum Hydrocarbons (EPA 8100M)
 - Volatile Organic Compounds (EPA Method 8260B with Method 5035)
 - PCBs (EPA Method 8082)
 - Priority Pollutant Metals (13), Barium and Manganese (EPA Method 6000-7000 series)
 - Semi-Volatile Organic Compounds (EPA Method 8270)
 - For each new source, at least one sample shall be analyzed for Pesticides (EPA Method 8081).
 3. Data provided to the Engineer shall be less than 3 months old. For earthwork operations extending beyond one-year, annual analysis of the borrow pit or material source shall be required.

1.09 QUALITY ASSURANCE

- A. Employ a qualified surveyor, registered with the State of Rhode Island as a Professional Land Surveyor, as required for all layout and to establish grades for the work being performed.
 1. Prior to commencing work, Contractor's surveyor shall perform a benchmark level verification to confirm vertical and horizontal control of the site. Notify Owner and Owner's Representative prior to commencing work if discrepancies are found.
- B. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 543 shall be hired to provide required testing of earthwork materials at the Contractor's Expense.
- C. All temporary shoring and bracing shall be designed, detailed, and stamped by a Professional Engineer registered in the State of Rhode Island. Refer to SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION
- D. Pre-excavation Conference: Conduct conference at Project site prior to the start of construction. Date and time to be specified by the Owner's Representative.
- E. The Contractor is responsible to furnish and install bioretention soil with a minimum infiltration rate of one in per hour such that the area will drain in accordance with the RIDEM requirement of 48-hours following all rain events. Contractor shall warranty bioretention soil and

performance of bioretention area for one year following substantial completion and stabilization of the upstream area. In the event the bioretention area does not drain, the Contractor shall remove bioretention soil remove plantings, scarify subgrade, replace bioretention soil or filter media, and provide new plantings at no additional cost to the Owner.

1.10 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Owner and Architect not less than two weeks in advance of proposed utility interruptions in writing. Renotify 72 hours in advance of proposed utility interruptions.
 - a. Notifications should be made to the Owner's Representative.
 - b. Do not proceed with utility interruptions without Owner's written permission.
 - c. All power shutdowns shall be coordinated with the Owner.
 - 2. Contact "Dig Safe" at 1-888-Dig Safe to verify locations of existing underground utilities in areas of proposed excavation prior to commencing any excavation effort.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed on the Drawings. Coordinate with utility companies to shut off services if lines are active.

1.11 EXCAVATION SAFETY

- A. The Contractor shall be solely responsible for making all excavations in a safe manner. Contractor shall comply with all Local and State OSHA requirements.
- B. Provide appropriate measures to attain a stable base, retain excavation side slopes and prevent earth slides to ensure that persons working in or near the excavation are protected.

1.12 LAYOUTS AND GRADES

- A. All line and grade work not presently established at the site shall be laid out by a survey team under the supervision of a Registered Land Surveyor or Professional Engineer employed by the Contractor in accordance with Drawings and Specifications. The Contractor shall supply all additional layout and grade control as necessary to properly implement and construct the work. The Contractor shall establish permanent benchmarks and replace as directed any which are destroyed or disturbed.
- B. The words "finished grades" as used herein shall mean final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas outside of the building shall be given uniform slopes between points for which finished grades are indicated or between such points and existing established grades.

1.13 TOLERANCES

- A. All material limits shall be constructed within a vertical tolerance of 0.1 foot and a horizontal tolerance of 1 foot except where dimensions or grades are shown or specified as minimum. All grading shall be performed to maintain slopes and drainage as shown. No reverse slopes will be permitted.

1.14 DRAINAGE

- A. The Contractor shall control the grading in areas under construction on the site so that the surface of the ground will properly slope to prevent accumulation of water in excavated areas and adjacent properties.

- B. The Contractor shall excavate interceptor swales and ditches where necessary prior to the start of major earthmoving operations to insure minimal erosion and to keep areas as free from surface water as possible.
- C. Should surface, rain, or ground water be encountered during the operations, the Contractor shall furnish and operate pumps or other equipment and provide all necessary piping to keep all excavations clear of water at all times and shall be responsible for any damage to work or adjacent properties for such water. All piping exposed above ground surface for this use, shall be properly covered to allow foot traffic and vehicles to pass without obstruction.
- D. Presence of ground water in soil will not constitute a condition for which an increase in the contract price may be made. Under no circumstances place concrete fill, lay piping, or install appurtenances in excavation containing free water. Keep utility trenches free of water until pipe joint material has hardened and backfilled to prevent flotation.

PART 2 -PRODUCTS

2.01 SOIL MATERIALS

- A. General: The Contractor may reuse excavated on-site material for fill and backfilling where the material excavated is satisfactory and conforms with the below specified gradation requirements. The Contractor is to provide imported soil materials with satisfactory properties conforming with the below specified gradation requirements when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soils being free of rock or gravel larger than 3 inches in any dimension, debris, broken pavement, waste, frozen materials, vegetation, and other deleterious matter and conform to the criteria listed below:
 - 1. Gradations of satisfactory soils are as shown in the Table below:

Table 1 – SOIL GRADATIONS						
Sieve Size	Sand Gravel Fill	Granular Fill	1-1/2 inch Crushed Stone	3/4 inch Crushed Stone	Coarse Sand	ASTM C33 Sand
3-inch*	100	60-100	-	-	-	-
1-1/2-inch*	70-100	-	85-100	100	-	-
3/4-inch	50-85	-	10-40	90-100	-	-
1/2-inch	-	50-85	0-8	10-50	-	-
3/8-inch	-	45-80	-	-	100	100
No. 4	30-55	40-75	-	0-5	95-100	95-100
No. 8	-	-	-	-	-	80-100
No. 16	-	-	-	-	50-85	50-85
No. 30	-	-	-	-	-	25-60
No. 40	-	0-45	-	-	-	-
No. 50	8-25	-	-	-	2-10	5-30
No. 100	-	-	-	-	-	0-10
No. 200	0-8	0-10	<1	<1	-	-

* The maximum recommended stone size is three inches where placed as base course below slabs and pavement; elsewhere, maximum stone size shall be 2/3 of the loose lift thickness.

- 2. Common Borrow shall be imported or excavated onsite material free of roots, sod, rubbish, debris, frozen materials, broken pavement, or other deleterious or organic matter, and conform to the following requirements.
 - a. Imported Common Borrow shall conform to the specified gradation of Granular Fill in Table 1.

- b. Onsite Common Borrow shall conform to the specified gradation of Granular Fill in Table 1, but may contain no more than 15-percent by weight passing the No. 200 sieve. Onsite Common Borrow shall not be placed as foundation wall backfill, as pavement base or subbase courses, as retaining wall backfill, or locations where free-draining backfill are required.
 - c. Stones from excavated onsite material retained on a 3-inch sieve, less than 6-inches in diameter, and not exceeding two-thirds of the thickness of the horizontal layers placed after compaction can be placed for construction. Materials meeting these criteria shall not be included in the analysis for gradation. Materials exceeding this size shall not be placed in backfill below paved areas.
 - 3. Subbase Material shall be free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, broken pavement, waste, frozen materials, vegetation, and other deleterious matter and conform to the gradation for Granular Fill in Table 1 within this specification.
 - 4. Base Course shall be material free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, broken pavement, waste, frozen materials, vegetation, and other deleterious matter and conform to the gradation for Sand Gravel Fill in Table 1 within this specification.
 - 5. Riprap shall conform to RI Standard M.10.03.
 - 6. Filter stone shall conform to RI Standard M.01.07.
 - 7. Drainage Stone or Crushed Stone or 1 ½" Crushed Stone shall be imported material conforming to the gradation for 1 ½" Crushed Stone in Table 1 and having a maximum percentage loss of 12 percent as determined by the sodium sulfate test, AASHTO T104, and comply to the gradation provided in the table above.
 - 8. Sand Gravel Bedding and Granular Fill Bedding shall conform to the Sand Gravel Fill and Granular Fill gradations, respectively, specified above except that 100% by weight must pass the 1 ½" sieve.
 - 9. Gravel Borrow shall conform to the Sand Gravel Fill Gradation in the Table above.
 - 10. Structural fill below footings and slabs on grade shall conform to the Sand Gravel Fill Gradation in the Table above except that 100% by weight must pass the 1 ½" sieve.
- C. Bioretention soil shall be sandy loam, loamy sand, loam (USDA), or a loam/sand mix.
- 1. The soil shall be free of stones, stumps, roots, other woody material over 1-inch in diameter, or brush/seeds from noxious weeds.
 - 2. Following soil characteristics, by volume.
 - 3. 1.5 to 3% Organic Matter
 - 4. 5 to 10% Silt
 - 5. 88 to 90% Sand.
 - 6. Bioretention soil shall be tested for following criteria:
 - 7. pH range, 5.2 – 7.0
 - 8. magnesium, not to exceed 32 ppm
 - 9. phosphorus P2O5, not to exceed 69 ppm
 - 10. potassium K2O, not to exceed 78 ppm
 - 11. soluble salts, not to exceed 500 ppm
 - 12. Each bioretention area shall have a minimum of one test. Each test shall consist of both the standard soil test for pH, phosphorus, and potassium and additional tests of organic matter, and soluble salts.
- D. Unsatisfactory Soils are defined as soils not conforming to the satisfactory soils criteria unless otherwise approved by the Engineer.
- E. The Contractor is responsible to furnish and install bioretention soil that will drain in accordance with the RIDEM requirement of 72-hours following all rain events. Contractor shall warranty bioretention soil and performance of bioretention area for one year following substantial completion and stabilization of the upstream area. In the event the bioretention area does not drain, the Contractor shall remove bioretention soil remove plantings, scarify

subgrade, replace bioretention soil and provide new plantings at no additional cost to the Owner.

2.02 GEOTEXTILES

- A. Permanent Turf Reinforcement Mat: Provide North American Green SC250 permanent turf reinforcement mat or approved equivalent. The permanent turf reinforcement matting shall meet the following minimum properties per the Erosion Control Technology Council Type 5A and Federal Highway Administration's FP-03 Section 713.18.

Test	Method	Nonwoven ⁽¹⁾
Performance Test Unvegetated Shear Stress (lb/ft ²)	ASTM D-6460	2.0 min
Performance Test Vegetated Shear Stress (lb/ft ²)	ASTM D-6460	6.0 min
Seedling Emergence (%)	ASTM D-7322	250 min
Tensile Strength (lb/ft)	ASTM D-6818	150 min
Material Mass / Unit Area (oz/yd ²)	ASTM D-6566	8.0 min
Thickness (in)	ASTM D-6525	0.25 min
UV Stability (% @ 500 hrs)	ASTM D-4355	80

- B. Filter Fabric: Non-woven geotextile shall be nonwoven and needle punched pervious sheets of polyester, polyethylene, nylon, or polypropylene filaments formed into a uniform pattern conforming to the MIRAFI 140N or approved equivalent. The geotextile shall have minimum properties as stated in the following table, when measured in accordance with the referenced standards.

Test	Method	Nonwoven ⁽¹⁾
Grab Tensile Strength (lbs)	ASTM D-4632	120
Puncture Strength (lbs)	Modified ASTM D-3787 Using 5/16-inch flat tipped rod	65 min
Mullen Burst (lbs/in ²)	ASTM D-3786	225 min
Elongation at Required Strength (%)	ASTM D-4632	50 min
Equivalent Opening (US Standard Sieve)	ASTM D-4751	70-100
Permittivity (sec-1)	ASTM D-4491 with 60 mm Falling Head	1.7 min
Water Flow Rate (gal/min/ft ²) at 50 mm Constant Head	(2)	80 –120

- (1) All numerical values represent minimum/maximum average roll values (i.e., the average of minimum test results on any roll in a lot should meet or exceed the minimum specified values).
- (2) Water flow rate in gal/min/ft² shall be determined by multiplying permittivity in sec⁻¹ as determined by ASTM D-4491 by a conversion factor of 74.

PART 3 -EXECUTION

3.01 PREPARATION

- A. Furnish, install, and maintain shoring, sheeting, bracing, and sloping necessary to support the sides of earth and rock excavations, and to keep and prevent any movement which may damage adjacent structures, pavements, and utilities, damage or delay the work, or endanger life and health. Furnish, install, and maintain shoring, sheeting, bracing, and sloping as required by OSHA and other applicable government regulations and agencies.
- B. All temporary shoring and bracing shall be designed, detailed, and stamped by a Professional Engineer registered in the State of Rhode Island.

- C. Provide excavation support and protection in accordance with SECTION 31 50 00 EXCAVATION SUPPORT AND PROTECTION.
- D. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent building area and walkways.
- E. The use of onsite, excavated material may require stockpiling to allow the material to dry prior to placement. Provide erosion-control measures as specified in the drawings and as required by the Owner's Representative to prevent erosion of piles during wet weather periods.

3.02 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. The Geotechnical Report prepared for this project indicates that groundwater may be present within the limits of excavation. The Contractor is made aware of this condition and shall include dewatering within his Lump Sum Bid.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system, specified in SECTION 31 23 19 DEWATERING, to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required at no additional expense to the Owner.

3.03 WORK IN FREEZING WEATHER

- A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees Fahrenheit.
- B. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of a day's operation. Prior to terminating operations for the day, the final layer of fill, after compaction, shall be rolled with a smooth-wheeled roller to eliminate ridges of soil left by tractors, trucks and compaction equipment.
- C. The Contractor shall not place a layer of compacted fill on snow, ice, or soil that was permitted to freeze prior to compaction. Removal of these unsatisfactory materials will be required as directed by the Owner's Representative.
- D. Do not excavate to full indicated depth when freezing temperatures may be expected, unless work can be completed to subgrade or piping can be installed and backfilled the same day. Protect the excavation from frost if placing of concrete or piping is delayed.
- E. The Contractor shall keep the operations under this Contract clear and free of accumulation of snow within the limits of Contract Lines as required to carry out the work.

3.04 ROCK EXCAVATION

- A. General
 - 1. Rock excavation includes the removal of rock to the lines and grades shown on the plans and as specified within this Section and the disposal of the Rock off site by legal methods.
 - 2. The Contractor shall obtain all necessary permit and licenses and pay all fees at no additional cost to the Owner.

3. All rock excavation shall be included within the original Contract Sum based upon the quantities provided in PART 4 – MEASUREMENT AND PAYMENT. Payment for rock excavation shall be adjusted in accordance with 4.01B.1 Quantities and Payment of Rock Excavation.
 4. Unit prices for rock excavation include all labor, equipment, and materials required for removal of rock and hauling of rock off-site. Unit prices for rock excavation also include all labor, equipment, and materials required for replacement of rock excavation with approved materials where the rock excavation extends beyond the specified excavation limits. Any excavation beyond the specified excavation limits must be approved by the Owner's Representative prior to removal. Specified excavation limits for rock are specified in 3.04 – ROCK EXCAVATION.
 5. Rock capable of removal through standard excavation procedures shall be removed from the excavation, measured by the Contractor, and verified by the Owner's Representative.
 6. The dimensions and quantity of the uncovered rock in place and the rock removed from the trench shall be measured by a Licensed Land Surveyor registered in the State of Rhode Island at the Contractor's expense. All survey information shall be supplied to the Owner's Representative for verification of the quantity. Survey information shall include the existing rock surface topography, the removed rock surface topography and the rock removal limits as specified herein.
 7. If a change in the work occurs, which includes the excavation of additional rock outside the original contract limits, the Contractor shall uncover all rock to be removed. Upon uncovering rock in excavations that cannot be removed by standard excavation measures, the Contractor shall expose all faces of rock in the area that requires excavation and notify the Owner. The dimensions and quantity of the rock in place and the rock removed from the trench shall be measured by a Licensed Land Surveyor registered in the State of Rhode Island at the Contractor's expense. All survey information shall be supplied to the Owner's Representative for verification of the quantity.
 8. Rock shall be removed by mechanical means and methods. Blasting is not permitted.
- B. Rock Removal Limits
1. The Contractor shall remove rock to elevations, which will allow the installation of all foundations, footings, utilities, structures, trees and plantings, shown on the drawings.
 2. The Contractor shall remove rock to a minimum of 30 inches below finished grade in paved areas and a minimum of 24 inches below finished grade in landscaped areas.
 3. Around proposed utilities, the Contractor shall remove rock to the lines and subgrade elevations indicated on drawings and as dictated within this specification. The Contractor shall remove sufficient rock to permit the installation of permanent construction without exceeding 6 inches beneath pipe in trench, and the greater of 24 inches wider than pipe or 36 inches wide.
- C. Rock Excavation for the Installation of Structures
1. Boulders and bedrock encountered during the site preparation should be removed from the building area. Any boulder or bedrock located within the building area should be removed to a depth of at least 12 inches below the foundation elevation. Voids that result from boulder removal should be backfilled with compacted Sand Gravel Fill.
 2. Bedrock excavated for the building footings and slabs should be over excavated to allow for the placement of a compacted 12-inch Sand Gravel Fill cushion below the foundations and slabs placed in horizontal lifts with a maximum loose lift thickness of 12 inches. The cushion material should extend a minimum of 2 feet beyond the horizontal limits of the foundations or slab. Care should be taken when removing rock adjacent to the existing structure to prevent undermining and disturbance of the footing.
- D. Rock Excavation for the Removal of Utilities and Structures
1. Remove rock directly above and to the sides of piped utilities and structures proposed for removal without exceeding the following dimensions:
 - a. 12 inches outside of concrete structures, walls, and footings.

- b. 12 inches from either edge of piped utility and 6 inches below piped utility
 - c. 6 inches outside of edge of concrete cast against grade.
 - d. 6 inches beneath bottom of concrete pads or slabs on grade.
- 2. Upon uncovering rock within a trench that cannot be removed by standard excavation measures, the Contractor shall expose all faces of rock within the trench and notify the Owner. The dimensions of the rock in place shall be measured by survey instrument by a RI Licensed Land Surveyor at the Contractor's expense and verified by the Owner's Representative.
- 3. Rock capable of removal through standard excavation procedures shall be removed from the trench, measured by the Contractor, and verified by the Owner's Representative.

3.05 EXCAVATION, GENERAL

- A. Excavate to subgrade elevations. Material to be excavated will be classified as earth or rock. Do not excavate rock until it has been classified and quantified by the Contractor's land surveyor, and verified by the Owner's Representative
 - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
- B. All topsoil and unsuitable or excess materials shall be stripped from areas of new construction or regrading. Materials suitable for reuse shall be stored in locations and approved by the Owner's Representative that will not interfere with construction operations.
- C. All excess and unsuitable materials shall be legally disposed of off-site by the Contractor.

3.06 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
- B. All unsuitable and fill materials shall be removed from the proposed building area to a limit defined by a 1-horizontal to 1-vertical slope extending downward and outward from two feet outside the edges of the building footing to firm undisturbed glacial till or bedrock. Boulders encountered within these areas shall be removed to a depth of at least 12 inches below the bottom of footings. Voids that result from boulder excavations shall be backfilled with Granular Fill and compacted.
- C. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grade to leave solid base to receive other work.
 - 1. Based upon the characteristics of the on-site soils, the influence area below footings is defined as the area under footings extending from 2-feet outside the bottom edge of footing downward at an angle of 1 horizontal to 1 vertical. The influence zone above footings is defined as the area extending upward and outward from 2-feet outside of the bottom edge of the footing at an angle of 1.5 horizontal to 1 vertical.
 - 2. Construction staging for the proposed building should be scheduled such that construction can proceed systematically and safely to avoid excavations within the influence areas of newly installed or existing footings. Where it will be necessary to excavate within influence areas, temporary support systems will be required to retain the surrounding soil and safely support structure loads. The scheduling process should consider the construction of structures within the project area and the construction of third-party structures that are adjacent to the project area.

3. The earth slope along the bottom of sloped footings (i.e., subgrade or bearing surface) should not exceed a slope of 2 horizontal and 1 vertical to allow a stable subgrade to be provided prior to the placing of concrete
 4. In fill areas within the building footprint, the soil subgrade shall be surface compacted with a minimum of six passes of a vibratory roller having a drum weight of at least 10,000 pounds and a dynamic force of at least 20,000 pounds. In the event that subgrade soils within the building area become disturbed during construction, they should be over-excavated and replaced with one foot of compacted Sand Gravel Fill or six inches of ¾-inch Crushed Stone placed on a layer of filter fabric to stabilize the subgrade.
 5. If the subgrade is wet, the Contractor shall over-excavate all footing excavations by 6 inches and place a working mat of ¾-inch Crushed Stone compacted to 95% underlain by filter fabric (Mirafi 140N or approved equivalent). Stone shall extend 2 feet beyond the edge of the footing on all sides. This working mat shall be provided by the Contractor in wet conditions at no additional expense to the Owner.
- D. Over-excavation by the Contractor, excavation below the proposed bottom of excavation, shall be backfilled in 6-inch lifts with compacted Sand Gravel Fill. In wet conditions, over excavation shall be backfilled in 6-inch lifts with ¾-inch Crushed Stone and a layer of filter fabric approved by the Engineer and compacted to 95% until the proposed subgrade elevation is reached and the subgrade stabilized.
 - E. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.07 SUBGRADE INSPECTION

- A. Notify Owner's Representative and Engineer when excavations have reached required subgrade.
- B. If the Owner's Representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Continue this process until the area has been proof-rolled 4-6 times. Limit vehicle speed to 3 mph.
 2. Proof-roll with a vibratory roller with a static weight of no less than 10,000 lbs and a dynamic weight of 20,000 lbs.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Owner's Representative, and replace with compacted backfill or fill as directed.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner's Representative or Engineer, without additional compensation.

3.08 EXCAVATION OF UNSUITABLE MATERIALS

- A. The Contractor shall notify the Owner's Representative and Engineer when excavations uncover potential unsuitable materials.
- B. Payment for all excavation and disposal of Unanticipated Unsuitable Soils within the limit of excavation shall be included as part of the original Contract Sum.

- C. Excavation and disposal of Unanticipated Unsuitable Soils outside the limit of excavation shall be paid for in accordance with the Unit Prices included in PART 4 – MEASUREMENT AND PAYMENT of this specification.
 - 1. Unit prices for unanticipated unsuitable soils excavation include all labor, equipment, and materials required for removal of unsuitable soils, hauling of unsuitable soils off-site, and disposal. Unit prices for unanticipated unsuitable soil also include all labor, equipment, and materials required for replacement of unsuitable soil excavation with approved materials. Any unanticipated unsuitable soil excavation must be approved by the Engineer and Owner's Representative prior to removal.
 - 2. The dimensions and quantity of the Unanticipated Unsuitable Soils excavated shall be measured by a Professional Land Surveyor registered in the State of Rhode Island at the Contractor's expense. The Surveyor shall measure the elevations of the unsuitable materials prior to excavation and the surface topography following excavation. All survey information shall be supplied to the Owner's Representative for verification of the quantity. Survey information shall include the topography of the uncovered suitable soil surface prior to excavation and the topography of the final soil surface following excavation.

3.09 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.
- B. Concrete required to fill unauthorized excavation shall be furnished and installed at the expense of the Contractor.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations in locations approved by the Owner. Do not store within drip line of remaining trees.

3.11 BACKFILL GENERAL

- A. The contractor shall notify the Engineer and Owner's Representative a minimum of 2 days prior to backfilling utility trench to schedule inspection.
- B. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation
 - 2. Surveying locations of underground utilities for Record Documents
 - 3. Testing and inspecting underground utilities
 - 4. Removing concrete formwork
 - 5. Removing trash and debris
 - 6. Removing temporary shoring and bracing, and sheeting
 - 7. Receiving approval from the respective Utility Company, and the Owners Representative following inspection
- C. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact initial backfill conforming to the specified material requirements to the height specified on the Drawings over the utility pipe or conduit.

- C. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- D. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- E. Bedding material shall be placed and compacted in maximum 6" lifts.

3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
 - 3. The Contractor shall furnish water for compaction. Water for compaction from sources other than potable sources shall be as approved by the Owner's Representative.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Compaction shall be completed with a vibratory roller having a static weight of 10,000 lbs and a dynamic weight of 20,000 lbs.
- C. The Contractor shall use caution when compacting near existing utilities including electric and communications duct banks. Any damage to existing utilities or structures resulting from compaction operations shall be repaired at the expense of the Contractor.
- D. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- E. Compact soil materials to not less than the following percentages of maximum dry density:

MINIMUM COMPACTION REQUIREMENTS TABLE	
Location	Percent of Maximum Dry Density ¹
Backfill below footings, within the building area and below slabs ²	95
Backfill for foundation walls and frost walls	95
Backfill within pavement base and sub base layers	95
Backfill below pavement sub base layers	92
Around and above utilities within the building area	95
Around and above utilities in paved areas	92
Backfill behind retaining walls	95 ³
Backfill within landscaped areas	85

¹ Maximum dry density as determined by the Modified Proctor test (ASTM D 1557)

² Building area is described as an area extending downward and outward from the outside edge of the footing at a 1H:1V slope.

³ During compaction of fill placed behind retaining walls, care shall be taken so as to maintain uniform elevation along both sides within the embedded areas, and to not overstress the wall by applying too much compactive energy at the top of the wall.

3.15 SUBBASE AND BASE COURSE

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. Place subbase and base course on subgrade in 6-inch lifts and compact as specified.

3.16 FIELD QUALITY CONTROL

- A. Testing Agency: The Owner shall engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed every 100 feet to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by the Owner's Representative.
 - 2. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
 - 3. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
 - 4. Trench Backfill: At each compacted backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specify tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Owner's Representative or Engineer; reshape and recompact.
- C. Where settling occurs remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by the Owner's Representative. If directed by the Owner, the Contractor shall remove surplus satisfactory material from the site and dispose of in a legal manner.
 - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

3.19 GEOTEXTILES

- A. Install Geotextiles in accordance with Manufacturer's recommendations.

3.20 BIORETENTION

- A. Do not compact the base of the bioretention area.
- B. If subgrade within the bioretention area shows signs of compaction, then utilize a primary tilling operation such as a chisel plow, ripper, or subsoiler to refracture the soil profile through the 12-in compaction zone.
- C. Do not use heavy equipment within the bioretention basin.
- D. Backfill bioretention soil in lifts of 12" to 18", loosely compacted.
- E. Mix approximately ½ the specified mulch layer into the bioretention soil to a depth of approximately 4 inches.
- F. Grade bioretention materials with light equipment.
- G. Absolutely no runoff shall be allowed to enter the bioretention area until all contributing drainage areas have been stabilized.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

- A. Payment for earthwork as outlined in this Section or shown on the Drawings, including, but not limited to, all design, submittals, materials, labor, equipment, and all other incidentals associated with this work shall be included in the Contractor's Base Bid.
- B. Unit prices for rock excavation include all labor, equipment, and materials required for removal of rock and hauling of rock off-site. Unit prices for rock excavation also include all labor, equipment, and materials required for replacement of rock excavation with approved materials where the rock excavation extends beyond the specified excavation limits. Any excavation beyond the specified excavation limits must be approved by the Owner's Representative prior to removal. Specified excavation limits for rock are specified in 3.04 ROCK EXCAVATION.
 - 1. Quantities and Payment of Rock Excavation
 - a. The Contractor shall include in his base bid 100 cubic yards of Bulk Excavation rock and its removal from site.
 - b. The Unit Price for Bulk Excavation rock removal as specified herein shall not exceed \$70.00 per cubic yard.
 - 2. The Contractor shall include in his base bid 100 cubic yards of trench rock and its removal from site.
 - a. The Unit Price for Trench Excavation rock removal as specified herein shall not exceed \$160.00 per cubic yard.
- C. Unit prices for unanticipated unsuitable soils excavation include all labor, equipment, and materials required for removal of unsuitable soils, hauling of unsuitable soils off-site, and disposal. Unit prices for unanticipated unsuitable soil also include all labor, equipment, and materials required for replacement of unsuitable soil excavation with approved materials. Any unanticipated unsuitable soil excavation must be approved by the Owner's Representative prior to removal.
 - 1. Quantities and Payment of Unanticipated Unsuitable Soil Conditions:

- a. If unanticipated unsuitable materials are encountered beyond the limits of excavation as specified on the Drawings and Specifications, the Contractor shall notify the Owner's Representative in writing. The Contractor shall carry excavation deeper and replace the excavated material with appropriate specified material or concrete as directed by the Owner's Representative or Geotechnical Engineer.
 - b. Removal of topsoil, subsoil, and rock layer as specified in this specification will not be considered as unanticipated unsuitable soil conditions. Similarly, removal of these materials within paved areas as specified herein will not be considered unanticipated unsuitable soil conditions.
 - c. Only changes in the work authorized in advance by the Owner's Representative in writing shall constitute an adjustment in Contract Price.
 - d. Material that is too wet or too dry for compaction of the particular material in place as determined by the Owner's Representative or the Geotechnical Engineer and/or Soil Testing Company and is disturbed by the Contractor during construction operations so that proper compaction cannot be reached shall be removed and replaced with approved material as directed by the Owner's Representative or Geotechnical Engineer at no additional cost to the Owner.
 - e. The Contractor shall follow a construction procedure, which permits visual identification of firm natural ground.
2. The Contractor shall carry in the Base Bid 100 cubic yards for removal of unanticipated unsuitable materials and replacement with suitable compacted fill material in place, as directed herein. The Base Bid shall cover all costs related to such excavation, removal off site, and replacement with compacted fill of approved material, overhead, and profit. No amount other than the Unit Price provided by the Contractor will be paid by the Owner for excavation herein defined.
- a. The Unit Price for unanticipated unsuitable soil materials removal as specified herein shall not exceed \$40.00 per cubic yard.
- D. All quantities of unanticipated unsuitable soils and rock excavated are to be measured in place by a Professional Land Surveyor registered in Rhode Island as described above and verified by the Owner's Representative prior to removal.
- E. The Contractor shall submit signed slips showing quantities of Unanticipated Unsuitable Soils and Rock removed from excavations at the end of each workday, with a total quantity mutually agreed upon. Slips shall be signed by the Owner's on-site representatives at the end of each day signifying that the quantities are accurate. The Owner has the right to inspect individual loads, slips and quantities as they arrive at or leave from the site and as they are weighed out at the stone quarry. These quantities are for reference only and will not be used to calculate payment with the unit prices above.

END OF SECTION

SECTION 311100

SITE PREPARATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.

1.03 SUMMARY

- A. The work of this Section includes the following:
 - 1. Provisions for protection of all existing utilities from damage particularly at heavy construction vehicle crossings.
 - 2. Removal, disposal, capping or plugging of drainage, sewer, gas, steam, and water piping at the locations specified on the drawings.
 - 3. Removal and disposal of flexible pavement, curbing, concrete entrance ramps, and concrete walks at the locations specified on the drawings.
 - 4. Removal and disposal of catch basins, manholes, cisterns, utility structures.
 - 5. Removal and disposal of steps, stairs, signs, and fence.
 - 6. Removal and disposal of remnants of concrete and stone foundations.
 - 7. Cleaning and maintenance of the site and stormwater management system.
 - 8. Removal and disposal of cesspools, leaching areas, and septic tanks.
 - 9. Transport and Disposal of Contaminated Soils
- B. Related Sections include the following:
 - 1. Section 310000 Earthwork

1.04 DEFINITIONS

- A. Cleaning as described in Subsection 212.01.2a of the State Standards.
- B. Maintenance as described in Subsection 212.01.2b of the State Standards.
- C. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- D. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.05 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain on the Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.
- B. The Owner reserves the right to claim ownership over any materials removed from the site, including earthwork. The materials claimed by the Owner shall be stockpiled on the site as directed.
- C. Stripped Topsoil is the property of the City of East Providence and shall not be removed from the site. Contractor shall haul topsoil to a location designated by the Owner.

1.06 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit drawings or details indicating proposed provisions for protection of existing gas line and utilities as the work requires. These utilities must be protected from damage particularly by heavy construction equipment driving over the top of them.

1.07 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner, Owner's Representative, and Architect not less than two weeks in advance of proposed utility interruptions in writing. Renotify in writing 72 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
 - 3. Underground utilities were compiled from available record plans and visible aboveground locations and are considered approximate only. Prior to commencing any excavation effort, the Contractor shall contact "Dig Safe" at 1-888-Dig Safe to verify locations of existing underground utilities in areas of proposed excavation.
- B. The Contractor is responsible to schedule the work and determine any required temporary utility lines and connections required to keep the existing facilities in operation. The cost to furnish and install temporary utility lines and connections shall be included in the Contractor's base bid.
- C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with the utility companies to shut off services if lines are active.
- D. Contractor shall not operate existing water gate valves and hydrants. Only utility company employees or designated personnel are authorized to operate Water System valves and hydrants..
- E. All abandoned underground utilities shall be designated on as-built drawings by the Contractor of record and provided to the Owner and Engineer in AutoCAD electrical format prior to completion of the project. All as-built drawings, (underground and above ground) shall be dimensioned from permanent benchmarks such as existing buildings and include depths at various points throughout the extent of the work, and invert elevations at all structures.
- F. Do not commence site operations until temporary erosion and sedimentation control measures are in place.
- G. Removal of all asbestos piping or structures, if found, shall be in accordance with Subsection 201.03.8 of the State Standard Specifications.

1.08 PROJECT CONDITIONS

- A. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The Contractor shall provide all materials and equipment in suitable and adequate quantity as required to accomplish the work shown and specified

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction. The Contractor shall employ a Professional Land Surveyor registered in the State of Rhode Island to perform a benchmark and field verification survey prior to commencing work. The Contractor is responsible to provide horizontal and vertical layout of all proposed work.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated. Review trees with Owner and Landscape Architect prior to removal.
- C. Protect existing site improvements to remain from damage during construction.
- D. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 REMOVE AND DISPOSE SEWER, DRAINAGE, STEAM, AND OTHER GRAVITY UTILITY PIPING

- A. All pipe or conduit designated to be removed shall be so-removed and legally disposed of off-site. Drain pipes or other pipes, ducts, etc., cut and deemed advisable to remain in the earth shall be plugged with concrete, except that metal drain pipes may be sealed with screw type plugs or caps. Drain pipes or other pipes that are cut for a new connection shall be temporarily capped and sealed water tight to prevent sediment or water from entering the utility.
- B. The Contractor shall cooperate with the Owner and utility companies so that the demolition work may be performed in accordance with their regulations and with the approval of the Owner.
- C. Removal of all asbestos cement pipe, if found, shall be in accordance with Subsection 201.03.8 of the State Standard Specifications.

3.03 REMOVE AND DISPOSE WATER

- A. Only utility company employees or designated personnel are authorized to operate Water System valves and hydrants.
- B. Once valves are closed, pipe shall be cut and cleaned prior to being capped with a watertight heavy duty cap.
- C. Cap shall be thoroughly cleaned of any dust, dirt or deposits prior to installation.

- D. Install concrete thrust block as required. If the cap and thrust block will be later removed for a connection, install the thrust block to not damage the water main upstream of the cap.

3.04 REMOVE AND DISPOSE IRRIGATION

- A. An irrigation system is located within the project area. Contractor shall remove and dispose of irrigation facilities as required to install proposed improvements within the existing field. Contractor shall protect and maintain existing irrigation that services the senior center.
- B. Contractor shall locate, protect, and maintain existing irrigation that services the senior center.

3.05 REMOVE AND DISPOSE CONCRETE UTILITY STRUCTURES

- A. All concrete utility structures designated to be removed shall be so-removed and legally disposed of off-site. The Contractor shall cooperate with the Owner and utility companies so that the demolition work may be performed in accordance with their regulations and with the approval of the Owner's Representative.

3.06 REMOVE AND DISPOSE GAS

- A. All gas mains, services, valves, and appurtenances shall be removed and demolished in accordance with National Grid, the utility company, requirements. Contractor shall coordinate all work adjacent to gas with National Grid prior to commencing work.

3.07 REMOVE AND DISPOSE FLEXIBLE PAVEMENT, CURBING, CONCRETE RAMPS, AND CONCRETE WALKS

- A. In accordance with Subsections 201.03.7, and 201.03.10 of the State Standard Specifications.

3.08 REMOVE AND DISPOSE CONCRETE OR STONE FOUNDATION REMNANTS

- A. The Contractor shall excavate concrete or stone foundation remnants uncovered during excavation for proposed improvements. Remove and dispose concrete and stone foundation remnants in accordance with local and State requirements.

3.09 DISPOSAL

- A. Disposal: Remove surplus soil material, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property. Any potentially contaminated soil material encountered, as specified by the State of Rhode Island Department of Environmental Management rules and regulations, shall be brought to the Rhode Island Resource Recovery Corporation or another appropriately licensed waste facility for legal disposal.
- B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

3.010 CLEANING AND MAINTENANCE OF STORM DRAIN SYSTEM

- A. The Contractor shall remove sediment and debris from the existing drainage system prior to commencing work.
- B. During construction the Contractor shall be responsible to clean sediment and debris from the existing and recently installed drainage system.

- C. Prior to project completion the complete drainage system shall be cleaned of all debris and sediment.

3.011 REMOVE AND DISPOSE CESSPOOLS, LEACHING AREAS, AND SEPTIC TANKS

- A. In accordance with Subsections 201.01.9 of the Standard Specifications.
- B. Concrete cesspools, septic tanks, galleys, or distribution boxes shall first be pumped out and then broken up into pieces sufficiently small to preclude the formation of voids. Pumped wastewater shall be disposed of at a licensed waste handling facility. The resulting depression shall then be backfilled with common borrow and compacted, all to the satisfaction of the Owner's Representative. Stone cesspools shall be treated in a similar manner.
- C. Steel septic tank covers shall be removed, and the interiors pumped out and subsequently completely filled with common borrow.
- D. Where the limit of work requires excavation within soil material beneath and adjacent to leaching areas, cesspools, and septic tanks, the Contractor shall test the soil material. Soils shall be characterized and a plan developed to legally dispose. Contractor shall dispose of any contaminated soil material at a waste facility licensed to accept such waste material.
 - 1. The Contractor shall include costs for working with these soil materials and contaminants within the original Contract Sum. Costs associated with testing, transporting, tipping fees, and disposing, of these soil materials shall be included in the Base Bid price.

END OF SECTION

SECTION 312319

DEWATERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.
- C. "Geotechnical Design Basis Report" for the New Community Center in East Providence prepared by Pare Corporation, Inc. of Foxboro, MA dated September 2024.

1.03 SUMMARY

- A. This Section includes construction dewatering for utility trenches and utility structure installation.
- B. Related Sections include the following:
 - 1. Section 310000 – Earthwork.
 - 2. Section 315000 – Excavation Support and Protection.

1.04 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.
- B. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
- C. Prevent surface water from entering excavations by grading, dikes, or other means.
- D. Accomplish dewatering without damaging existing buildings adjacent to excavation.
- E. Remove dewatering system if no longer needed.

1.05 SUBMITTALS

- A. Shop Drawings for Information:
 - 1. For dewatering system. Show arrangement, locations, and details of dewatering locations; locations of erosion controls and dewatering basins.
 - 2. Include a written report outlining control procedures to be adopted if dewatering problems arise.

- B. Record drawings at Project closeout identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions performed during dewatering.
- C. Field Test Reports: Before starting excavation, submit test results and computations demonstrating that dewatering system is capable of meeting performance requirements.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.
 - 1. At no time is discharge to be allowed to enter an existing drainage structure without sedimentation controls. Any damage caused by dewatering will be repaired in full to match existing conditions at the Contractor's expense.
 - 2. At no time is discharge allowed to enter the existing sanitary sewer system.

1.07 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by the Owner's Representative and then only after arranging to provide temporary utility services according to requirements indicated.
- B. Make additional test borings and conduct other exploratory operations necessary for dewatering.
- C. Soil borings and test pits have been made by qualified Contractors prior to this Contract. This information shall be made available to bidders as specified under other Sections. The Contractor is responsible to employ qualified personnel capable of interpreting geotechnical information, test pit logs, and boring logs. The results of these subsurface explorations and recommendations for work were prepared by the Engineer, consulting geotechnical engineers, and are hereby attached to this specification for information only. Procedures for dewatering, areas to receive special fill and other methods and procedures specified herein shall be supplemented by this information. For purposes of this specification, this information will be referred to as the Geotechnical Report. Where procedures within the report vary from procedures as specified herein, this specification shall override. The Geotechnical Report is included elsewhere in the Project Manual
- D. The Geotechnical Report states that groundwater is present on the site. The groundwater has been observed over the last few months above the elevations included in the Geotechnical Report. The water table may be within the proposed limits of excavation in several areas on the site. The Contractor is made aware of this condition and will not be eligible to receive additional compensation for dewatering exceeding the Contractor's initial bid.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The Contractor shall provide any equipment and materials necessary for dewatering at the Contractor's own expense.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

- B. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
- C. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- D. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
- E. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- F. Provide erosion controls in accordance with the Rhode Island Soil Erosion and Sediment Control Handbook.
- G. Dewatering basins capable of handling the flows directed to them shall be supplied whenever dewatering is required.
- H. Control surface water and groundwater such that excavation to final grade is made in-the-dry, and bearing soils are maintained undisturbed. Contractor shall prevent softening, or instability of, or disturbance to the subgrade due to water seepage.
- I. Provide protection against flotation for all work.
- J. The impact of anticipated subsurface soil/water conditions shall be considered when selecting methods of excavation and temporary dewatering and drainage systems. Type of dewatering system, spacing of dewatering units and other details of this work shall address site specific conditions.
- K. Take all necessary measures to prevent damage to adjacent structures, utilities, property(ies).

3.02 INSTALLATION

- A. Install dewatering system utilizing pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, utilities, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of drains, sewers, utilities and other excavations.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others.
- E. Provide sumps, dewatering basins, sedimentation tanks, and other flow-control devices to avoid erosion and sedimentation.
- F. Direct discharges to storm drains will be unacceptable unless proper sediment and siltation removal devices are installed prior to discharge to the storm water conveyance system.

- G. Any discharge of water, generated from a dewatering operation, into wetlands or an open water body will not be permitted.
- H. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
- I. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
- J. Damage including but not limited to erosion or sedimentation, resulting from untreated dewatering discharges shall be restored to meet or exceed the existing condition. All remedial work shall be completed in accordance with local and State Environmental Regulations and Requirements.

3.03 PROPERTY LOSSES FROM REMOVAL OR DISTURBANCE OF GROUNDWATER

- A. Any structure, including but not limited to embankments, buildings, streets, and utilities that become unstable or vulnerable to settlement due to removal or disturbance of groundwater will be supported immediately by the Contractor. Support shall include but not be limited to bracing, underpinning, or compaction grouting.
- B. All loss or damage arising from removal or disturbance of groundwater, including but not limited to claims for subsidence and the loss of structure support, that may occur in the prosecution of the work shall be sustained and borne by the Contractor. If the Contractor needs to correct the damage resulting from his operations, the Owner may, 30 days after notifying the Contractor in writing, proceed to repair, rebuild or otherwise restore such damaged property as may be deemed necessary, and the cost thereof shall be deducted from compensation which may be or become due the Contractor under this Contract.

END OF SECTION

SECTION 313200

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.

1.03 SUMMARY

- A. The work of this Section includes the following:
 - 1. Provision of temporary erosion and sediment controls and permanent site stabilization, specifically compost filter socks, temporary diversions, temporary sediment traps, and catch basin inlet protection as indicated on the drawings or as directed by the Owners Representative.
 - 2. Maintenance and cleaning of erosion and sedimentation controls specifically compost filter socks, temporary diversions, temporary sediment traps, and catch basin inlet protection as necessary or as directed by the Owner's Representative.
 - 3. Permanent site stabilization including loam and seed.
- B. Related Sections include the following:
 - 1. Section 310000 Earthwork.

1.04 DEFINITIONS

- A. Cleaning as described in Subsection 212.01.2a of the State Standards.
- B. Compost Filter Sock: Three-dimensional tubular filtration device constructed by filling a mesh tube with a compost filter media.
- C. Maintenance as described in Subsection 212.01.2b of the State Standards.

1.05 SUBMITTALS

- A. Shop Drawings:
 - 1. Product information depicting that the products furnished meet the project specifications.
 - 2. Provide a Phasing Plan for each phase of the proposed work. Use the Soil Erosion and Sediment Control Plan prepared for the project and approved by RIDEM to prepare a Phasing Plan for each construction phase depicting the location of the following:
 - a. portions of the site that will be exposed
 - b. areas that will be temporarily seeded
 - c. construction entrances
 - d. laydown areas

- e. general temporary grading scheme
- f. temporary diversions or swales
- g. temporary sediment traps
- h. perimeter sediment barriers,
- i. dewatering areas
- j. concrete washout areas
- k. designated fueling areas

1.06 PROJECT CONDITIONS

- A. Do not commence operations which disturb the ground surface until temporary erosion and sedimentation control measures are in place.
- B. The Contractor is responsible to follow the "Soil Erosion and Sediment Control Plan" prepared for this project. This Plan has been reviewed by RIDEM and is subject to the RIPDES program. The Contractor is required to meet all conditions of this permit document.
 - 1. The Contractor shall provide Phasing Plans depicting the information requested herein and any other pertinent information. The Contractor is responsible to update this Phasing Plan prior to expanding the work area and exposing additional portions of the site.
- C. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division.
 - 1. Erosion controls and the first Phasing Plan shall be discussed at this meeting.

PART 2 - PRODUCTS

2.01 EROSION AND SEDIMENTATION CONTROL MEASURES

- A. Compost Filter Sock.
 - 1. Materials shall be in accordance with AASHTO Designation: MP 9-06. Compost material shall meet applicable Federal and State Regulations.
 - 2. For compost filter socks 18" or less in diameter, wooden stakes shall be 1 inch by 1 inch, at 10-foot intervals on center, and of a length that shall project into the soil 1 foot leaving 3 to 4 inches protruding above the filter sock.
 - 3. For compost filter socks greater than 18" in diameter, wooden stakes shall be 2 inch by 2 inch, at 10-foot intervals on center, and of a length that shall project into the soil 1 foot leaving 3 to 4 inches protruding above the filter sock.
- B. Temporary Turf Reinforcement Mat
 - 1. Temporary turf reinforcement mats shall be North American Green Product S150 or approved equivalent.
 - 2. Temporary turf reinforcement mat shall be degradable after 12 to 24 months
 - 3. Provide a temporary turf reinforcement mat designed to stabilize a 3:1 slope or greater.
- C. Filter Fabric
 - 1. See Geotextiles in Division 2 Section 31 00 00 "Earthwork" for specification.
- D. Temporary Seed
 - 1. Provide temporary seeding in accordance with Section M.18.10.5 Temporary Seed Mix of the State Standards.
- E. Temporary Sediment Traps, Swales, and Diversions
 - 1. Refer to Section 310000 Earthwork for soil materials and excavation.
 - 2. Provide temporary seeding.
 - 3. Provide turf reinforcement mat as required to stabilize side slopes.

F. Construction Accesses

1. Construction Accesses shall comply with RIDOT Standard Specification Section 211.

PART 3 - EXECUTION

3.01 PROVISION OF COMPOST FILTER SOCKS

- A. Trenching is not required for typical installation; therefore, soil should not be disturbed upon installation. Compost filter socks shall be placed over the top of ground and wooden stakes shall be driven through the center of the filter socks to anchor them to the ground. To ensure optimum performance, heavy vegetation shall be cut down or removed and extremely uneven surfaces shall be graded to ensure that the compost filter sock uniformly contacts the ground surface.
- B. Compost filter socks may be vegetated by incorporating seed into the compost prior to placing it in the tube.
- C. The ends of the compost filter sock shall be directed upslope, to prevent stormwater from running around the end of the sock.

3.02 TURF REINFORCEMENT MAT

- A. Install turf reinforcement mat on all exposed cut/fill slopes with a slope 3:1 or greater to protect against rainfall and wind erosion and hold moisture content to enhance vegetation growth in seed where shown in the plans.
- B. Install erosion control lining in the required locations immediately after the areas has been seeded.
 1. Place the erosion control lining over the seed mulch to fit against the contours of the area. It shall be applied without stretching, lie smoothly but loosely, and be free of wrinkles and bunches. Roll the material in place and in the direction of the flow of surface water. Anchor the up-grade end of the erosion lining in a narrow trench 6" deep. Firmly tamp the trench backfill in place.
 2. In ditches and on slopes, provide check or junction slots at no greater than 50' intervals.
 3. Where the erosion lining comes into contact with the edges of catch basins or other structures, place a tight fold in the edge of the material and bury it a minimum of 6" into the soil.
 4. Install staples no more than 6" apart at all anchor, junction or check slots.
 5. Where two lengths of erosion control lining are joined, the end of the upgrade strip shall overlap the downgrade by a minimum of 6" strip and the two strips shall be anchored together.

3.03 MAINTENANCE AND CLEANING OR EROSION AND POLLUTION CONTROLS

- A. In accordance with Subsection 212.03 of the State Standards.
- B. Repair all erosion controls until substantial completion and request inspection and approval of the condition of the protection from the Owner's Representative.

3.04 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to the Drawings.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Following stabilization of the site and the receipt of permission from the Owner's Representative, the Contractor shall remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.05 DISPOSAL

- A. Disposal: Remove surplus soil material, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property. Any potentially contaminated soil material encountered, as specified by the State of Rhode Island Department of Environmental Management rules and regulations, shall be brought to the Rhode Island Resource Recovery Corporation or another appropriately licensed waste facility for legal disposal.
- B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

3.06 PREPARATION

- A. Restore damaged improvements to their original condition, as acceptable to Owner.

3.07 TEMPORARY SEEDING

- A. In accordance with Subsection L.02 for Type 3 Temporary Seeding of the State Standards:

3.08 CONSTRUCTION ACCESSES

- A. In accordance with Section 211 Construction Accesses of the State Standards.
 - 1. Watering requirements shall be per seed provider.

END OF SECTION

SECTION 315000

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.
- C. "Geotechnical Design Basis Report" for the New Community Center in East Providence prepared by Pare Corporation, Inc. of Foxboro, MA dated September 2024.

1.03 SUMMARY

- A. This Section includes temporary excavation support and protection systems.
- B. Related Sections include the following:
 - 1. Section 312319 - Dewatering.
 - 2. Section 310000 - Earthwork

1.04 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.
- B. The Contractor assumes all responsibility for the excavation support systems used. In the event of a failure, all resulting damages are the responsibility of the Contractor.

1.05 SUBMITTALS

- A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.
 - 1. Include Shop Drawings signed and sealed by a qualified Registered Professional Engineer licensed in the State of Rhode Island.
 - 2. Working drawings and details on the excavation support proposed by the Contractor shall be provided along with detailed calculations showing the design of the bracing and sheeting proposed also stamped by a Registered Professional Engineer licensed in the State of Rhode Island.
 - 3. Working Drawings and design calculations, at a minimum, shall indicate the following:

- a. Design criteria.
- b. Details, arrangement and method of assembly and disassembly of proposed system and sequence of construction.
- c. Connection details.
- d. Method of preloading the bracing.
- e. Full excavation depth.
- f. Loads on support system for various stages of excavation and bracing removal.
- g. Expected equipment loads.
- h. Maximum design load carried by various members of support system, and preload values.
- i. Depths below main excavation to which support system will be installed.
- j. Methods of resolving difficulties arising from misalignment of soldier piles or steel sheetpiling exposed during excavation, and criteria for implementing procedures.
- k. Design calculations, for various stages of excavation and bracing removal.
- l. Existing utility facilities. After checking locations by field investigations, revise drawings to show actual locations of facilities and excavation supports interference with proposed Work, and measures proposed to overcome such interferences.
- m. Manufacturer's product data.
- 4. Design Computations: The Contractor shall also submit complete computations for the design of the sheeting and bracing system(s) proposed to be installed.
 - a. The design shall be in accordance with sound engineering practice and modern, accepted principles of soil mechanics.
 - b. The design shall include the effects of all surcharge which may be reasonably anticipated.
 - c. The minimum factor of safety for each of the design conditions required to be considered shall be 1.50.
- B. Qualification Data for Installer and Professional Engineer.
- C. Submittal Review:
 - 1. The design and layout will be reviewed by the Engineer as to type and suitability, providing that the arrangements presented by the Contractor are satisfactory, but such review will not relieve the Contractor of the sole responsibility for the adequacy of the system, nor shall it be construed as a guarantee that the Contractor's proposed equipment, materials and methods for sheeting and bracing will be adequate for the work required at the locations of and for the work required by this contract.

1.06 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
- B. The Contractor may make test borings and conduct other exploratory operations necessary for excavation support and protection.
- C. Survey adjacent structures and improvements adjacent to the excavation support system to monitor settlement. Employ a qualified professional engineer or land surveyor to establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations during construction.
- D. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Owner's Representative if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

1.07 QUALITY CONTROL

- A. Provide in accordance with the requirement as specified in Division 1 Specification Sections.
- B. Support of Excavation shall be of sufficient strength to safely sustain all loads from the sides of the excavations, together with all water pressure and reasonable surcharge.
- C. The Contractor shall, at all times, be entirely responsible for the adequacy of sheeting and bracing used:
 - 1. to permit the satisfactory and safe installation and construction of the work;
 - 2. to provide adequate protection against damage to all existing utilities, structures, and completed portions of the work; and
 - 3. to prevent injury to persons.
- D. The Contractor shall control, and pitch, the grading to prevent water from running into the excavated areas of the structures, or to prevent damage to other structures or work already accomplished.
 - 1. Welding Operations – in accordance with AWS D1.1

1.08 DESIGN CRITERIA

- A. This design criteria applies where the Contractor is responsible for design of the excavation support:
 - 1. Design the excavation support system in accordance with the earth pressures and other detailed criteria indicated.
 - 2. Design the excavation support system to support the earth pressures, decking system and AASHTO HS20 traffic loads if any, utility loads, equipment and construction loads, and other surcharge loads to allow the safe and expeditious construction of the permanent structures without movement or settlement of the ground, and to prevent damage to, movement or settlement of, adjacent buildings, structures, or utilities.
 - 3. Design sheet pile and soldier pile and lagging excavation support systems to penetrate to a depth below the bottom of excavation adequate to prevent lateral and vertical earth movement, and permit lowering of the indicated bottom of excavation at least two feet without any change in the support system as installed except for additional lagging and bracing for soldier pile and lagging systems.
 - 4. Design the bracing system to furnish sufficient reaction against the side banks to maintain stability in such banks. Obtain such reaction by timely stressing to predetermined locations until the necessary reaction is produced against the banks, or by such other methods that may be necessary to prevent displacement of ground and movement of structures.

PART 2 -PRODUCTS

2.01 MARKINGS

- A. Structural Steel:
 - 1. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
 - 2. Steel sheet piling – ASTM A328,; ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
- B. Lagging:
 - 1. Timber Lagging: use sound, well-seasoned Douglas Fir of rectangular cross section, Grade 2 or better. Timber shall be stamped and certified ALOPB LP-22 by the American Preserves Bureau.
 - 2. Moisture Content shall not exceed 20%.
 - 3. Minimum fiber stress in bending perpendicular to the grain shall be 1200 psi.

- C. Timber Sheeting:
 - 1. Any species of wood sheets that will satisfactorily withstand all driving and construction stresses and the loads, to which the members will be subjected, may be used for sheeting and bracing.
 - 2. Wood sheeting shall not be less than three (3) inches nominal thickness.
 - 3. All timber sheeting and bracing shall be free from worm holes, windshakes, loose knots, decayed or unsound portions or other defects which might impair its strength or tightness.
- D. Other Materials:
 - 1. The Contractor shall provide all hardware and fastenings necessary to accomplish satisfactory installation of all sheeting and bracing.

PART 3 -EXECUTION

3.01 INSTALLATION

- A. General: Sheeting and bracing shall be of sufficient strength to sustain all loads from the sides of the excavations, together with all water pressure and surcharge.
- B. The Contractor shall be entirely responsible for adequacy of sheeting and bracing used, and shall take all precautions necessary to prevent movement of material along the sides of excavations, and to prevent the intrusion of water beyond that which his pumping or well point system can control.
- C. Sheeting shall be permanently left in place where indicated or directed.
- D. It is expressly understood and agreed that whenever sheeting and bracing is used, it shall not relieve the Contractor of the sole responsibility for any damages, delays, or injury due to installation or failure of the sheeting or bracing, or the settling of the backfill, the pipeline, or the adjacent ground.

3.02 TIMBER SHEETING

- A. Sheeting shall be driven to sufficient depth below the deepest excavation level to maintain sufficient restraint of the adjacent soil and to prevent movement of the sheeting or excessive intrusion of groundwater.
- B. If voids occur behind the sheeting, they shall be filled immediately with proper material from earth excavation or other sources to the satisfaction of the Engineer.
- C. Withdrawal of sheeting shall be carefully performed to prevent movement of material along the sides of the backfilled excavations, to prevent damage to utilities, structures, or the work, and to avoid injury to persons.
- D. Unless otherwise permitted, sheeting shall be withdrawn in lifts of not more than four (4) feet, and all voids shall be filled immediately with selected materials and thoroughly compacted.

3.03 STEEL SHEET PILING

- A. Install in plumb position with each pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, being tightly against original ground. Use vibratory pile driver to install sheeting to depth required for design. The equipment and methods of installation, cutting, and splicing shall conform to the approved Working Drawings.

- B. Steel sheet piling located within a one to one slope from the bottom of the foundation element shall not be removed.

3.04 SOLDIER PILES AND LAGGING

- A. Provide bored holes for soldier piles adequate to accommodate pile sections shown on approved Working Drawings. Extend holes to necessary depth below level of subgrade. When pre-boring is to occur within two feet of a utility, uncover utility and install a steel drill casing to a level at least six inches below bottom of utility prior to pre-boring.
- B. Carry bottom of sheeting system to a depth below main excavation adequate to prevent lateral movement and to obtain adequate vertical support. In areas where additional excavation is required below main excavation subgrade, prevent movement of main excavation supports.
- C. Encase soldier piles with a minimum of 2500 psi concrete up to lowest point of excavation adjacent to pile location. Fill remainder of hole with lean concrete, completely encasing pile.
- D. Use timber lagging secured in place to soldier piles.
- E. Follow excavation closely with placement of lagging. Do not allow height of unlagged face of excavation to exceed five feet in rock and predominately clayey soils, or three feet in sandy soils. Extend lagging to final subgrade. Decrease height as required to prevent ground movement.
- F. Do not permit height of unlagged face to exceed 15 inches if water flows from face of excavation, or if soil (of any type) in face moves towards excavation area. Decrease unlagged face height as required to prevent ground movement.
- G. Carefully perform excavation for installation of lagging to minimize formation of voids. Separate lagging members only as necessary to permit packing behind them.
- H. Pack behind lagging as installation progresses; establish tight contact between excavation face and lagging. Pack openings between lagging members with straw or other suitable material to allow free drainage of water without loss of soil or sand packing.
- I. If unstable material is encountered during excavation, take suitable measures to contain unstable material in place and prevent ground displacement, which may cause damage.
- J. Maintain sufficient quantity of material on hand for lagging, bracing and other operation for protection of Work and for use in case of accident or emergency.

3.05 SUPPORT SYSTEMS WITH INTERNAL BRACING

- A. Use walers, struts, and rakers as necessary to provide internal support of excavation faces retained by soldier piles. Internal columns are unacceptable.
- B. When walers are used, obtain tight bearing between wales and wall, and ample bearing area with starpack for load transfer.
- C. Provide struts as indicated and intermediate bracing as needed to enable struts to carry maximum design load without distortion or buckling.
- D. Provide diagonal bracing as needed for stability of system.
- E. Include web stiffeners, plates or angles as needed to prevent rotation, crippling or buckling of connections and points of bearing between structural steel members. Allow for eccentricities caused by field fabrication and assembly.

- F. Install and maintain internal bracing support members in tight contact with each other and with surface being supported. Attach struts to wales using direct end bearing vertical plate (shimmed) connections at all levels.
- G. Design internal bracing support members for maximum forces occurring during excavation or removal stages.
- H. Preloading:
 - 1. Preload internal bracing members, including struts, (except deck beams), shores and similar members, to 50 percent of design compression load occurring during excavation phase.
 - 2. Use procedures that produce uniform loading on bracing members without inducing appreciable eccentricities or overstressing and distortion.
 - 3. Make provisions for permanently fixing each member with steel shims or wedges welded into place.
 - 4. Accomplish preloading by jacking supports in place against soldier piles or wales.
 - 5. Do not use wooden wedges to preload bracing member.
 - 6. Include in preloading system means to determine, within five percent, amount of preload induced into bracing members.
- I. If decking beams are not required, or if decking beams are not designed to support excavation loads, install uppermost tier of bracing at vertical distances not more than eight feet below top of excavation.
- J. Install tiers of internal bracing with a vertical distance between them and level of excavation below of not greater than 15 feet. Reduce maximum vertical distance to nine feet where ground movement and settlement shall be minimized to prevent damage, where indicated or as directed.
- K. Excavate below point of support as indicated. Install bracing, and preload immediately after installation and before continuing excavation.
- L. When removing struts, increase vertical spacing provided invert slab has been place for at least ten days and support system is adequate to support, safely, adjacent structures and works.
- M. Vertical spacing of bracing may be increased when removing struts, provided support system is adequate to support adjacent structures and works.

3.06 REMOVAL OF SUPPORTING SYSTEM

- A. When removing excavation support system, do not disturb or damage adjacent buildings structures, construction, or utility facilities. Fill voids immediately with lean concrete or with approved backfill compacted to the density as specified in Section 31 00 00, "Earthwork".
- B. Except as specified herein and below, remove sheeting system to a depth of at least six feet below the ground surface.
- C. Remove material of supporting system from the Worksite immediately.

END OF SECTION

SECTION 321217

HOT MIX ASPHALT PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.

1.03 SUMMARY

- A. This Section includes the following:
 - 1. Hot mix asphalt paving.
 - 2. Heavy-duty hot mix asphalt paving.
 - 3. Concrete base.
 - 4. Pavement patching.
 - 5. Pavement overlay.
 - 6. Asphalt surface treatments.
 - 7. Cold milling of existing hot-mix asphalt pavement.
 - 8. Curbing.
- B. Related Sections include the following:
 - 1. Section 310000 "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.
 - 2. Section 321723 "Pavement Markings" for pavement marking paint.

1.04 DEFINITIONS

- A. DOT: Rhode Island Department of Transportation

1.05 DESIGN REQUIREMENTS

- A. Use all means necessary to protect pavement materials before, ongoing, and after installation, and to protect the installed work and materials of all other trades.
- B. In the event of damage, immediately make all repairs and replacements necessary as directed by the Owner's Representative at no additional expense to the Owner.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated include technical data, gradation, and composition of materials proposed.
- B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

- C. Qualification Data: For manufacturer.
- D. Material Test Reports: For each paving material.
- E. Conformance Certificates: For each paving material, signed by manufacturers.
- F. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international graphics symbol, spaces dedicated to people with disabilities.

1.07 QUALITY ASSURANCE

- A. The manufacturer shall be a paving-mix manufacturer registered with and approved by the Rhode Island Department of Transportation.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 and ASTM E 329 for testing indicated.
- C. Regulatory Requirements: Comply with the State Standards.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
 - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 - 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.01 AGGREGATES

- A. Conform to State Standards.

2.02 HOT MIX ASPHALT SURFACE COURSE

- A. HMA: RIDOT HMA Class 9.5 mix; Conform to Subsection 401.02 and Item M.03 of the State Standards.
- B. Heavy-Duty HMA: RIDOT HMA Surface Course Modified Class 12.5 mix; Conform to Subsection 401.02 and Item M.03 of the State Standards
- C. HMA Overlay: RIDOT HMA Class 9.5 mix; Conform to Subsection 401.02 and Item M.03 of the State Standards.
- D. Surface course shall not include reclaimed asphalt pavement materials.

2.03 HOT MIX ASPHALT BASE COURSE

- A. HMA: RIDOT HMA Class 12.5 mix; Conform to Subsection 401.02 and Item M.03 of the State Standards.

2.04 TACK COAT

- A. Conform to Asphalt Emulsion Tack Coat as specified in Section 403 of the State Standards

2.05 GRAVEL BASE COURSE

- A. Conform to Sand Gravel Fill as specified in Section 310000 – Earthwork

2.06 GRAVEL SUBBASE COURSE

- A. Refer to plans and Section 310000 – Earthwork.

2.07 SUBGRADE

- A. Reuse on-site material, or Common Borrow, as specified in Section 310000 - Earthwork.

2.08 CONCRETE BASE

- A. The pavement profile within the State Right-of-Way shall include a 8" thick concrete base. Refer to the plans for the pavement profile.
- B. Concrete base shall be 4000 psi Class XX and shall be in accordance with sections 505 and 601 of the State Standard Specifications.
- C.

2.09 CURBING

- A. Granite curbing shall conform to Subsection 906.02.1, and Item M.09.01 of the State Standards.
- B. Provide concrete curb lock on all curbing.

2.010 COARSE AGGREGATE

- A. ASTM D 692, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.

2.10 FINE AGGREGATE

- A. ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.11 TEMPORARY TRENCH PATCHING

- A. Conform to Section 410.02 of the State Standards.

PART 3 - EXECUTION

3.01 CONTRACTOR REQUIREMENTS

- A. The Contractor shall perform and complete the construction work within the limits indicated in a continuous manner so that the pavement placement work may proceed without delay.
- B. The Contractor shall, at all times, prior to acceptance of the work by the Engineer, maintain the completed work in a safe and satisfactory condition. All maintenance and repairs to the completed work shall be subject to the approval of the Engineer and the controlling municipal and State authorities. All maintenance and repairs of the completed work shall be provided by the Contractor at no additional cost to the Owner.

- C. Equipment used in the work will be subject to approval by the Engineer and shall be maintained in a satisfactory condition at all times. Unless otherwise permitted, compaction shall be performed by use of suitable power rollers. Finished surfaces of new asphaltic surface courses shall finish even with adjacent existing pavement surfaces and be free from surface irregularities.
- D. It shall be the responsibility of the Contractor to obtain from the controlling municipal authorities all required permits for cutting roadway pavements and to perform the work in accordance with all customs and requirements of the controlling authorities, in addition to those specified herein, and at no additional expense to the Owner.
- E. Existing pavements outside of the indicated work limits which are damaged as a result of the Contractor's operations, including base courses, tack coats and surface courses, shall be replaced by the Contractor in accordance with the requirements specified herein for the respective type of pavement; in a satisfactory manner and at no additional cost to the Owner.
- F. In case of settlement or other defects in new or replaced pavements, the Contractor shall cut out, replace, restore or repair the damaged pavements at no additional expense to the Owner. This requirement shall remain in effect for 2 years after the acceptance of the work by the Owner. The pavement area to be replaced, repaired or restored, shall extend from edge of pavement to edge of pavement, a minimum of 20 feet on either side of the defect; final pavement course shall be feathered to provide a smooth finish detail.
- G. The Contractor shall furnish a bond for the 2-year duration to the Owner insuring that the corrective repairs will be performed if necessary.
- H. This contract shall not be considered complete until the replacement, restoration and repair of pavements has been provided in a manner satisfactory to the Owner's Representative, and in accordance with the requirements specified herein.

3.02 CURBING

- A. Granite curbing shall be installed or reset in accordance with Subsection 906.03.1 of the State Standards.
- B. Precast concrete curbing shall be installed in accordance with Subsection 906.03.2 of the State Standards.
- C. All curbing in all locations shall be installed with concrete curb lock prior to backfill to lock curb in place at all locations on-site. Curb lock shall be 3,000 psi concrete.

3.03 SUBGRADE PREPARATION

- A. Prepare subgrade by shaping and compacting to proper grade. Remove all soft and yielding material from the subgrade and replace with suitable material. Compact thoroughly using approved types of rollers or tampers. Ensure that all areas are stable and dry.
- B. Saw cut edges of existing pavement along even lines to obtain undisturbed, clean and sound vertical edges of original pavement.
- C. Do not store or stockpile materials on the subgrade.

3.04 GRAVEL BASE COURSE AND SUB-BASE COURSE PLACEMENT

- A. Place materials in the proper lift depths and perform compaction as specified in the earthwork section. Make proper allowance for asphalt courses.
- B. All compaction shall be performed with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers where heavy equipment is authorized.

- C. Do not operate heavy equipment closer to a foundation than a horizontal distance equal to height of backfill above bottom of foundation. Compact remaining area with hand tampers suitable for material being compacted. Place and compact backfill around pipes with care to avoid damage.

3.05 HOT MIX ASPHALT BASE COURSE

- A. Provide a HMA Base Course in the compacted thickness as shown on the drawings.
- B. The HMA Base Course shall be provided in accordance with the applicable requirements of the State Standards, Section 401, Subsection 401.02 and Item M.03 for materials; and Item 401.03 for construction methods.

3.06 HOT MIX ASPHALT SURFACE COURSE

- A. Place HMA Surface Course in compacted thickness as shown on drawings. The finished pavement surface shall conform to the proposed grades of the roadway or as directed, and shall be flush with all existing pavements unless otherwise indicated.
- B. The HMA Surface Course shall be provided in accordance with the applicable requirements of the State Standards, Section 401, Subsection 401.02, and Item M.03 for materials, and Subsection 401.03 for construction methods.
- C. A tack coat conforming to the Rhode Island State Standards shall be applied to the base course prior to the placement of the surface course regardless of the timing between coats.

3.07 CONCRETE BASE COURSE

- A. Install Concrete Base course within State Right-of-Way.
- B. Install Concrete Base Course in accordance with Sections 505 and 601 of the State Standards.

3.08 COMPACTION

- A. The Contractor shall conform to the State Standards for pavement operations, including compaction (401.03.10).
- B. Immediately after the HMA mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition and when rolling does not cause undue displacement, cracking and shoving.
- C. The number, weight and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. Rolling shall be continued until all roller marks are eliminated and the minimum densities have been obtained based upon 95 percent of theoretical maximum laboratory densities made in the proportions of the job-mix formula and will be determined using nuclear density gauge or in-place cores.
- D. Steel-Tired, Static Weight Rollers: The maximum roller speeds for steel-tired static-weight rollers for various operations shall not exceed three miles per hour. The wheels of steel-wheel rollers shall be kept moist and clean to prevent adhesion of the fresh material, but an excess of water will not be permitted.
- E. Vibratory Rollers: The maximum roller speed for vibratory rollers shall be that which provides impact spacing less than the compacted lift thickness. When vibratory rollers are used in the static mode, roller speed shall not exceed three miles per hour.
- F. When an approved vibratory roller is used for breakdown rolling in a vibratory mode, intermediate rolling will not be required. When the vibratory roller is used for finish rolling it shall be used in the

static mode. Rolling shall progress continuously until the specified density of the corresponding theoretical maximum density obtained at the plan has been attained. Finish rolling shall continue until all roller marks are eliminated.

- G. Unless otherwise directed, rolling shall start longitudinally at the sides and gradually progress toward the center of the pavement except on super-elevated curves where the rolling shall begin on the low side and progress to the high side, overlapping on successive trips by at least one-half the width of tandem rollers and uniformly lapping each preceding track.
- H. The motion of the rollers shall be slow enough at all times to avoid displacement of the hot mixture. Any displacement resulting from reversing the direction of the rollers or from any other cause shall be satisfactorily corrected.
- I. When the base course fails to comply with the density requirements herein specified additional compaction might be applied when permitted and as directed, to attain the required density. If satisfactory density cannot be attained the Contractor shall be required to remove and replace, at his own expense, any affected area that is proven to be structurally inadequate and/or incapable of maintaining material integrity.
- J. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be removed and replaced with fresh hot mixture, which shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of material shall be removed and replaced.
- K. In the event of dispute as to the creditability of the results, density shall be determined from cores taken from the pavement.

3.09 TACK COAT

- A. Tack coat shall be installed in accordance with Section 403 of the State Standards except that the tack coat should be applied to the base course prior to the placement of the surface course regardless of the time elapsed between placement of the base and surface course.

3.010 TEMPORARY TRENCH PATCHING

- A. Install temporary trench patch in accordance with to Section 410 of the State Standards.

END OF SECTION

SECTION 321313

CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.

1.03 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Sidewalks
 - 2. Vehicular Concrete Pavement
 - 3. Detectable Warning Panels
- B. Related Sections include the following:
 - 1. Section 310000 Earthwork

1.04 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.05 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated. Indicate name, source, and description of each material and product.
- B. Design Mixtures:
 - 1. Submit prior to start of Work written reports of each proposed mix for each class of concrete. Do not begin concrete production until mixes have been approved by the Engineer.
 - 2. For each concrete pavement mixture, include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Qualification Data: For testing agency.
- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the aggregates and concrete mix with requirements indicated.
- E. Batch Ticket Information: Provide concrete delivery tickets showing job name and location, date and time of delivery, quantity of concrete, quality and type of concrete, admixtures, amount of water added, and all other relevant information as described in ASTM C-94. Submit original batch tickets and 2 copies at the end of each week.

- F. Field quality-control test reports.
- G. Sample of Detectable Warning Panel for review by Owner
- H. Submittal depicting proposed locations for expansion and control joints on all cement concrete pavement surfaces.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- E. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
 - 1. Build mockups of approximately 100 square foot size in the location as directed by the Architect.
 - 2. Notify Owner's Representative a minimum of seven days in advance of dates and times when mockups will be constructed.
 - 3. Obtain Owner's Representative's approval of mockups before starting construction.
 - 4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
 - 5. Demolish and remove approved mockups from the site when directed by Owner's Representative.
 - 6. Approved mockups may become part of the completed Work if approved by the Owner's Representative.

1.07 DESIGN REQUIREMENTS

- A. Design formwork to support vertical loads and lateral pressures resulting from placement and vibration of concrete in accordance with the requirements of ACI 301 and ACI 347, and as specified herein.
- B. Camber the formwork to compensate for anticipated deflections due to the weight and pressure of the fresh concrete and due to construction loads.
- C. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Use wedges or jacks, individually or in combination for adjustment.
- D. Design forms and falsework to include assumed values of live loads, dead load, weight of moving equipment operated on formwork, concrete mix, height of drop, vibrator frequency, ambient temperature, lateral stability, and other factors pertinent to the safety of the structure during construction.
- E. Provide and design forms to conform with expansion and construction joint locations

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Order concrete from batching plant so that trucks arrive at discharge locations when concrete is required. Avoid excessive mixing of concrete or delays in placing successive layers of concrete in forms.
- C. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the water-cement ratio, slump, air entrainment, temperature and homogeneity.
- D. Concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket will be rejected.

1.09 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Weather: Protect concrete from damage and reduced strength or performance due to weather extremes during mixing, placing and curing.
- C. Cold Weather: Unless special precautions are taken to protect concrete, do not Work when temperatures are below 40°F or when temperatures are expected to fall below 40°F within 72 hours after placing concrete.
 - 1. Comply with ACI 306 in cold weather.
 - 2. Maintain concrete temperature of at least 60°F. Reinforcement, forms and ground in contact with concrete, shall be free of frost.
 - 3. Keep concrete and formwork at least 50°F for at least 96 hours after placing concrete.
 - 4. The use of calcium chloride in any form is not permitted. Non-chloride accelerator shall be used when ambient temperature is below 50°F.
 - 5. Admixture manufacturer shall provide technical assistance at no additional cost. A manufacturer's representative shall be available for consultation by phone or on site upon 72-hour notice.
- D. Hot Weather: Concrete, when deposited, shall be less than 85°F. Cool the mix in a manner acceptable to the Engineer if the concrete temperature is higher.
 - 1. Comply with ACI 305 in hot weather.
 - 2. Retarder shall be used when ambient temperature exceeds 80°F.

PART 2 - PRODUCTS

2.01 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

- C. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- D. Form Ties:
 - 1. Form Ties: For concrete structures, which will not be in view or buried below finish grade, use carbon steel factory-fabricated, removable or stay in place snap-off type form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units, which will leave no metal closer than 1-1/2" to surface. Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface. Patch all holes with non-shrink grout.
 - 2. Form ties and spreaders for walls in areas exposed to view shall be Stainless Steel Cone-Tight Tyscru by Richmond Screw Anchor Co.; Dayton Sure-Grip and Shore Co.; or substitute approved by Engineer with Plastic cone-tight type cones having a 1" setback and a taper from 1" to 1-1/4". Tycone holes shall be sealed with plastic set back plugs, color as selected by Engineer from manufacturer's standard color selection or filled with non-shrink grout. Tyscru ties shall be sized to satisfy loading requirements.
 - 3. In lieu of form ties specified above, fiberglass form tie systems shall be used. Fiberglass form ties shall be standard gray color. The concrete structure shall be finished by grinding the fiberglass form tie flush with the finish surface of the concrete structure.
 - a. If tapered architectural holes are required, dummy tapered cones having a 1" setback and a taper from 1" to 1-1/4" shall be fastened to the interior of the formwork to achieve the specified pattern on the finish structure.
- E. Chamfer Strips: Provide 3/4-inch triangular fillets to form all exposed concrete corners. Material shall be rubber or polyvinyl chloride type, or smooth clear, sealed softwood.

2.02 STEEL REINFORCEMENT

- A. Steel reinforcement required for the construction of sidewalks, walkways, and concrete apron shall conform to the requirements of the State Standards.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- D. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- E. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- F. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.

2.03 CONCRETE MATERIALS

- A. The Contractor shall insure that the final appearance of the sidewalks is consistent throughout the whole project. Any difference in color, texture, or finish will not be accepted by the Engineer.
 - 1. Any portion of sidewalk or walkway that does not match the color, texture, or finish of previously constructed sidewalks will be removed and replaced with a sidewalk that matches the recently poured sidewalks at the expense of the Contractor.
- B. Cementitious Materials conforming to the State Standards shall be provided for the construction of the proposed sidewalks.
 - 1. The cement factor shall be between 658 lbs/cy and 799 lbs/cy.
 - 2. The maximum water/cementitious ratio is 0.42.

3. The slump shall be between 1 and 3 inches.
 4. The minimum compressive strength after 7 days shall be 2,400 lbs with a 28-day compressive strength of 4,000 lbs.
- C. Aggregate shall conform to the requirements and gradations specified in the State Standards.
 - D. Water: ASTM C 94/C 94M.
 - E. Air-Entraining Admixture: ASTM C 260.
 - F. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.04 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

2.05 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to the State Standards, for each type and strength of normal-weight concrete required.

2.06 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
 1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For concrete mixes larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

2.07 PREMOLDED JOINT FILLER

- A. Provide premolded joint filler conforming to ASTM D1752, Type I or Type II.
- B. Provide Type III self-expanding cork where specifically indicated.
- C. Provide joint filler of same thickness as expansion joint width indicated.
- D. Provide maximum length filler manufactured to minimize field splicing.

2.08 JOINT COMPOUNDS

- A. Provide joint compound for expansion joints in horizontal surfaces and surfaces inclined less than 30 degrees from the horizontal conforming to ASTM C920, Type S or M, Grade P, Class 25. Use type T in pedestrian and vehicular traffic areas and use type NT in non-vehicular areas.
- B. Provide joint compound for expansion joints in walls and surfaces inclined greater than 30 degrees from the horizontal conforming to ASTM C920, Type S or M, Grade NS, Class 25.
- C. Provide compatible joint compounds as recommended by manufacturer when they abut each other.
- D. Provide compound intended for continuous submergence in liquid containing structures.

2.09 BOND BREAKER FOR JOINT COMPOUNDS

- A. Provide polyethylene tape, coated tape or metal foil.

2.10 BACK-UP MATERIAL FOR JOINT COMPOUNDS

- A. Provide polyethylene foam or polychloroprene foam rubber.
- B. Do not use material impregnated with oil, bitumen, or similar substances.
- C. Provide back-up material as recommended by joint compound manufacturer that is compatible with the joint compound and has the same expansion/contraction capability as joint compound.

2.11 DETECTABLE WARNING PANELS

- A. Cast iron detectable warning surface shall conform to the Americans with Disabilities Act Title 49 CFR Transportation, Part 37.9 Standards for Accessible Transportation Facilities, Appendix A, section 4.29.2 detectable warnings on walking surfaces)
- B. Detectable warning panels shall conform to Subsection 905 of the State Standards.
- C. Detectable warning panels shall be manufactured and installed to the sizes and dimensions indicated on the Contract Documents and approved Submittals.
- D. Detectable warning panel shall be set in a minimum of 4" of concrete base.
- E. Mortar for Detectable Warning Panel
 - 1. Mortar for grouted joints between panel shall be a cement mortar composed of one part Portland cement and two parts sand, by volume with sufficient water to form a workable, stiff mixture.
 - 2. Setting bed mortar shall conform to ASTM C 270, Type S, except that latex polymer additive shall be mixed with the cementitious materials and aggregate in lieu of water.

3. Cement: Shall be an American portland cement conforming to ASTM C150, Type I or II, except Type III may be used for cold-weather construction, and shall exhibit no efflorescence when cast into 2 inch x 7 inch x ½ inch (50 mm x 178 mm x 13 mm) slabs comprising the mortar under test.
4. Water: clean, fresh and potable, from public water system.
5. Sand: clean, washed, uniformly well-graded, conforming to ASTM C144 with 100 percent passing No. 8 sieve (2.37 mm), and not more than 35 percent passing No. 50 sieve (300um), with a fineness modulus maintained at 2.25 plus or minus 0.10.
6. Hydrated Lime: provide plastic hydrate, conforming to ASTM C207, Type "S" as approved by the Owner's Representative.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
 2. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in SECTION 310000 EARTHWORK.
- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.
- D. Remove loose material from compacted subbase surface immediately before placing concrete.

3.02 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.
- C. General:
 1. Construct forms as designed and in accordance with Contractor's approved working drawings conforming to ACI 347, to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, level, and plumb work in finished structures.
 2. Provide for openings, offsets, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required. Use selected materials to obtain required finishes.
 3. Forms for concrete which accommodate work of other trades, fabricated before the opportunity exists to verify the measurements of adjacent construction, shall be accurately sized and located as dimensioned on the Drawings. In the event that deviation from the Drawing dimensions results in problems in the field, the Contractor shall be responsible for resolution of the conditions as approved by the Engineer, at no cost to the Owner.
- D. Fabrication:
 1. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage concrete surfaces.

2. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to temporary openings on forms in as many inconspicuous locations as possible, commensurate with design requirements. Form intersecting planes to provide true, clean cut corners.
- E. Falsework:
1. Erect falsework and support, brace, and maintain it to safely support vertical, lateral, and asymmetrical loads applied until complete structure has attained design strength. Construct falsework so that adjustments can be made for take-up and settlement, and access is provided for inspection.
 2. Provide wedges, jacks or chamfer strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to product work of required dimensions.
- F. Forms for Exposed Concrete:
1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes
 2. Provide sharp clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or grits to maintain true, square intersections.
 3. Use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material, which will produce bow.
- G. Corner Treatment:
1. Unless shown otherwise, form chamfers with $\frac{3}{4}$ -inch by $\frac{3}{4}$ -inch strips, accurately formed and surfaced to produce uniformly straight lines and tight edge joints on exposed concrete. Extend terminal edges to required limit and miter chamfer strips at changes in direction.
- H. Control Joints: Locate as indicated on the Drawings.
- I. Provision for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Verify size and location of openings, recesses and sleeves with the trade requiring such items. Accurately place and securely support items to be built into forms.
- J. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove encrusted mortar and grout, chips, wood, sawdust, dirt, and other debris just before concrete is placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.03 REMOVAL OF FORMS

- A. Formwork not supporting concrete, such as sides of walls, columns, and similar parts of the Work, may be removed after cumulatively curing at not less than 50 degrees F for 72 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operation, and provided that curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as elevated beams, joists, slabs and other structural elements may not be removed until concrete has attained 70% of its design minimum 28-day compressive strength, and has cumulatively cured for no less than 7 days. Concrete shall have sufficient strength to safely support its own weight and construction live loads and lateral pressures. Determine potential compressive strength of in-place concrete testing field-cured specimens representative of the concrete location or members in accordance with State Standards.

- C. Form facing material may be removed one day after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.
- D. Form ties: The concrete structure shall be finished by grinding the fiberglass form ties flush with the finish surface of the concrete structure.

3.04 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. When forms are reused for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Apply new form releasing agent to all form areas that will be in contact with concrete.
- B. Do not reuse forms if there is any evidence of surface wear and tear, splits, fraying, delamination or other damage which would impair the quality of the concrete surface or prevent obtaining the specified concrete finish.

3.05 STEEL AND WELDED WIRE FABRIC REINFORCEMENT

- A. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- B. Place steel or welded wire fabric in conformance with the construction methods specified within the State Standards.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.06 CONSTRUCTION JOINTS

- A. Locate and install construction joints as indicated or, if not indicated, locate so as not to impair the strength and appearance of the structure. Submit proposed construction joint locations for approval.
- B. The Contractor shall score the concrete sidewalks in conformance with the scoring pattern shown on the Drawings where specified.
- C. Where the scoring pattern is not specified, the Contractor shall score the concrete sidewalk in conformance with the State Standards.
- D. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints.
- E. Key groove all construction joints unless otherwise indicated. Wall horizontal joints need not be keyed except where specifically indicated.
- F. Key grooves shall be one-third the thickness of the thinner member and 1-1/2-in. deep unless otherwise indicated.
- G. Use tapered key groove forms to permit form removal without damage to the groove. Taper not to exceed 2 inches per foot.
- H. Center waterstops in construction joints unless otherwise indicated. Secure waterstops in position by tie wire to adjacent reinforcing every 12 inches.

- I. Consolidate concrete during placement in the vicinity of key groove without damaging or dislodging waterstop.
- J. Remove all key groove forms.
- K. Clean key groove of laitance, curing compound, foreign materials and protrusions of hardened concrete. Roughen by bush hammer or lightly sandblast to expose coarse aggregate. Blow out debris and dust with oil-free compressed air.
- L. Protect exposed key groove and waterstop from damage.

3.07 EXPANSION JOINTS

- A. Install expansion joints in accordance with the manufacturers printed instructions and as indicated.
- B. Center waterstops in expansion joints unless otherwise indicated. Secure waterstops in position by tie wire to adjacent reinforcing every 12 inches.
- C. Consolidate concrete during placement in vicinity of expansion joint without damaging premolded joint filler and waterstop.

3.08 PREMOLDED JOINT FILLER

- A. Treat cut surface of premolded joint filler in conformance with manufacturer's printed instructions.
- B. Place premolded joint filler against the bulkhead form and fasten to the inside of the form with noncorrosive fasteners. Remove all fasteners when bulkhead form is removed.
- C. Prevent disturbance of or damage to premolded joint filler.
- D. Fill expansion joint completely with premolded joint filler, except as specified below.
- E. Secure wood strips to expansion joint surfaces, which are to receive joint compound.
- F. Use tapered wood strips with smaller widths being the same width as the expansion joint and of depth necessary to install the joint compound and back-up materials.
- G. Use materials to secure the premolded joint filler and wood strips that will not harm concrete or affect the joint compound bond to concrete.
- H. Do not remove wood strips until forms are removed as specified in 3.03REMOVAL OF FORMS.
- I. Clean groove of laitance, curing compound, foreign materials and protrusions of hardened concrete. Blow out debris and dust with oil-free compressed air.

3.09 JOINT COMPOUND

- A. Seal the dry clean concrete in expansion joints in conformance with manufacturer's printed instruction.
- B. Install back-up and bond breaker materials.
- C. Prime concrete, fill flush with joint compound or required thickness, tool to concave shape and seal in conformance with manufacturer's printed instructions and ASTM C1193.

- D. Prevent spilling joint compound over adjoining surfaces. Use tape adjacent to joint as required. Remove all tape completely from concrete surface after installing joint.
- E. Do not prime concrete or install joint compound when compound, air or concrete temperature is less than 40 deg. F. or as required by manufacturer.

3.10 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site.
- F. Do not add water to fresh concrete after testing.
- G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
 - 1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.
- J. Screed pavement surfaces with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- L. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- M. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- N. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.11 FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.12 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 2. Water.
 3. Continuous water-fog spray.
 4. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 5. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 6. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.13 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 - 1. Elevation: 1/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/4 inch.
 - 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
 - 5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
 - 6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
 - 8. Joint Spacing: 3 inches.
 - 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 10. Joint Width: Plus 1/8 inch, no minus.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least 1 composite sample for each 5000 sq. ft. or fraction thereof of each concrete mix placed each day.
 - 2. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 - 4. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 - 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 - 7. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 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.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall 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.

- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.15 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section at no expense to the Owner.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

3.16 DETECTABLE WARNING PANELS

- A. No panels shall be laid in inclement weather or when the temperature is 36 degrees Fahrenheit, and dropping, nor shall any work be done on rising temperatures until the temperature reaches 32 degrees Fahrenheit. Frozen mortar materials shall not be used.
- B. Cast iron detectable warning panels in a prepared concrete base slab. All setting shall be done by competent workmen under adequate supervision.
- C. Damp the surface immediately before placing the mortar setting bed, but do not allow free water to remain on the surface.
- D. Exposed surfaces of panels shall be kept free from bed mortar at all times. Any bed mortar smears shall be immediately removed with a clean sponge and clean water before latex modified mortar can set.
- E. Panels shall be set true to the required lines and grades in the pattern detailed on the Contract Documents.
- F. Joints between panels shall be filled with mortar to prevent water intrusion.

END OF SECTION

SECTION 321723

PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.

1.03 SUMMARY

- A. This Section includes the following:
 - 1. Pavement-marking paint.
- B. Related Sections include the following:
 - 1. Section 321217 Hot Mix Asphalt

1.04 DEFINITIONS

- A. DOT: Rhode Island Department of Transportation

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated include technical data and composition of materials proposed.
- B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- C. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international graphics symbol, spaces dedicated to people with disabilities.
- D. Qualification Data: For manufacturer.
- E. Material Test Reports: For each paving material.
- F. Conformance Certificates: For each paving material, signed by manufacturers.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the State Standards.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.08 PROJECT CONDITIONS

- A. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.01 PAVEMENT MARKINGS

- A. Pavement markings shall be composed of epoxy resin conforming to the State Standards.
- B. Pavement markings shall be "yellow" or "white" in color as specified on the Drawings.
- C. Pavement marking stripes shall measure 4 inches in width or as specified on the Drawings.
- D. Waterborne pavement markings are not acceptable.

PART 3 - EXECUTION

3.01 PAVEMENT MARKINGS

- A. Epoxy Resin Pavement Markings shall be installed in accordance with Section T.20 of the State Standards.

END OF SECTION

SECTION 331100

WATER DISTRIBUTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. All work specified in this Section shall conform to the City of East Providence Standard Technical Specifications for Water Main Installation.
- C. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.
- D. American Water Works Association (AWWA):
 - 1. AWWA B300: Standard for Hypochlorites
 - 2. AWWA B301: Standard for Liquid Chlorine
 - 3. AWWA C104: Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - 4. AWWA C110: Standard for Ductile-Iron and Gray-Iron Fittings for Water
 - 5. AWWA C111: Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 6. AWWA C150: Standard for the Thickness design of Ductile Iron Pipe
 - 7. AWWA C151: Standard for Ductile Iron Pipe, Centrifugally Cast
 - 8. AWWA C153: Standard for Ductile-Iron Compact Fittings for Water Service
 - 9. AWWA C502: Dry-Barrel Fire Hydrants
 - 10. AWWA C509: Resilient Seated Gate Valves for Water Supply Service
 - 11. AWWA C515: Reduced-Wall, Resilient Seated Gate Valves for Water Supply Service
 - 12. AWWA C600: Standard for Installation of Ductile Iron Water Mains and their Appurtenances
 - 13. AWWA C605: Standard for Installation of Polyvinyl Chloride Water Mains and Their Appurtenances
 - 14. AWWA C651: Standard for Disinfecting Water Mains
 - 15. AWWA C900: Standard for PVC Pressure Pipe and Fabricated Fittings
 - 16. AWWA C906: Standard for Polyethylene (PE) Pressure Pipe
 - 17. AWWA M41: Ductile Iron Pipe and Fittings
- E. American Society for Testing and Materials (ASTM):
 - 1. ASTM D-638: Tensile Properties
 - 2. ASTM D1784: Rigid Poly (Vinyl Chloride)(PVC) Compounds and Chlorinated Poly (Vinyl Chloride)(CPVC) Compounds
 - 3. ASTM D-1238: Flow Rates of Thermal Plastics
 - 4. ASTM D-1505: Density of Plastics by Gradient Technique
 - 5. ASTM D-2837: Hydrostatic Design Basis for Thermal Plastics
 - 6. ASTM D-3261: Butt Heat Fusion for Polyethylene (PE)
 - 7. ASTM D-3350: Specification for Polyethylene Pipe and Fittings
 - 8. ASTM F-714: Polyethylene (PE) Plastic Pipe (SDR-PR)

9. ASTM F-1248: Environmental Stress Crack Resistance (ESCR)

F. Other Publications:

1. ASME B32.8: Hydrostatic Testing Guidelines
2. ANSI B31.3: Fittings, Flanges and Valves
3. JM Eagle Blue Brute / Big Blue / Ultra Blue Installation Guide
4. Plastic Piping Institute Best Practices TR 31/9-79

1.03 SUMMARY

- A. This Section includes water distribution piping and related components outside the building for water service and fire service mains.
- B. Related sections include the following:
1. 310000 – Earthwork for excavating, trenching, and backfilling.

1.04 SUBMITTALS

- A. Product Data and Shop Drawings:
1. For each type of product indicated.
 2. Shop drawing of temporary connection backflow preventer used for testing and disinfection.
 3. Detail of temporary connection between existing and new water pipelines.
- B. Field quality-control test reports and disinfection notification:
1. The Contractor shall initially notify and subsequently provide the test reports to the Owner's Representative and the designated authority upon completion of the disinfection and pressure testing.
 2. Include certified reports of the required bacteriologic test from an approved qualified independent testing laboratory.
 3. Provide a copy of the test reports to the Owner and Engineer.
- C. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.
- D. A copy of any permits required by the utility company or local authorities having jurisdiction shall be submitted to the Engineer prior to commencing work on the water system.
- E. Certificate of Compliance:
1. Each shipment of valves, tapping sleeves and appurtenances shall be accompanied with the manufacturer's notarized certificate certifying conformance with the requirements of the Specifications.
- F. Contractor shall submit qualifications as outlined under the "Contractor's Qualifications" section below.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Comply with requirements of the Owner, the designated authority, and the National Standard Plumbing Code including requirements pertaining to the tapping of water mains and backflow prevention.
 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
 - 1. Marking of all pipes shall conform to the requirements of AWWA C151, latest revision.
 - 2. Marking of all fittings shall conform to the requirements of AWWA C153 or C110, latest revision.
 - 3. Marking of all tapping sleeves shall conform to the requirements of AWWA C110 latest revision and marking of all valves shall conform to the requirements of AWWA C509 latest revision.
 - 4. Marking of all ductile iron pipes shall conform to the requirements of AWWA C151, latest revision, and marking of all fittings shall conform to the requirements of AWWA C153, latest revision.
 - 5. Marking of all hydrants shall conform to the requirements of AWWA C502, latest revision.
- C. National Fire Protection Agency (NFPA) Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- D. All water pipe and appurtenances shall be "American Made".
- E. Any water pipe, fitting, or appurtenance that does not meet the specifications, field quality testing, or is damaged during installation, shall be removed and disposed from the project site and replaced with new material conforming to this specification at no additional cost to the Owner.

1.06 MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall furnish, at no additional expense to the Owner, the services of pipe manufacturer's representatives for instruction of the Contractor's personnel who will be installing the pipe, tapping sleeves, transition couplings, and valves. The instruction shall include proper handling, installation, and jointing and other construction areas, and shall be for such lengths of time required to fully familiarize the Contractor's personnel with the proper techniques. This information shall be bound and indexed for each type of unit as herein specified.

1.07 CONTRACTOR'S QUALIFICATIONS

- A. PVC Water Pipe:
 - 1. The Contractor's personnel responsible for the installation of the new PVC water main, specifically the personnel responsible for the joint connection and fitting installation, shall have demonstrable experience in the installation of buried pressure PVC water pipe. The Contractor shall provide at least five project references for projects of similar size and scope that demonstrate that the personnel assigned to this project have experience in the installation of buried pressure PVC water pipe.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture. If factory-applied end caps are not present, plastic covering shall be used over each end of the pipe. The covering shall be secured in-place with a cord or cable and each pipe opening shall be provided with its own covering.
- E. Pipe and related materials shall be stored in locations and in a manner approved by the Owner and Owner's Representative. The locations and manner of storage shall be as to minimize handling of materials.
- F. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- G. Protect flanges, fittings, and specialties from moisture and dirt. Piping or materials damaged during delivery storage or handling shall be replaced at the expense of the Contractor.
- H. The Contractor shall, at all times, be solely responsible for the safe storage of all materials.

1.09 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Owner and Owner's Representative in writing no fewer than 2 weeks in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Owner's and Owner's Representative's written permission.

1.010 COORDINATION

- A. Coordinate connection to water main with the designated authority prior to commencing work.
- B. The Contractor shall contact "Dig Safe" at 1-888-Dig Safe to verify locations of existing underground utilities in areas of proposed excavation at least 72 hours prior to commencing any excavation effort. Timeframe excludes weekends and legal holidays.
- C. The Contractor shall be responsible for notifying the City of East Providence Water Division 48 hours prior to any desired valve operations required for the work of this contract, the Contractor shall not operate any valves without the express permission of the City of East Providence Water Division.

1.10 PERMITS

- A. The Contractor shall obtain and pay fees for any permits required by the designated authority and any other authorities having jurisdiction.
- B. Permits shall be obtained prior to commencing work on the water system.

1.11 QUALITY CONTROL

- A. Sampling for laboratory analysis following disinfection shall be conducted by qualified personnel familiar with sampling procedures and protocols.
- B. Reference Standards: Except as modified or supplemented herein, the testing of the pipeline system shall meet the requirements of the following standard specifications:
 - 1. AWWA C600, Latest Revision - Pressure and Leakage Tests; and C651, Latest Revision - Disinfecting Water Mains.

2. NSF/ANSI 60: National Sanitation Foundation Standard for Drinking Water Treatment Chemicals
3. NSF/ANSI 61: National Sanitation Foundation Standard for Drinking Water System Components

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials to be incorporated into the work shall be new and purchased specifically for the project.
- B. All material shall be made in the United States of America in accordance with the American Recovery and Reinvestment Act (ARRA) requirements.
- C. All materials, coatings, lubricants and/or protective oils used on materials that will eventually be in contact with potable water must be ANSI/NSF approved standard 60 or 61 as appropriate.
- D. All water piping, fittings, and appurtenances are to follow the designated authority's rules and regulations for product requirements.

2.02 POLYETHYLENE WATER SERVICE PIPE

- A. Service pipe $\frac{3}{4}$ inch to 2 inch shall be blue HDPE pipe with a virgin clear natural center. Continuous identification markings over the entire length of the pipe with sealed ends and coiled in rolls from 100 ft. minimum.
- B. A solid stainless steel insert shall be installed at each connection and a 12-foot type "K" copper whip shall be installed at the point of entry into any building or structure.
- C. HDPE pipe shall conform to ASTM D3350 Type III, Grade P34, Class A, Category 5, color blue with virgin clear natural center. AWWA C901, 200 psi (CTS).

2.03 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end used only where connections to fittings are made.
 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile iron glands, rubber gaskets, and steel bolts.
 3. Piping shall have a working pressure rating of 200 psi minimum.
 4. Lubrication material is to be food grade quality, kept in original container and stored according to Manufacturer's recommendations.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end used where no connection to fittings is required.
 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile iron standard pattern or AWWA C153, ductile iron compact pattern.
 2. Piping shall have a working pressure rating of 200 psi minimum.
 3. Gaskets: AWWA C111, rubber.
- C. Ductile Iron Pipe shall be Class 52 and shall conform to AWWA C150 and C151, latest revision. Pipe shall have a petroleum-asphaltic on all exterior surfaces.
 1. Interior pipe surfaces shall be covered with a double cement-mortar continuous lining not less than $\frac{1}{16}$ " thick, of materials, and applied in accordance with, ANSI/AWWA C104/A21.4 standards.

2. Ductile Iron Pipe shall be manufactured by one of the following.
3. Pacific States Cast Iron Pipe Company
4. United States Pipe Company
5. Griffin Pipe Products Company
6. American Cast Iron Pipe Company
7. Approved Equivalent

2.04 FITTINGS

- A. Fittings and plugs for use with the ductile iron pipe specified shall be ductile iron, with a working pressure rating of not less than 350 psi, class 350 conforming to AWWA C153, for buried ductile iron pipe, latest revision.
- B. All hardware, in particular nuts, washers, and bolts, for use with mechanical and flange fittings shall be stainless steel.

2.05 JOINTS

- A. Push-on and mechanical type joints for pipe as specified above shall conform to AWWA C111, latest revision. Gasket material for all jointing requirements shall be styrene butadiene (SBR) for buried pipe. Glands shall be ductile iron. Bolts shall be stainless steel.
- B. All lubricants shall be certified NSF approved for use in potable water systems.
- C. Piping shall have a working pressure rating of 200 psi minimum.
- D. HDPE Pipe:
 1. Fittings shall be PE 3408 and, where applicable, shall meet the requirements of AWWA C906. Molded fittings shall be manufactured in accordance with either ASTM D2683 (socket fused) or ASTM D3261 (butt fused) and shall be so marked.

2.06 TAPPING SLEEVES AND TAPPING VALVES

- A. Tapping sleeves shall comply in all respects to AWWA Standard C153 and the following design standards:
 1. Tapping sleeve shall be installed at the locations shown on the plans and details.
 2. The tapping sleeve shall be a mechanical type joint to provide pressure-tight installation and be suitable for use with the existing pressurized pipe material. Outlet flange shall be Class 125C, ANSI B16.1.
 3. Mechanical joint tapping sleeves shall have totally confined end gaskets and be designed to withstand a minimum of 200 psi working pressure.
 4. Mechanical tapping sleeves are to be stainless steel. Nuts and bolts shall be Type 304 stainless steel.
 5. Tapping valves shall comply with Section 2.09 Gate Valves except one end shall be flanged and the other mechanical.
 6. Tapping valves shall be provided with an oversized opening to allow the use of full size cutters.
 7. For tapping sleeves less than (<) 12" in diameter, stainless steel sleeves are acceptable provided they are all stainless steel body with removable bolts. The outlet, body, flanges, nuts, bolts, and washers shall be 18-8 type 300 stainless steel. All welds shall be fully passivated to restore stainless characteristics. Flanges shall conform to AWWA Standard C207, Class D, ANSI 150 lb. with drilling recessed to accept standard tapping valves per MSS-SP60. Bolt holes straddle pipe centerline. Gasket shall be full circumferential gasket compounded for water use per ASTM D2000. Gaskets to be Buna-N (NBR). Sleeves shall be Ford FTSS, JCM 432, Smith Blair 665, or Mueller H-304.

2.07 GATE VALVES

- A. Resilient seated gate valves shall meet AWWA C515 and be UL listed and FM approved. This valve shall be ductile iron-body, stainless steel mounted, non-rising stem, 3-inch through 12-inch in

diameter as shown on the Drawings. All valves shall open RIGHT. All valves shall be mechanical joint.

- B. Sizes 3-inch through 12-inch shall be suitable for 200 psig maximum working pressure and 400 psig test pressure.
- C. Valve shall have a minimum of two O-ring stem seals.
- D. All gate valve hardware, in particular nuts, washers, and bolts, shall be stainless steel for corrosion resistance.
- E. Bonnet and gland bolts and nuts shall be stainless steel for corrosion resistance.
- F. The interior and exterior of valves shall be fully epoxy coated 8 mils thick. Epoxy shall be certified NSF approved for use in potable water systems. Field touch-up of the bonded epoxy within the body of the valve will be allowed; however, touch-up kit must be provided by the manufacturer of the valve and must meet the same NSF approval as the original bonded epoxy.
- G. For purposes of system standardization gate valves shall be manufactured by Mueller.

2.08 GATE VALVE ACCESSORIES AND SPECIALTIES:

- A. Cast iron valve boxes shall be two-piece adjustable style, sliding type. Barrel inside diameter shall be 5¼ inches with 26 inch top section and 48 inch bottom section lengths adjusted to finish grade.
- B. Covers shall be cast iron, 5¼ inch, with the word "WATER" and a direction to open arrow imprinted thereon. The boxes and covers shall be compatible with the valves to which they attach. Covers shall be the heavy, non-tilting 2" drop style recessed in the top to prevent plow breakage.
- C. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- D. An approved operating wrench shall be provided to the Owner.

2.10 STRAIGHT AND TRANSITION PIPE COUPLINGS

- A. The center sleeve and end rings of couplings shall be made of ductile iron, meeting or exceeding ASTM A536. The coupling shall accommodate the entire O.D. range in the specified size by use of interchangeable color-coded end rings and gaskets. Couplings shall have pressure rating that meets or exceeds piping to be joined.
- B. The coupling gasket shall be made of virgin rubber compound for water use. The SBR shall meet or exceed ASTM D2000-3-BA715. The gasket shall have raised lettering and sizing and state the proper color code for the appropriate end ring.
- C. The coupling shall be equipped with stainless steel bolts, washers, and nuts and conform to the latest edition of the AWWA specification designation C111.
- D. Straight couplings shall be as manufactured by Smith Blair Model 441, Romac style 501, or approved equivalent.
- E. Transitional couplings shall be as manufactured by Smith Blair Model 441, Romac style 501 or approved equivalent.
- F. All straight and transition pipe couplings shall be mechanically restrained with approved means. Contractor shall submit to the Engineer for review and approval proposed means of restraint for all pipe couplings.

2.11 FLANGED COUPLING ADAPTERS

- A. Flanged coupling adapters shall be Romac Restrained Flanged Coupling Adapter or approved equivalent. All nuts, washers and bolts shall be stainless steel.
- B. Mechanical restraint shall be an integral part of the follower gland utilizing multiple single tooth wedges. Each follower gland shall incorporate cam action, independent wedge engagement and meet applicable requirements of ANSI/AWWA C111/A21.11.

2.12 VALVE BOXES AND COVERS

- A. Valve boxes shall be two-piece adjustable style, slip type, and heavy pattern ductile iron. Lower section barrel inside diameter shall be at least 5 1/4" inches with 26-inch top section and 48-inch bottom section lengths adjusted to finish grade.
- B. Covers shall be cast iron, 6 inch, with the word "WATER" and a direction to open arrow imprinted thereon. The boxes and covers shall be compatible with the valves to which they attach.
- C. An approved operating key shall be provided.

2.13 THRUST RESTRAINTS

- A. Restraining devices shall be utilized on all mains under the following conditions:
 - 1. Pipeline direction changes (tees, bends)
 - 2. Dead end lines (caps or plugs)
 - 3. Transition pieces (reducers)
 - 4. Couplings
 - 5. All mechanical joints
- B. Mechanical restraining devices may be utilized on bends, mechanical joints, valves where applicable.
 - 1. Unless otherwise directed, thrust restraint of mechanical joint pipe bends or other fittings, for use with standard push-on C900 PVC and Ductile Iron pipe, shall be provided via ductile iron restraint gland mechanism conforming to ANSI/AWWA C111/A21.11, C110/A21.10 and C153/A21.53, latest revisions.
 - 2. Restrained joint pipe lengths (restrained length) shall be sufficient to restrain thrust imparted by 1½ times the anticipated working pressure but not less than 200 psi.
 - 3. Restraint mechanisms used for restraint beyond the mechanical joint locations shall be suitable for push-on pipe bells of the pipe specified herein.
 - 4. Pipe restrained joints shall be the Series 1100 or 2000PV (as appropriate) Megalug restraining system, as manufactured by EBAA Iron Sales, Inc.
- C. Concrete thrust blocks may be used to thrust restraint. Thrust blocks shall be designed to withstand the force imparted by the main with a minimum 1-½ times the anticipated working pressure but not less than 200 psi. Maximum lateral bearing capacity shall be 1,500 lb/sf. Sizing guidelines for thrust blocks are detailed on the project Drawings.
- D. All valves shall be anchored with concrete blocks. Provide straps or stirrups to secure valve to block. Anchorage shall be provided in accordance with manufacturer's recommendations.
- E. Thrust restraint utilizing tie-rods shall not be utilized unless approved by the Owner or specifically indicated. Tie-rod diameters shall be 2 times the diameter required to restrain the main. All rods shall be protected from corrosion with two coats of bituminous paint or epoxy.

2.14 HYDRANTS

- A. All fire hydrants shall comply in all respects to AWWA C-502 and the following design standards:

1. Fire hydrants shall be of the compression type, closing with the line pressure. The connecting line of hydrant lateral shall be 6 inches in diameter, as per AWWA Standard M17.
2. The depths of bury shall have a typical bury of 5.5 feet, but at all times be installed to meet manufacturer's specifications for proper operation of the traffic breakaway feature. Hydrant extensions, which may be required, shall be manufactured by the same manufacturer of the hydrants being installed. Contractor shall field verify exact bury depths of all proposed hydrants prior to ordering. Should extensions be necessary on new hydrants, the contractor shall not be entitled to additional compensation or time.
3. Hydrant shall be furnished with a sealed reservoir located in the bonnet so that all threaded and bearing surfaces are lubricated each time the hydrant is operated.
4. Hydrant shall be equipped with "O" ring packing. Each nozzle cap shall be provided with a Buna-N rubble washer.
5. A bronze nut and check nut shall be provided to hold the main hydrant valve on its stem.
6. Hydrant stem shall be dual O-ring.
7. Hydrant shall be equipped with 5-¼ inch main valve opening.
8. Hydrants shall have a 150 PSI working pressure. Each hydrant shall be able to deliver 500 gallons per minute through its two hose nozzles when opened together with a loss of not more than 2 psi through hydrant.
9. Each hydrant shall be able to deliver 500 gallons per minute through its two 2-½ inch hose nozzles when opened together with a loss of not more than 2 psi through hydrant.
10. Hydrant shall have at least two (2) bronze or copper lined drain outlets. The shoe of the hydrant shall be 6-inch mechanical joint D-150, suitable for use either with centrifugally cast pipe or Class D Pit Cast Pipe. Lugs will be case on either side shoe, securely anchoring the hydrant. Hydrants shall be furnished with a breakable feature that will break cleanly upon impact. This shall consist of a 2-part breakable safety flange with a breakable stem coupling. Hydrant nozzles must be able to be rotated to any position without disassembly of ground-line flange.
11. All nozzles shall be provided with heavy cast iron caps, screwed on and attached to the upper barrel by non-kinking chains with connector rings. Chain loop shall permit free turning of the cap. All nozzles shall be fitted with gaskets. The operating nuts on nozzle caps shall be exactly the same size as that on top of the main stem. The operating nuts on nozzle caps and on top of the main stem shall be 1-1/2 inch pentagonal nuts. Hose and steamer nozzles shall be secured to the upper barrel by thread or quarter turn lock-type nozzles and locked into place for easy field replacement.
12. Hydrants shall open to the LEFT (counter-clockwise) and shall have a direction-to open arrow with the work "OPEN" imprinted on the hydrant weather cap. Weather cap shall be provided to protect the opening between the wrench nut and tip of the hydrant bonnet from rain and dirt.
13. Hydrants shall be post type.
14. The above grade stem shall be factory-coated with chrome yellow enamel.
15. One field applied coat of chrome yellow epoxy-based paint shall be applied to the above grade stem of the fire hydrant after it has been installed and backfilled. Epoxy based paint shall have NSF 61 approval.
16. Hydrants shall be so arranged that the direction of outlets may be turned 90 degrees without interference with the drip mechanism or obstructing the discharge from any outlet.
17. Hydrants shall be furnished with caps, double galvanized steel hose cap chain, galvanized steel pumper hose cap chain, a galvanized steel chain holder and any other hooks and/or appurtenances required for proper use.
18. All hydrants shall be equipped with a 6" gate valve in accordance with Section 2.7 above and be fully restrained as shown on the drawings. Joints shall be mechanically restrained by a Megalug Thrust Restraint Wedge manufactured and sold by EBAA Iron Sales Inc. or approved equivalent.
19. Hydrants shall be Superior Centurion 250 Model No. A423 as manufactured by Mueller Company, American Darling B-84-B-5 as manufactured by American Flow Control, or AVK Series 2780 Nostalgic Style Dry Barrel as manufactured by American AVK Co. For purposes of system standardization, no substitutions shall be allowed.
20. Drain valve shall operate automatically when the hydrant is operated, to provide drainage of the barrel. Bronze to bronze seating shall be provided.

21. The valve drainway shall be all bronze. Pressure seals in the main valve area shall be O-rings.
22. Hydrant shall have two – 2 1/2-inch Hose Outlets and one 4 1/2-inch Pumper Outlet. Hose and Pumper Outlets to have National Standard Thread (Field Replaceable).
23. Upper valve plate, seat ring, drain ring, operating nut, and nozzles shall be bronze.
24. For every 4 hydrants installed the following shall be provided to the Owner or the Engineer (If less than 4 hydrants are installed, at least one completed set of the following shall be provided):
 - a. One (1)-traffic repair kit,
 - b. One (1) full set of "O" - rings and gaskets,
 - c. One (1) set of drain valve facings,
 - d. One (1) hydrant valve removal wrench, and
 - e. One (1) hydrant-operating wrench.
25. All parts shall be properly labeled and housed in a carton with part numbers clearly indicated.
26. Hydrants shall be installed with sufficient height that when installed a 15-inch hydrant wrench will not contact the ground when making a full 360-degree turn on any nozzle cap.
27. Hydrant stem shall be constructed of ductile iron pipe conforming to this specification.
28. A drainage pit with a volume of 10 cubic feet shall be provided at the base of the fire hydrant barrel. The pit shall be filled with gravel or crushed stone to a depth of 6 inches above the hydrant drain opening and covered with filter fabric prior to backfilling. The gravel or crushed stone aggregate shall provide void space greater than the volume of the hydrant barrel.

2.19 TESTING PRODUCTS

- A. Liquid Chlorine
 1. Liquid chlorine shall conform to AWWA Standard B301, current edition.
- B. Hypochlorite
 1. Hypochlorite shall conform to AWWA Standard B300, current edition.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Refer to Section 310000 - Earthwork for excavating, trenching, and backfilling.

3.02 NOTIFICATIONS

- A. The designated authority shall be notified at least forty-eight (48) hours prior to any item being installed within the water system.
- B. Pressure testing and/or chlorination shall require a two (2) business day notification. It is required that the designated water authority witness *all* testing.

3.03 PIPE INSTALLATION

- A. General:
 1. Contractor shall verify the locations of all potentially conflicting utilities and structures as indicated on the Drawings.
 2. Lay out piping as shown on the Drawings. Any deviation from the layout shown must be approved by the Engineer.
 3. Piping shall be cut from measurements taken at the site and not from the plans. All necessary provisions shall be taken in laying out piping to provide for expansion and contraction caused by temperature fluctuations.
 4. Pipe shall be carried manually or by mechanical equipment with flat forks or fabric slings. Cables and chains shall not be used. Pipe shall be assembled and welded immediately adjacent to its final location and set or carefully rolled into position. Pipe shall not be dragged on the ground.

5. Cleaning and Inspection: The interior of all pipe, fittings, valves, and appurtenances shall be thoroughly cleaned of all foreign material and inspected for cracks, flaws, or other defects before installation, and shall be kept clean until the work is accepted.
 6. Pipelines shall be constructed in dry trenches and shall not be laid when the conditions of the trench or the weather is unsuitable for such work.
 7. All pipes and accessories shall be carefully inspected by the Contractor for defects before installation and any defective, unsound, or damaged materials shall be rejected. Any damaged pipe shall be removed from the site and replaced by the Contractor at no additional cost to the Owner.
- B. Storage:
1. Pipe shall be stored on a clean, level, dry ground. If the pipe must be stacked for storage, such stacking should be done in accordance with the pipe supplier's recommendations. The handling of the pipe should be done in such a manner that the pipe is not damaged by dragging over sharp objects or cut by lifting equipment.
 2. Segments of pipe having cuts or gouges in excess of 10% of the wall thickness shall not be incorporated into the system.
- C. Inspection of Piping:
1. Carefully inspect all pipe fittings before installation, removing all dirt. The pipe shall be installed with the markings up for visual inspection and verification.
 2. All pipe shall have smooth exterior and interior surfaces, be first quality, be free from cracks, blisters, and other imperfections, and be true to shape or form throughout each length. Piping judged by the Owner or Engineer to be unacceptable shall be removed from the site and new undamaged pipe shall be provided at no extra cost to the Owner.
 3. The interior of the pipeline shall be kept free from all dirt, joint material, and other foreign materials as the work progresses. Tight fitting stoppers or bulkheads shall be securely placed at the ends and any other openings of the pipe when work is stopped temporarily or at the end of the workday to prevent dirt or refuse from entering the pipe.
- D. Installation:
1. Ductile Iron Pipe:
 - a. Bending of the pipe during installation shall be limited and shall not exceed the pipe system supplier's recommendations.
 - b. The trench bottom and gravel bedding shall be shaped and compacted to give substantially uniform unyielding circumferential support to the lower fourth of the full length of each pipe.
 - c. Holes for the bells shall be excavated so that after placement the pipe and coupling receives uniform bearing pressure from the trench bottom.
 - d. Each pipe shall be laid to the line and grade and in such a manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line.
 - e. As the work progresses, the interior and exterior of the pipes and couplings shall be cleaned of all dirt and superfluous material of every description.
 - f. To keep interior of pipe clean, a suitable drag shall be kept in the pipe and pulled forward past each joint immediately after the jointing has been completed.
 - g. At times when work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipe or fitting.
 - h. Any pipe that has been disturbed after laying shall be taken up and re-laid.
 - i. All materials found to be defective during the progress of the work will be rejected by the Owner and the Contractor shall promptly remove such defective material from the site of the work and replace with new material at no additional expense to the Owner.
 - j. The Contractor shall be responsible for the safe storage and proper handling of all materials.
 - k. No shims or mounds of earth shall be used to raise the pipe to grade.

- l. All pipe shall be maintained accurately to the required line and grade.
- m. No pipe shall be covered until the Owner or Engineer has inspected the joints.
- n. The pipeline shall not be used to convey trench drainage during construction.
- o. Pipes shall be protected at all times during construction against flotation. They shall be thoroughly secured, properly supported and bedded to prevent settlement or disturbance. Compaction of bedding and backfill material shall be in strict accordance with Section 31 0000 – Earthwork.
- p. Bends, crosses, tees, caps, plugs, and other appurtenances shall be strapped and clamped where indicated and/or as directed. Steel bars, rods and plates shall be of structural steel. Straps, bridle rods, clamps, anchors and such other parts shall be provided to the details as directed and as approved. After installation, all parts of the strapping and clamping devices shall be given two (2) heavy coats of an approved coal tar base protective coating.
- q. All lumps, burrs, excessive coatings, and irregularities on the plain and socket ends of the pipe, valves, sleeves, and appurtenances shall be removed.
- r. Field cutting of the pipe is to be square and free of any burrs and defects.
- s. Water shall be laid with a minimum horizontal separation of 5' from all utilities and 10' from sewer lines. Sewer lines crossing over water lines shall be constructed of ductile iron or sleeved in ductile iron for 10 feet on either side of crossing regardless of vertical separation distance. Sewer lines crossing under water lines shall be constructed with a minimum vertical separation of 18" or the sewer shall be constructed of ductile iron or encased in concrete for 10 feet on either side of crossing.
- t. Bury piping with depth of cover over top at least 60 inches.
- u. Connect to water-supply source and construct water-service piping to a point 5 feet from the outside face of the building wall in locations and pipe sizes indicated on Drawings. It is the responsibility of the plumber to construct the required piping from this point through the building wall.
- v. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, and other supports.
- w. Valves shall be set in the pipeline as directed. Blocking or supports of a permanent nature shall be placed under each valve to ensure against settlement.
- x. Each valve shall be tightly closed before being placed in the line and shall remain so until the joints on each side are completely tightened.
- y. All Building connections to the Water System or at any potential cross connection shall have a backflow prevention device installed.

E. Pipe Embedment and Backfill:

- 1. Ductile Iron pipe systems and fittings shall be installed in full compliance with the manufacturer's recommendations.
- 2. The pipe shall be completely surrounded with sand bedding, haunching, and initial backfill materials that provide stable and permanent support to the pipe. These materials are as shown on the Drawings.
- 3. Care should be taken to ensure that the haunching of the pipe is performed without disturbing the pipe. Initial backfill shall be placed in 6-inch layers and hand tampered to assure compaction.
- 4. Reference Specification Section 310000 – Earthwork.
- 5. Contractor shall not flood excavations to compact backfill.

F. Joint Construction:

- 1. Make ductile iron pipe joints according to the following:
 - a. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - b. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- 2. No pipes shall be jointed until couplings and ends of pipe have been inspected to determine that the joint surfaces are free from any defects in materials or workmanship, and free from dirt or other foreign matter.

3. Pipe, pipe fittings and accessories shall be stored, installed, jointed and protected by the Contractor in strict accordance with the printed recommendations of the manufacturer of the piping material, and as approved.
4. Field assembled joints shall be checked with a suitable gauge as recommended by the manufacturer to ensure that the rubber rings are properly located.
5. If inspection indicates that the rings are improperly located, the contractor shall disassemble, and properly install the pipe.
6. Pipe stoppers shall be installed, sealed and blocked in such a manner as to prevent any leakage and so as to withstand an internal hydrostatic pressure of no less than 5 psi.
 - a. Timber blocking shall be of adequate size and arrangement to prevent the stopper form being blown off the line.
 - b. Timber bracing shall extend back to the undisturbed end of the trench.
7. Jointing by pushing the pipe home with a backhoe bucket or other heavy equipment shall not be permitted. Utilizing the backhoe and a sling to suspend the pipe while pushing home by bar or jack is permitted.
8. Protect the end of the pipe from damage at all times by using a timber header between the end of the pipe and the bar or jack.
9. Bolts and nuts used with all mechanical joints shall be tightened to the manufacturer's specified torque with a torque wrench to verify that all bolts and nuts receive the same tightening. Under no conditions shall extension wrenches or pipe over handle of ordinary ratchet or wrench be used to secure greater leverage.

3.04 THRUST RESTRAINTS

- A. Install mechanical restraining devices on all bends, mechanical joints, valves, tees, plugs and caps, bends, crosses, valves, and hydrant branches. Anchorages and restrained-joint types that may be used include the following:
 1. Concrete thrust blocks.
 2. Megalug Restraining System or approved equivalent.
 3. Locking mechanical joints.
 4. Reinforced concrete wall anchors
- B. The Contractor shall provide the type of anchorage or restrained joint as specified by the Engineer.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.05 VALVE, TAPPING SLEEVES, COUPLING, AND APPURTENANCE INSTALLATION

- A. General:
 1. All tapping sleeves, valves, and accessories shall be carefully inspected by the Contractor for defects before installation and all defective, unsound, or damaged materials shall be rejected.
 2. The Owner will make such additional inspections as deemed necessary and the Contractor shall furnish all necessary assistance for such inspection.
 3. Proper implements, tools, and facilities satisfactory to the Owner shall be provided by the Contractor for the proper and satisfactory execution of the work.
- B. Tapping sleeves, valves, couplings, and appurtenances shall be new and unused and shall be of the types and materials specified as indicated or as directed.
- C. The interior of tapping sleeves, valves, and fittings shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operation.
- D. Tapping sleeves, valves, and fittings shall be constructed in dry trenches and shall not be laid when the conditions of the trench or the weather are unsuitable for such work.
- E. Tapping sleeves, valves, and couplings shall be laid to the line and grade in such a manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line.

- F. At times when work is not in progress, open ends of tapping sleeves, valves, couplings, and fittings shall be securely closed so that no trench water, earth or other substances will enter.
- G. Any tapping sleeves, valves, couplings, or fittings that have been disturbed after laying shall be taken up and re-laid.
- H. All materials found to be defective during the progress of the work will be rejected by the Owner and the Contractor shall promptly remove such defective material from the site of the work and replace with new material at no additional expense to the Owner.
- I. The Contractor shall be responsible for the safe storage and proper handling of all materials.
- J. No shims or mounds of earth shall be used to raise the equipment to grade.
- K. No tapping sleeve, valve, or appurtenance shall be covered until the joints have been inspected.
- L. Installed materials shall be protected at all times during construction against flotation; they shall be thoroughly secured, properly supported and bedded to prevent settlement or disturbance. Compaction of bedding and backfill material shall be in accordance with Section 31 0000 – Earthwork.
- M. Tapping sleeves shall be installed where indicated or as directed by the Owner and shall be installed according to the manufacturer's recommended procedures.
- N. Valves and joint restraints shall be installed where indicated or as directed by the Owner and shall be installed according to the manufacturer's recommended procedures.
- O. Should asbestos cement pipe be encountered during the work it shall be abandoned in-place. The Contractor shall not crush any asbestos cement pipe. Should removal be required to facilitate the connection to the existing water main, the Contractor shall make arrangements for the legal disposal of the asbestos cement pipe sections.

3.06 SETTING VALVES AND VALVE BOXES

- A. Valves shall be set in the pipelines as directed. Blocking or supports of a permanent nature shall be placed under each valve to ensure against settlement. Concrete Anchoring for each valve shall be provided. Construct anchoring in accordance with PVC pipe manufacturer's recommendations. Provide straps to secure valve to anchor.
- B. Each valve shall be tightly closed before being placed in the line and shall remain so until the joints on each side are completely tightened.
- C. Valve boxes shall be set for all valves and shall be locking type. They shall be carefully fitted together and to the valve and securely held during backfilling. They shall be centered over the valve-operating nut. The bedding material around them shall be thoroughly tamped in place and the box cover set to the finished grade.

3.07 PIPE REMOVAL

- A. Where old pipe conflicts with new pipe, old pipe shall be cut and capped on both ends and the caps shall be secured. No fittings or pipe deflections will be allowed on new pipe to go over or under old pipe. In areas where water mains are to be removed, the Contractor shall disconnect each service lateral from the main at the corporation prior to removal of the main. The contractor shall be responsible for legal disposal of the removed water main.

3.08 FIELD QUALITY CONTROL

- A. Field Testing:

1. Alignment Tests: Each section of pipe will be checked by the Engineer in order to determine whether any displacement of the pipe has occurred. The Contractor shall provide suitable assistance to the Engineer. The Contractor shall repair any poor alignment, displaced pipe, or other defects discovered, as directed by the Engineer.
2. Hydrostatic Tests: After the pipe has been laid and the trench has been backfilled, all newly laid pipe or any valve section thereof, shall be subjected to a pressure and leakage test in accordance with AWWA C600 or C605, latest edition, and as approved by the Engineer. The Contractor shall provide all pumps, pipe, connections, gauges, measuring devices, and all other apparatus necessary for the test and shall conduct the test in the presence of and to the satisfaction of the Owner and Engineer. The Owner will supply water to the Contractor for testing purposes at no expense to the Contractor.
 - a. Test Pressure - The required minimum test pressure shall be 1-½ times the working pressure measured at the point of lowest elevation of the pipeline and corrected to the elevation of the test gauge, but shall not be less than 200 psi. Test pressures shall not vary by more than plus or minus 5 psi for the duration of the test.
 - b. Duration of Test - two (2) hours minimum.
 - c. Length of main to be tested in no event shall be greater than 1,000 linear feet measure along the centerline of the trench.
 - d. Air Removal - Prior to performance of the test, the pipeline shall be completely filled with water for a period of 72 hours. Expel air by means of air relief valves, hydrants, or other means as required. If permanent air vents or taps are not located at all high points, the Contractor shall install corporation stops at such points so air can be expelled. After the tests are completed, plug all temporary taps.
 - e. Allowable Leakage:
 - 1) Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valve section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.
 - 2) No pipe installation will be accepted if the leakage is greater than that determined by the following formula in which "L" is the allowable leakage in gallons per hour; "S" is the length of pipe tested in feet; "P" is the average test pressure during the leakage test in pounds per square inch (gauge); and "D" is the nominal diameter of the pipe in inches.

$$L = SD \times \sqrt{P} / 133,200$$
 - f. Repair of Leaks - If the test discloses leakage greater than the allowable leakage, the Contractor shall, at his own expense, locate and repair the defective joints until leakage is within the specified allowable. The Contractor shall repair any specific leaks regardless of the test results if, in the opinion of the Owner or Engineer, they are serious enough to endanger the future serviceability of the pipeline.

3.09 DISINFECTIONS OF POTABLE WATER LINES & PUMP SYSTEMS

A. General:

1. Flushing and disinfection of potable water lines and pump systems shall be done in accordance with the procedure set forth in AWWA C651 - Disinfecting Water Mains, latest edition, and shall be witnessed by the Engineer unless otherwise approved. Furthermore, any chlorine used in the disinfection of the potable water systems shall be NSF 60 certified. The Contractor shall provide all temporary blowoffs, pumps, chlorination equipment, chlorine, and all other necessary apparatus required.
2. All new valves shall be operated during the disinfection procedure in order to ensure complete disinfection.
3. The form of chlorine proposed by the Contractor for disinfection shall be approved by the Owner.
4. The Contractor shall take adequate measures to prevent backflow of flushing water and chlorinated water into the existing water distribution system.

5. Contractor shall not make physical connection to the existing water system prior to satisfactory results of chlorination. An approved backflow prevention device shall be utilized to transfer water from the existing system to the new piping network. A closed gate valve shall not constitute a separation from the existing system and new work.
- B. Pipe Cleaning:
1. If the pipe contains dirt or heavy encrusted matter that, in the opinion of the Engineer, will not be removed during the flushing operation, the Contractor shall clean and swab the interior of the pipe with a one (1) percent hypochlorite disinfecting solution.
 2. The pipeline shall be flushed to remove all remaining foreign material prior to disinfection, except when the tablet method is used. The flushing operation shall develop a minimum velocity of 2.5 ft/s. It will be the Contractor's responsibility to properly size and locate corporations within test sections to adequately flush all piping at least 2 times its volume at the desired velocity. The Contractor must coordinate all flushing operations with the Owner. If in the Owner's opinion flushing of the new main will cause a significant disruption to the existing system, the Owner may require the Contractor to perform flushing at times designated by the Owner or in a manner that the Owner views as suitable. The Contractor shall not be entitled to additional monies as a result of the Owners requirements for flushing. It may be necessary for the Contractor to utilize a pump to achieve the minimum required velocity for flushing. If a pump is necessary, the Contractor shall utilize a pump at no additional cost to the Owner.
- C. Chlorine Application:
1. In general, chlorine shall be applied using the continuous feed method, as specified in AWWA C651. Chlorine used for disinfection shall be NSF 60 certified for potable water use.
 2. Introduce water into the line at a constant rate while adding chlorine to the water at a constant rate, such that the water will have not less than 25 mg/L free chlorine. Maintain the chlorinated water in the pipeline for a minimum of 24 hours, after which period the treated water shall have a free chlorine residual of not less than 10 mg/L throughout the entire length. Repeat the above procedure if the residual, at the end of the 24 hours, fails to meet the minimum concentration. Chlorinated water above the normal system prevailing concentration shall not be allowed to remain in the pipeline for a period longer than 5 days.
- D. Final Flushing:
1. After the required retention period, flush all heavily chlorinated water from the main until the chlorine concentration is no higher than that prevailing in the system, or is acceptable for domestic use. The Contractor shall be responsible for satisfactory disposal of all flushing water and chlorinated water at no additional expense to the Owner.
 2. Prior to discharging, a reducing agent shall be applied to the water to be wasted, to neutralize thoroughly the chlorine residual remaining in the water. Where necessary, Federal, State and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.
- E. Bacteriologic Tests/VOCs:
1. After completion of the final flushing and prior to connecting pipeline to distribution system and placing it into service, collect two (2) consecutive sets of samples from the end of the line at least 24 hours apart and test for coliform organisms (i.e., total coliform) and heterotrophic plate count (HPC). A single sample shall also be collected and tested for volatile organic compounds (VOCs) by EPA Method 524.2. No VOCs shall be detected in the sample analyzed to obtain acceptance of the disinfected line. Testing shall be performed in accordance with Standard Methods for the Examination of Water and Wastewater. The results shall be submitted to the RI Department of Health on RI Department of Health – Office of Drinking Water Quality official reporting forms for review and approval prior to placing the pipeline into service. Contractor shall coordinate with the Engineer/Owner for sampling. Engineer and/or Owner shall have the option of collecting independent samples at time of sampling.
 2. Sample sets will be required for each isolated section of pipe tested.

3. Collect samples in sterile bottles, treated with sodium thiosulfate, from a standard corporation stop with gooseneck assembly installed in the main. Do not collect samples using a hose or fire hydrant.
 - F. Repetition of Procedure - If the original disinfections fail to produce satisfactory bacteriological samples, repeat the disinfections procedure until satisfactory results are obtained at no additional expense to the Owner.
- 3.10 IDENTIFICATION
- A. Install 6" wide blue continuous underground metallized detectable warning tape with white printing reading "CAUTION WATER LINE BURIED BELOW" during backfilling of trench for underground water-distribution piping. Locate tape 12" below finished grade, directly over piping.
- 3.11 RECORD DRAWINGS
- A. All installed underground utilities shall be designated on as-built drawings by the contractor of record and provided to the Owner and Engineer in AutoCad format prior to completion of the project. All as-built drawings, (underground and above ground) shall be dimensioned from permanent benchmarks such as existing buildings and include depths at various points throughout the extent of the work, and invert elevations at all structures. Top of pipe elevations shall be provided on the as-built at every bend and every 50 linear feet along a straight run of piping.

END OF SECTION

SECTION 333000

SANITARY SEWERAGE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.
- C. All sanitary sewers and appurtenances shall be designed and constructed in accordance with TR-16, "Design and Construction of Sanitary and Storm Sewers" as prepared by the Technical Advisory Board of the New England Interstate Water Pollution Control Commission.
- D. All work shall conform to the following standards
 - 1. ASTM D 3034 Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
 - 2. ASTM D 3212 Joints for Sewer Pipes using Flexible Elastomeric Seals Federal Specification.

1.03 SUMMARY

- A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:
 - 1. Precast concrete and Cast-in-place concrete manholes.
 - 2. Gravity Sewer Piping.

1.04 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.05 PERFORMANCE REQUIREMENTS

- A. Pipe used for sanitary sewers shall be SDR 35 unless specified otherwise on the Drawings.

1.06 SUBMITTALS

- A. Provide Shop Drawings for the following:
 - 1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.
 - 2. Pipe: Include specifications on pipe materials, dimensions, and physical characteristics.
- B. Conformance Certificates: Each shipment of castings, concrete manholes, pipe, pipe fittings, and appurtenances, shall be accompanied by the manufacturer's notarized certification and cylinder testing that materials meet specified requirements.

- C. Permits
 - 1. Provide Engineer with copy of all permits required prior to commencing work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Deliveries shall be scheduled so that the progress of the work is at no time delayed and also so that large quantities of products shall not be stored for excessive lengths of time in crowded locations or in locations where large storage areas might be considered objectionable.
- E. Avoid damage to pipe from impact, bending, compression, or abrasion during handling and storage.
- F. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat, and the direct rays of the sun.
- G. Use only nylon-protected slings to handle pipe. The use of hooks or bare cables will not be permitted.
- H. The Contractor shall dispose of pipe damaged during delivery, handling, or storage and replace at no cost to the Owner.

1.08 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: do not interrupt service to facilities occupied by Owner or others.

1.09 PERMITS

- A. The Contractor shall obtain any permits required by the local authority prior to commencing with work affecting the sanitary sewer system.
- B. No work shall commence until the Contractor has acquired all required permits and receives authorization from the Engineer.

1.10 MARKINGS

- A. Mark pipe with the following information applied at intervals of not more than 5 feet:
 - 1. Manufacturer's name or trademark.
 - a. Nominal pipe size;
 - b. PVC cell classification;
 - c. Applicable dimension ratio;
 - d. Date and location of manufacturer;
 - e. Applicable standard designation number.

PART 2 - PRODUCTS

2.01 IDENTIFICATION

- A. Underground-Type Line Markers for Non-Metallic Pipelines: Manufacturer's standard permanent detection tape, bright-colored, continuous printed polyethylene tape with a metallic core for each detection of non-metallic underground installations, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide green detection tape with black printing reading "CAUTION SEWER LINE BURIED BELOW" as manufactured by Seton or approved equivalent.

2.02 POLYVINYL CHLORIDE GRAVITY SEWER PIPE

- A. PVC sewer pipe for gravity sewers and service connections shall conform to ASTM D 1784 and D 3034-SDR 35, and shall meet the following specific requirements and exceptions:
 - 1. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusion, or other injurious defects. The pipe shall be as uniform as commercially practical in color, capacity, density, and other physical properties.
 - 2. Joints shall be bell and spigot. The bell shall consist of an integral wall section with a solid cross section rubber ring factory-assembled, securely locked in place to prevent displacement. Joints shall conform to ASTM Standard D 3212. For SCH 40 PVC piping, joints shall be glued with a PVC cement approved by the manufacturer.
 - 3. All fittings and accessories shall have dimensions as recommended by the manufacturer and have bell and/or spigot configurations compatible with that of the pipe.
 - 4. Pipe shall pass impact resistance test in accordance with ASTM D 2444 and minimum pipe stiffness test at 5% deflection in accordance with ASTM D 2412.
 - 5. The normal length of 12-inch size and smaller pipe shall be 12.5 feet and 15-inch size shall be no longer than 20 feet.
 - 6. Pipe and fittings shall be manufactured in the United States of America and shall be accompanied by the manufacturer's certificate of compliance, in addition to meeting the performance tests specified hereinafter.
 - 7. If required by the Owner's representative, prior to installation, six specimen lengths each 6-inches long of each size pipe shall be furnished by the Contractor for impact resistance test and three specimen lengths each 6-inches long of each size pipe for pipe stiffness test. These tests are to be made in accordance with ASTM D 2444 and ASTM D 2412, respectively, at the expense of the Contractor. No pipe shall be accepted if the tests do not meet the test requirements.
- B. PVC pipe shall be SCH 40 where pipe has less than 2 feet of cover or as directed by the Engineer.
 - 1. PVC pipe shall meet ASTM F794, latest revision.
 - 2. Joints shall be bell and spigot. Joints shall be glued with a PVC cement approved by the manufacturer.

2.03 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end as manufactured by Fernco, Inc. or approved equivalent.

2.04 MANHOLE MATERIALS

- A. Cement shall be Portland cement conforming to ASTM C150, Type III, high early strength.
- B. Aggregate: shall conform to ASTM C330 and shall be graded, crushed stone with a resulting unit weight of concrete of up to one hundred fifty five (155) pounds per cubic foot, and a minimum unit weight of not less than one hundred forty-eight (148) pounds.

- C. Water: shall be clear and free of injurious and deleterious substances.
- D. Concrete: shall have a minimum strength of 5000 psi at twenty eight (28) days and a strength of 3000 psi at the time of form release.
- E. During the process of manufacturing of the units not less than two (2) test cylinders shall be tested at time release of the form and two (2) at age twenty-eight (28) days.
- F. All compression test cylinders shall be made, cured and stored in accordance with ASTM C31.
- G. Cylinders shall be tested in accordance with ASTM C39.
- H. All concrete shall be air entrained as specified per RIDOT Standard Specifications.
- I. Admixtures shall only be used after prior approval of the Engineer.
- J. All reinforcing bars shall conform to the requirements of ASTM designation: A615, Grade 60.
- K. Welded wire fabric shall conform to the requirements of ASTM designation: A185.

2.05 PRECAST CONCRETE MANHOLES AND BRICK

- A. Precast Concrete Manhole sections shall be equal to that shown on the drawings and shall conform to ASTM Specifications C-478 and C-76 Class IV Wall "B". The horizontal joints between sections shall be sealed using a flexible butyl resin sealant and shall conform to ASTM C 443. In addition, the horizontal joints on the inside and outside of the manhole and catch basin shall be sealed with a "Quick Plug" as manufactured by Parson or approved equivalent.
- B. Brick shall conform to ASTM Specification C-32 for sewer brick, except that the table therein is amended to provide that the required minimum compressive strength in pounds per square inch shall be for any individual brick 3,000 or 5,000 for the average of five bricks selected at random. The maximum absorption of water by five-hour boiling test shall not exceed 16% for any individual brick or 12% for the average of any five bricks selected at random.
- C. Unless otherwise noted on the Drawings, sanitary manholes less than or equal to ten (10) feet deep shall have an interior diameter of 48 inches. Manholes greater than ten (10) feet shall have an interior diameter of 60 inches unless otherwise noted. All manholes with interior drops shall have an interior diameter of 60 inches unless otherwise noted. Manholes with an interior diameter of 72 inches shall be utilized where indicated on the Drawings.
- D. Openings for pipe insertions shall be round and shall be precast or cored only. The diameter of the opening shall be adequate to install a rubber boot seal. The cored or precast opening shall maintain a minimum undisturbed distance of 6" from manhole section joints. Flexible rubber boot shall be neoprene with stainless steel clamps and bands.

2.06 MANHOLE FRAMES AND COVERS

- A. Manhole Frames and Covers shall be cast iron and conform to the details on the drawings. Cast iron shall conform to ASTM A-48, Class 25. The underside of the cover and upper side of lip frame must present parallel plane surfaces, and at these points of contact, the frames and covers shall be machined to prevent covers from rocking in the frames under traffic.
- B. Frame and covers shall be capable of withstanding H-20 highway loading.

- C. Covers shall bear evenly in the frame and both frame seats and covers shall be accurately fabricated so that covers are interchangeable for use with any and all frames. Where indicated, frames and covers shall be watertight, and locked. The sizes and weights (medium duty, heavy duty, etc.) are shown on the detail sheets for special manholes.
- D. Mortar shall consist of one part cement and two parts clean sand. No lime shall be used.
- E. Covers shall have a non-slip surface and shall have the word "SEWER" inscribed.
- F. Frames and covers shall be installed on the manholes as indicated on the drawings. They shall be well bedded and encased in cement mortar and accurately set to the grades indicated or as directed. Red clay brick with cement mortar shall be used to adjust grade of frame and cover. One half inch of cement mortar plaster cast shall be applied to exterior of red clay bricks.

2.07 MANHOLE STEPS

- A. Manhole steps shall be manufactured of Copolymer Polypropylene plastic with ½" grade 50 steel reinforcement.
- B. Steps shall conform to ASTM C-478 and Fed. Spec. A-A-60005.
- C. The capacity of each step shall be 1000 lb. at 6-inch distance from wall and 1500 lb. at 4-inch distance from wall.
- D. Steps shall measure 12 inches wide (min.) and extend 6 inches from wall.
- E. Manhole steps shall be provided in each base, riser and top section and shall be integrally cast in each; 12 inches O.C.

2.08 WATERPROOFING FOR UNDERGROUND STRUCTURES

- A. Elastomeric waterproofing membrane shall conform to ASTM C836.
- B. Elastomeric waterproofing shall be CS-1800 as manufactured by ConSeal, MasterSeal HLM 5000 as manufactured by BASF, or approved equivalent.

PART 3 EXECUTION

3.01 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 31 0000 - Earthwork.

3.02 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Gravity-Flow, Non-pressure Sewer Piping: Use the following pipe materials as specified on the Drawings:
 - 1. SDR 35 sewer pipe and fittings; gaskets; and gasketed joints.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves,

and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

- D. Install gravity-flow, non-pressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, to the slope indicated on the Drawings. An even alignment of the pipe shall be maintained.
 - 2. Install piping with 36-inch minimum cover unless specified otherwise on the Drawings.
 - 3. The Contractor shall excavate around the bell portion of the pipe so the pipe barrel bears on the prepared bed.
 - 4. Blocking is not permitted.
 - 5. All pipes shall be clean and free of dirt before laying and open ends shall be kept covered and free of dirt during construction.
 - 6. Where new pipes are to adjoin existing structures, extreme care shall be taken in coring into existing structure. Tight waterproof connections shall be made without interrupting service.
- E. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.
- F. The Contractor shall install piping as specified to within 5 feet of the building foundation. The Plumbing Contractor shall make the connection to the sanitary sewer from this point.
- G. Where installing pipe below standing water table, trench shall be dry and free of water and pipe bedding. Below bottom of pipe can be replaced with 1 ½" crushed stone.
- H. Glue all joints for Sch 40 PVC pipe.

3.03 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, non-pressure, drainage piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints and manufacturer's recommendations.
 - 1. Machinery shall not be used to push the pipe into place. The pipe shall be pushed into place by hand. The use of a hammer or mallet is permitted, with the use of a board to shield the end of the pipe being struck by the hammer. The pipe shall not be directly contacted with a hammer or mallet.

3.04 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Construct cast-in-place manholes as indicated.
- D. Form continuous concrete or brick channels and benches between inlets and outlet as specified on Drawings.
- E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements.
- F. Concrete Base Slabs for manholes and shall have a full thickness of 12 inches extending 6 inches beyond the outside walls.
- G. Bottom riser sections of reinforced concrete manholes and catch basins may be either cast-in-place or precast concrete. The top edges, of cast-in-place bottom sections, shall be formed

with a removable steel ring template designed to fit the tongue end of the precast riser sections.

- H. Inverts: Where pipe alignment permits, and where directed by the Engineer, the pipe shall be continued through the manhole and the top half carefully and evenly cut away. Where changes in alignment occur, unless otherwise authorized by the Engineer, inverts shall be constructed of brick and mortar with a smooth flow line and an even curve in accordance with the plans.
- I. Joints: Pipe joints into manholes shall be constructed in accordance with the details shown on the plans. Complete details of the joint manufacture and installation shall be submitted for approval. All areas around pipes passing through walls of manholes and catch basins shall be completely filled with waterproof cement mortar to tightly fill any space through which water can pass.
- J. Bricks shall be laid in a workmanlike manner, true to line, and the joints shall be carefully struck and pointed on the inside. Bricks shall be thoroughly wet when laid and each brick shall be laid in mortar so as to form full bed, end and side joints in one operation. The outside of the brickwork shall be neatly plastered with ½" layer of cement mortar as the work progresses. The brickwork shall be satisfactorily bonded to the concrete and cast iron frame. No brick masonry shall be laid in water, or any water allowed to rise on the brickwork until the masonry has set for at least 24 hours.
- K. Waterproofing: All exterior surfaces of underground manholes shall receive one coat of waterproofing.

3.05 IDENTIFICATION

- A. Materials and their installation are specified in Section 31 00 00 - Earthwork. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - 1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.06 FIELD QUALITY CONTROL

- A. Inspect interior piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Defects requiring correction include the following:
 - 2. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - a. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - b. Crushed, broken, cracked, or otherwise damaged piping.
 - c. Infiltration: Water leakage into piping.
 - d. Exfiltration: Water leakage from or around piping.
 - 3. The Contractor shall repair any defects or corrections required by the Engineer.
 - 4. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified at no expense to the Owner.
 - 5. Reinspect and repeat procedure until results are satisfactory at no expense to the Owner.
- B. Testing Manholes:
 - 1. All sanitary manholes shall be vacuum tested prior to backfilling.
 - 2. Install vacuum tester and inflate compression band to affect a seal between the vacuum base and the new manhole, connect vacuum pump to the outlet part with the valve open, draw a vacuum of 10 inches of mercury, (HG), and close the valve.
 - 3. The manhole shall pass the test if the vacuum remains at 10 inches of HG in a time greater than 60 seconds for a 48-inch diameter manhole, time greater than 75 seconds

for 60-inch diameter manhole and time greater than 90 seconds for 72-inch diameter manhole.

4. If the manhole fails the initial test, the Contractor shall make proper repairs or replace the manhole and re-test at no additional compensation.

C. Testing Gravity Sewers:

1. Low Pressure Air Test:

- a. After completing backfill of the pipeline, the Contractor shall, at his expense, conduct a line acceptance test. The test shall be performed according to stated procedures and in the presence of the Engineer. The line shall be flushed and cleaned prior to testing.
- b. All pneumatic plugs shall be seal-tested before being used in the actual test installation. One (1) length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
- c. After a manhole-to-manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low-pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average backpressure of any groundwater that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize.
- d. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "acceptable". If the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe) shall not be less than the time shown for the given diameters in the following: 8 inches -- 4 minutes; 10 inches -- 5 minutes; 12 inches -- 6 minutes; 18 inches -- 9 minutes; 21 inches -- 10 minutes; 24 inches -- 12 minutes; 27 inches -- 13 minutes; 30 inches -- 15 minutes; 36 inches -- 17 minutes; 42 inches -- 20 minutes; and 48 inches -- 23 minutes.
- e. If the installation fails the air test, the Contractor shall, at his expense determine the source of leakage. He shall then repair or replace all defective materials and/or workmanship to the Engineer's satisfaction and the pipeline shall be re-tested, all performed at no additional compensation to the Contractor.

2. Infiltration Test:

- a. The infiltration test shall be conducted at such time as the ground water level is at a height of not less than one foot above the top of the pipe for the full length of the section of sewer being tested.
- b. Each manhole-to-manhole reach shall be tested separately. At no time will the Contractor be allowed to test more than one manhole-to-manhole reach.
- c. The Contractor shall construct such weirs or other means of measurement as shall be required and shall do such pumping as shall be necessary to enable the tests to be made satisfactorily.
- d. The groundwater leakage into the pipes will be measured by the Engineer after a minimum of one hour and the infiltration rate shall not exceed 50 gallons per day per mile per inch-diameter.

D. Pipe Deflection:

1. Pipe provided shall be so installed that there be a maximum deflection of 5 percent. Such deflection shall be computed by multiplying the amount of deflection (nominal diameter of the pipe less minimum diameter when measured) by 100 and dividing by the nominal pipe diameter.
2. The Contractor shall measure the amount of deflection by pulling a specially designed gauge assembly through the completed section after 120 days of installation. The gauge assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Engineer.
3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the Engineer may require without additional compensation.

- E. Leaks and loss in test pressure constitute defects that must be repaired. All repairs shall be at the expense of the Contractor.
- F. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.07 CLEANING

- A. Interior of piping and manholes shall be cleaned of dirt and superfluous material prior to acceptance of sanitary sewer.

3.08 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
 - 1. Remove manhole and close open ends of remaining piping.
 - 2. Remove top of manhole down to at least 60 inches below final grade

3.09 RECORD DRAWINGS

- A. All installed underground utilities shall be designated on as-built drawings by the contractor of record and provided to the Owner and Engineer in AutoCad electrical format prior to completion of the project. All as-built drawings, (underground and above ground) shall be dimensioned from permanent benchmarks such as existing buildings and include depths at various points throughout the extent of the work, and invert elevations at all structures.

END OF SECTION

SECTION 334000

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, AIA 201, and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. All work specified in this Section shall conform to "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".
- B. Survey plan entitled "Limited Content Boundary Survey Senior Center Property" prepared by the City of East Providence dated June 23, 2021.

1.03 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
 - 1. Pipe
 - 2. Area Drains
 - 3. Precast concrete drain manholes
 - 4. Precast concrete catch basins
 - 5. Subdrainage
 - 6. 30 mil PVC impermeable liner
 - 7. Cleanouts
 - 8. Underground Infiltration System

1.04 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.
- B. HDPE: High Density Polyethylene.
- C. RCP: Reinforced Concrete Pipe.
- D. PE: Polyethylene.

1.05 SUBMITTALS

- A. The Contractor shall submit for approval, manufacturer's printed recommendations for the storage, protection, handling, installation and testing of stormwater piping, fittings and appurtenances, which shall be strictly adhered to by the Contractor.
- B. Shop Drawings: For the following:
 - 1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.
 - 2. Catch Basins: Include plans, elevations, sections, details, and frames, covers, and grates.
 - 3. Area Drain: Include plans, elevations, sections, details, and frames, covers, and grates.

- 4. 30 MIL PVC Impermeable Liner: Include specifications on materials, dimensions, and physical characteristics. Indicate manufacturer's recommended method for joining and bonding multiple sections.
- C. Conformance Certificate: Each shipment of castings and concrete manholes and catch basins shall be accompanied with the manufacturer's notarized certification and cylinder testing results that materials meet specified requirements.
- D. Record Drawings: All installed underground utilities shall be designated on as-built drawings by the contractor of record and provided to the Owner and Engineer in AutoCad electrical format prior to completion of the project. All as-built drawings, (underground and above ground) shall be dimensioned from permanent benchmarks such as existing buildings and include depths at various points throughout the extent of the work, and invert elevations at all structures.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.
- B. Handle catch basins and manholes according to manufacturer's written rigging instructions.
- C. Use only nylon-protected slings to handle pipe. The use of hooks or bare cables will not be permitted.
- D. Avoid damage to castings from impact, abrasion, or corrosion during handling and storage.
- E. Do not store PVC piping and fittings in the sunlight for extended periods of time. Store pipe in accordance with manufacturer's recommendations.
- F. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct rays of the sun.
- G. Use all means necessary to protect precast concrete units and materials before, during and after installation and to protect the installed work and materials for all other trades.
- H. In case of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative at the Contractor's expense.
- I. Pipe, pipe fittings, and other associated appurtenances damaged during deliver handling or storage shall be replaced at no additional cost to the Owner.

1.07 PROJECT CONDITIONS

- A. The Contractor shall provide means of stormwater management during construction to control runoff and protect downstream areas from damage resulting from stormwater runoff.
- B. The Contractor is responsible for any damage resulting from stormwater runoff during construction, including damage from flooding.

1.08 QUALITY CONTROL

- A. All precast concrete shall be the product of a manufacturer who has demonstrated capability to produce precast concrete products of the quality specified. A manufacturer must be able to show that he has experienced personnel, physical facilities, established quality control procedures, and a management capability sufficient to execute the work of this contract. When requested by the Owner's Representative, the Contractor shall submit written evidence of the above requirements.

- B. Experienced plant personnel shall closely supervise the manufacturing process, and daily records of concrete strength shall be kept and submitted to the Owner's Representative for control.
- C. Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly trained and experienced in the installation of the precast concrete structures and shall direct all work performed under this Section.

PART 2 - PRODUCTS

2.01 PVC PIPE AND FITTINGS

- A. PVC Profile Gravity Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends.
- B. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusion or other injurious defects. The pipe shall be as uniform as commercially practical in color, capacity, density and other physical properties.
- C. Joints shall be bell and spigot. For SDR-35 PVC pipe, the bell shall consist of an integral wall section with a solid cross section rubber ring factory-assembled, securely locked in place to prevent displacement. Joints shall conform to ASTM Standard D 3212. For SCH 40 PVC piping, joints shall be glued with PVC cement approved by the manufacturer.
- D. All fittings and accessories shall have dimensions as recommended by the manufacturer and have bell and/or spigot configurations compatible with that of the pipe.
- E. Pipe shall pass impact resistance test in accordance with ASTM D 2444 and minimum pipe stiffness test at 5% deflection in accordance with ASTM D 2412.
- F. The normal length of 12-inch size and smaller pipe shall be 12.5 feet.
- G. Pipe and fittings shall be manufactured in the United States of America and shall be accompanied by the manufacturer's certificate of compliance, in addition to meeting the performance tests specified hereinafter.
- H. PVC pipe shall be SCH 40 where pipe has less than 2 feet of cover or as directed by the Owner's Representative.
- I. PVC perforated pipe shall conform to ASTM/ANSI D 2729 or ASTM F 810. Perforations shall be 5/8" holes on 5" centers.

2.02 HIGH-DENSITY POLYETHYLENE PIPE AND FITTINGS

- A. High-Density Polyethylene Pipe and fittings shall be ADS N-12 IB ST Smooth Interior Pipe, ADS N-12 IB ST High Capacity Large Diameter Pipe or approved equivalent. Joints shall be soil-tight and include a rubber gasket on the spigot end of the pipe. When installed into the bell end, the joint shall be sealed.
- B. Pipe shall conform to AASHTO M294 (Type 'S') for the specified diameters and strength classes.
- C. Pipe shall be rated to withstand H-20 Loading Criteria with 18" of cover.
- D. HDPE Perforated pipe shall conform to AASHTO M252. Perforations shall be AASHTO Class II. Perforations shall be located in the valley of the outside corrugations. The water inlet area shall be no less than 0.945 in²/ft. Perforations shall be slots with minimum length of 0.875" and minimum width of 0.125".

2.03 REINFORCED CONCRETE PIPE

- A. Reinforced-Concrete Pipe and Fittings: ASTM C 76 (ASTM C 76M), with bell-and-spigot ends and sealant joints with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant.
- B. Pipe shall conform to AASHTO M170 for the specified diameters and strength classes. The minimum cement content shall be 564 pounds per cubic yard.
- C. Strength class of reinforced concrete pipe shall be Class III unless specified otherwise on the drawings.
- D. Joint of reinforced concrete pipe shall be made with flexible watertight rubber gaskets and the remaining exterior void of the joint shall be sealed with Portland cement mortar.

2.04 FLEXIBLE PIPE COUPLINGS

- A. Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end as manufactured by Fernco Inc. or approved equivalent.

2.05 CLEANOUTS

- A. Cast-Iron Cleanouts: Frame and cover shall be able to withstand HS-20 loading criteria.
- B. PVC cleanouts: PVC body with PVC cap and screw type cover set no more than 6" below cast iron frame and cover. The cast iron cover shall be set to finish grade and secured with concrete as shown in the Drawings. Frame and cover shall be able to withstand H20-44 loading criteria.

2.06 AREA DRAINS

- A. Area drain shall be formed of PVC pipe stock meeting ASTM D1784 utilizing a thermoforming process to reform the pipe stock to the specified configuration. Drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system.
- B. Joints shall use elastomeric seals and conform to ASTM D3212, latest revision. Flexible elastomeric seals shall conform to ASTM F477.
- C. Frame and grates shall be 24" dia. ductile iron grates made specifically for each area drain. Casting shall conform to ASTM A536 grade 70-50-05.
- D. Frame and cover shall be 24" dia. ductile iron grates made specifically for each area drain. Casting shall conform to ASTM A536 grade 70-50-05.
- E. Frames and grates within pedestrian traveled areas shall meet ADA requirements.
- F. Area Drains shall be rated to withstand HS-20 loading criteria and construction traffic.
- G. Area drains shall be equipped with a sump and outlet tee as specified on the plans and details.

2.07 MANHOLE AND CATCH BASIN MATERIALS

- A. Cement shall be Portland cement conforming to ASTM C150, Type III, high early strength.
- B. Aggregate: shall conform to ASTM C330 and shall be graded, crushed stone with a resulting unit weight of concrete of up to one hundred fifty-five (155) pounds per cubic foot, and a minimum unit weight of not less than one hundred forty-eight (148) pounds.

- C. Water: shall be clear and free of injurious and deleterious substances.
- D. Concrete: shall have a minimum strength of 5000 psi at twenty-eight (28) days and a strength of 3000 psi at the time of form release.
- E. During the process of manufacturing of the units not less than two (2) test cylinders shall be tested at time release of the form and two (2) at age twenty-eight (28) days.
- F. All compression test cylinders shall be made, cured and stored in accordance with ASTM C31. Cylinders shall be tested in accordance with ASTM C39.
- G. All concrete shall be air entrained as specified per RIDOT Standard Specifications.
- H. Admixtures shall only be used after prior approval of the Engineer.
- I. All reinforcing bars shall conform to the requirements of ASTM designation: A615, Grade 60.
- J. Welded wire fabric shall conform to the requirements of ASTM designation: A185.

2.08 PRECAST CONCRETE MANHOLES, CATCH BASINS AND BRICK

- A. Precast Concrete Manhole and Catch Basin sections shall be equal to that shown on the drawings and shall conform to ASTM Specifications C-478 and C-76 Class IV Wall "B". The horizontal joints between sections shall be sealed using a flexible butyl resin sealant and shall conform to ASTM C-990. In addition, the horizontal joints on the inside and outside of the manhole and catch basin shall be sealed with a "Quick Plug" as manufactured by Parson or approved equal.
- B. Brick shall conform to ASTM Specification C-32, except that the table therein is amended to provide that the required minimum compressive strength in pounds per square inch shall be for any individual brick 3,000 or 5,000 for the average of five bricks selected at random. The maximum absorption of water by five-hour boiling test shall not exceed 16% for any individual brick or 12% for the average of any five bricks selected at random.
- C. Unless otherwise noted on the Drawings, manholes less than fifteen (15) feet deep shall have an interior diameter of 48 inches. Manholes fifteen (15) feet and deeper shall have an interior diameter of 60 inches unless otherwise noted. Manholes with an interior diameter of 72 inches shall be utilized where indicated on the Drawings. All catch basins shall have an interior diameter of 48 inches unless specified otherwise.
- D. Openings for pipe insertions shall be round and shall be precast or cored only. The diameter of the opening shall be adequate to install a rubber boot seal. The cored or precast opening shall maintain a minimum undisturbed distance of 6" from manhole section joints. Flexible rubber boot shall be neoprene with stainless steel clamps and bands.
- E. Weirs for diversion manholes may be constructed with concrete block joined with mortar or cast into the structure. Contractors shall form each weir as depicted on the plans. Provide a watertight seal with no gaps between weir wall and structure wall. Weirs shall be connected to structure wall using epoxy coated steel rebar reinforcement.

2.09 MANHOLE FRAMES AND COVERS

- A. Manhole Frames and Covers shall be cast iron and conform to the details on the drawings. Cast iron shall conform to ASTM A-48, Class 25. The underside of the cover and upper side of lip frame must present parallel plane surfaces, and at these points of contact, the frames and covers shall be machined to prevent covers from rocking in the frames under traffic.
- B. Covers shall bear evenly in the frame and both frame seats and covers shall be accurately fabricated so that covers are interchangeable for use with any and all frames. Where

indicated, frames and covers shall be watertight, and locked. The sizes and weights (medium duty, heavy duty, etc.) are shown on the detail sheets for special manholes.

- C. Mortar shall consist of one part cement and two parts clean sand. No lime shall be used.
- D. Covers shall have a non-slip surface and shall have the word "DRAIN", inscribed.
- E. Frames and covers shall be installed on the manholes as indicated on the drawings. They shall be well bedded and encased in cement mortar and accurately set to the grades indicated or as directed. Red clay brick with cement mortar shall be used to adjust grade of frame and cover. One half inch of cement mortar plaster cast shall be applied to exterior of red clay bricks.

2.10 CATCH BASIN FRAMES AND GRATES

- A. Catch Basin Frames and Grates shall be cast iron and conform to the details on the drawings. Cast iron shall conform to ASTM A-48, Class 25. The underside of the grate and upper side of lip frame must present parallel plane surfaces, and at these points of contact, the frames and grates shall be machined to prevent grates from rocking in the frames under traffic.
- B. Grate shall bear evenly in the frame and both frame seats and grates shall be accurately fabricated so that grate is interchangeable for use with any and all catch basin frames.
- C. Mortar shall consist of one part cement and two parts clean sand. No lime shall be used.
- D. Gratings shall have a non-slip surface.
- E. Gratings shall be installed on the catch basins as indicated on the drawings. They shall be well bedded and encased in cement mortar and accurately set to the grades indicated or as directed. Red clay brick with cement mortar shall be used to adjust frame and grate. One half inch of cement mortar plaster cast shall be applied to exterior of red clay bricks.

2.11 MANHOLE STEPS

- A. Manhole steps shall be manufactured of Copolymer Polypropylene plastic with ½" grade 50 steel reinforcement.
- B. Steps shall conform to ASTM D-4101 under Type II.
- C. The capacity of each step shall be 1000 lb. at 5-1/8 inch distance from wall and 1500 lb. at 4-inch distance from wall.
- D. Steps shall measure 12 inches wide (min.) and extend 5-1/8 inches from wall.
- E. Manhole steps shall be provided in each base, riser and top section and shall be integrally cast in each; 12 inches O.C.

2.12 GEOTEXTILES

- A. Refer to Section 310000 for requirements regarding geotextile filter fabrics.

2.13 30 MIL PVC IMPERMEABLE LINER

- A. Barrier shall be a PVC membrane of sufficient tensile strength to withstand perforation including cracking, tearing, and breaking during installation and backfill.
- B. Barrier shall be a minimum of 30 mils thick and constructed of PVC.
- C. Barrier shall have no holes, gaps or perforations.

2.14 IDENTIFICATION

- A. Underground-type line markers for non-metallic pipelines: manufacturer's standard permanent detection tape, bright-colored, continuous printed polyethylene tape with a metallic core for each detection of non-metallic underground installations, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide green detection tape with black printing reading "Caution Drain Line Buried Below" as manufactured by Seton or approved equivalent.

2.14 UNDERGROUND INFILTRATION SYSTEM

- A. The chamber shall be designed to AASHTO LRFD Bridge Design Specifications (Section 12), as applied to material and performance requirements for buried thermoplastic pipes. Design live load shall be the AASHTO HS-25 or HS-20 truck and applies to chamber spacing of 5" (127 mm) or greater.
- B. The chamber system shall be comprised of three chamber configurations. The "middle" chambers shall be open-ended to allow unobstructed hydraulic flow, inspection, and maintenance. The "start/end" chambers shall each have an integral end wall designed to resist loading at the start and end of the chamber rows.
- C. The underground infiltration system shall have a minimum total storage volume of 6,505 cubic feet including the stone below and above the chamber with a stone porosity of 33%. The total volume is inclusive of the pretreatment row.
- D. The underground infiltration system shall be a minimum of 25 feet from any building with a basement.
- E. The nominal dimensions of the "start/end" and "middle" chambers shall be recommended by the manufacture and approved by the engineer.
- F. The chamber shall have an arch-shaped section profile with an open bottom.
- G. The "start/end" chambers end wall shall be structurally suitable for cutting and inserting inlet pipes up to 24" (610 mm) diameter.
- H. The chamber shall be an open-bottom design with slotted or perforated side wall openings for lateral flow and top vent orifices for hydraulic pressure equalization.
- I. The chamber shall have a circular cut line for an optional reinforced inspection or cleanout port configured to accept a minimum 4" (102 mm) Schedule 40 pipe.
- J. The "end" chambers shall be capable of being cut to shorter lengths to accommodate site specific requirements.
- K. The chamber shall be supported by integral structural footings comprised of load dispersing toe ribs and longitudinally aligned stiffening ribs.
- L. The underground infiltration system shall be Stormtech SC-310 chambers or approved equivalent. If the Contractor selects an equivalent product, a permit modification shall be submitted to the RIDEM at the Contractor's expense.
- M. The manufacturer of the underground infiltration system shall be present during at least the first two days of installation of the infiltration system at the Contractor's expense. The

manufacturer of the underground infiltration system shall certify installation of the infiltration system is in accordance with their specifications.

PART 3 EXECUTION

3.01 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 310000 "Earthwork."

3.02 PIPE INSTALLATION

- A. Reinforced Concrete Pipe: The method of joining reinforced concrete pipe sections shall be such that the ends are fully entered, and the inner surfaces are reasonably flush and even. Joints shall be made with rubber gaskets and Portland Cement grout. The completed joints shall be protected against rapid drying by suitable covering material.
- B. Use only nylon-protected slings to handle pipe. The use of hooks or bare cables will not be permitted.
- C. PVC Piping: No machinery shall directly contact the PVC pipe to push the pipe into place. The pipe shall be pushed into place by hand. The use of a hammer or mallet is permitted, with the use of a board to shield the end of the pipe being struck by the hammer. The pipe shall not be directly contacted with a hammer or mallet. Any pipe damaged while being pushed into place or while being laid in the trench shall be removed from the site and replaced at the expense of the Contractor.
- D. Pipe shall be inspected before any backfill is placed. Any pipe determined by the Owner's Representative to be out of alignment, unduly settled, or damaged shall be taken up and re-laid or replaced at no additional cost to Owner.
- E. General Locations and Arrangements: Drawing plans and details indicate location and arrangement of underground storm drainage piping. Install piping as indicated, following piping manufacturer's written instructions.
- F. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- G. If conflicts between utilities, the Contractor shall stop work on the utilities, contact the Engineer, and await direction from the Engineer.
- H. Install piping with 36-inch minimum cover unless otherwise specified on the Drawings.
- I. Install piping with a minimum slope as specified on Drawings.
- J. Install PVC piping according to ASTM D 2321, ASTM F 1668, and manufacturer's recommendations.
- K. Install reinforced-concrete piping according to ASTM C 1479 and manufacturer's recommendations.

3.03 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from drain pipe to cleanout at grade. Cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.

- B. Set cleanout frames and covers in earth in a cast-in-place concrete block, 12 by 12 by 8 inches deep. Top of concrete block shall be laid 3" below finished grade. Top of frame shall be set flush with finish grade where laid in earth.
- C. Set cleanout frames and covers in bituminous concrete and concrete pavement or slabs with tops flush with pavement surface. Top of concrete block shall be laid at the bottom of the bituminous binder course where laid in pavement surface.

3.04 MANHOLE INSTALLATION

- A. Excavation and backfilling requirements for installation of manhole and catch basin structures shall be in accordance with the requirements as specified in Section 310000, Earthwork.
- B. Manhole and catch basin barrel and cone sections shall be set so as to be vertical and in true alignment.
- C. Where required for future connections, openings shall be cast in the manholes and catch basins at the proper location and shall be sealed with watertight brick bulkheads or plugs.
- D. The inverts of all manholes shall be constructed of brick and formed to the details shown on the contract drawings.
- E. Concrete Base Slabs for manholes and catch basins shall have a full thickness of 12 inches shall extend 6 inches beyond the outside walls.
- F. Bottom riser sections of reinforced concrete manholes and catch basins may be either cast-in-place or precast concrete. The top edges, of cast-in-place bottom sections, shall be formed with a removable steel ring template designed to fit the tongue end of the precast riser sections.
- G. Inverts: Where pipe alignment permits, and where directed by the Owner's Representative, the pipe shall be continued through the manhole and the top half carefully and evenly cut away. Where changes in alignment occur, unless otherwise authorized by the Engineer, inverts shall be constructed of brick and mortar with a smooth flow line and an even curve in accordance with the plans.
- H. Joints: Pipe joints into manholes and catch basins shall be constructed in accordance with the details shown on the plans. Complete details of the boot manufacture and installation shall be submitted for approval. All areas around pipes passing through walls of manholes and catch basins shall be completely filled with waterproof cement mortar to tightly fill any space through which water can pass. All manhole and catch basin joints between sections shall be sealed with 1" diameter Butyl rubber sealant with hydraulic cement and coated with bitumastic sealant on the exterior.
- I. Bricks shall be laid in a workmanlike manner, true to line, and the joints shall be carefully struck and pointed on the inside. Bricks shall be thoroughly wet when laid and each brick shall be laid in mortar so as to form full bed, end and side joints in one operation. The outside of the brickwork shall be neatly plastered with ½" layer of cement mortar as the work progresses. The brickwork shall be satisfactorily bonded to the concrete and cast iron frame. No brick masonry shall be laid in water, or any water allowed to rise on the brickwork until the masonry has set for at least 24 hours.
- J. Damp-proofing: All exterior surfaces of manholes and catch basins shall receive at least one coat of asphalt damp-proofing.

3.05 AREA DRAIN INSTALLATION

- A. Area drains shall be stored out of direct sunlight until they are ready to be installed.

- B. Excavation and backfilling requirements for installation of the structures shall be in accordance with the requirements as specified in Section 31 00 00 Earthwork. Use sand gravel fill bedding with no stones larger than 1 ½" dia. Compact backfill uniformly.
- C. The area drain basin shall be set level and set so as to be vertical and in true alignment.
- D. Joints: Pipe joints into area drains shall be constructed in accordance with the details shown on the plans. Complete details of the boot manufacture and installation shall be submitted for approval.
- E. Drain basin body shall be cut at the time of final grade. No brick, stone, or concrete block will be required to set the grate to the final grade height.

3.06 UNDERGROUND INFILTRATION SYSTEM

- A. Refer to Manufacturer's Installation Guide for proper procedure required to maintain structural integrity and functionality of the chamber system.
- B. Erosion controls shall be in place to prevent any sediment from entering the underground infiltration system.
- C. The system shall not receive run-off until the entire contributing drainage area to the infiltration system has received final stabilization.
- D. Construction equipment and traffic shall be restricted from traveling over the infiltration system areas to minimize compaction of the soil.

3.07 PVC BARRIER INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install barrier at the elevations indicated on the plans.
- C. No holes or gaps shall be made during installation and backfill or to hold the barrier in place. Barrier shall be impervious.

3.08 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use procedure below:
 - 1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
 - 1. Remove manhole or structure and close open ends of remaining piping.
 - 2. Remove top of manhole or structure down to at least 48 inches below final grade. Fill manhole below this point with gravel borrow and compact to 92%
 - 3. Backfill to grade according to Section 310000 - Earthwork.

3.09 IDENTIFICATION

- A. Materials and their installation are specified in Section 310000 - Earthwork. Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.010 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - a. The Contractor shall, at his own expense, replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - b. The Contractor shall repair any defects or corrections required by the Owner's Representative.

3.10 CLEANING

- A. The Contractor shall clean interior of piping and structures of dirt, debris, and superfluous materials prior to commencing work, during construction and prior to acceptance of stormwater drainage system.
- B. The Contractor shall also clean downstream portions of the stormwater conveyance system which recovered silt deposits from the construction activity.

3.11 RECORD DRAWINGS

- A. All installed underground utilities shall be designated on as-built drawings by the contractor of record and provided to the Owner and Engineer in AutoCAD electrical format prior to completion of the project. All as-built drawings, (underground and above ground) shall be dimensioned from permanent benchmarks such as existing buildings and include depths at various points throughout the extent of the work, and invert elevations at all structures.

END OF SECTION