

PROJECT MANUAL **DESIGN DEVELOPMENT**

CENTRAL ARKANSAS WATER HEADQUARTERS RENOVATIONS

Little Rock, Arkansas

March 28, 2025

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CERTIFICATIONS PAGE

ARCHITECT

I HEREBY CERTIFY THAT THIS PROJECT MANUAL WAS PREPARED BY ME, OR UNDER MY
DIRECT SUPERVISION, AND THAT I AM A DULY LICENSED ARCHITECT UNDER THE LAWS OF
THE STATE OF ARKANSAS.

NAME: _____ DATE: ####/## REG. NO C-44

END OF SECTION

SECTION 00 3100
AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 EXISTING CONDITIONS

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of the Contract Documents, as follows:
- B. Geotechnical Report: Entitled RESULTS of GEOTECHNICAL INVESTIGATION - CENTRAL ARKANSAS WATER HEADQUARTERS ADDITIONS - LITTLE ROCK, ARKANSAS, dated MARCH 21, 2025.
 - 1. Prepared by Grubbs, Hoskyn, Barton & Wyatt, LLC, dba UES, Little Rock, Arkansas.
 - 2. For Contractor's convenience a copy is included following end of this section.
 - 3. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of the Architect Engineer.
 - 4. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in Contract Documents.
 - 5. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Sum accruing to Owner by a Change Order.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

March 21, 2025
Project No. A24184.00536

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c/o Cromwell Architects Engineers
Attn: Mr. Michael Callahan, P.E.
Principal, Structural

**RESULTS of GEOTECHNICAL INVESTIGATION
CENTRAL ARKANSAS WATER HEADQUARTERS ADDITIONS
LITTLE ROCK, ARKANSAS**

INTRODUCTION

Submitted herewith are the results of the geotechnical investigation performed for the additions planned for the Central Arkansas Water (CAW) headquarters building at 221 East Capitol Avenue in Little Rock, Arkansas. This study was authorized by Mr. Mason Ellis on behalf of WER Architects on December 11, 2024. This study has been performed in general accordance with our proposal of December 10, 2024. The scope of this study was modified on January 15, 2025 to include an additional boring after the initial field work was performed due to an additional structures being added to the design. A proposal for this supplemental work was submitted on January 20, 2025. Preliminary recommendations were discussed as the project developed.

It is understood that the project presently consists of four (4) additions to the CAW headquarters building. A four-story stair tower is planned on the east side of the existing building. The tower addition will have approximate footprint dimensions of 10 ft by 62 feet. The addition on the northeast side of the building will be an exterior “bump” approximately 12 ft long and extending 6.5 ft beyond the current building line. This addition will also extend up four (4) stories with a total height on the order of 49 ft above existing grade. The “bump” addition is expected to facilitate a lobby expansion and a structurally independent elevator utilizing block (CMU) construction. A two-story building addition at the northwest corner and a three-story building addition at the southwest corner are also planned. The northwest corner addition has plan dimensions of approximately 12 ft by 60 ft and will include a balcony at the third floor. The



southwest corner addition will be about 18 ft by 36 ft in plan and will be structurally independent of the original building. The building additions are expected to have a steel-frame structures. Some additional one-story canopy and isolated additions are also planned.

Maximum allowable foundation loads for the stair tower and north “bump” addition are anticipated to be 35 kips and 3.5 kips per foot. Maximum foundation loads for the northwest and southwest additions are anticipated to be about 60 kips. Canopies and other isolated, one-story additions are expected to have very light structural loads. Site grading information has not been provided. However, grading associated with the building additions is expected to be minor with final grades generally matching the existing grades. The elevator pit bottom is expected to be about 6.5 ft below plan finish floor. In addition, 4- to 5-ft-tall landscape retaining walls are planned to transition grades across the site.

The purposes of this study have been to explore subsurface conditions in the proposed additions areas and to develop recommendations to guide design and construction of foundations, floor slabs, and below-grade walls. The results of the field and laboratory studies are discussed in the following report sections. Subsequent report sections provide recommendations for design and construction.

SUBSURFACE EXPLORATION

Subsurface conditions were explored by drilling five (5) sample borings to depths of 1.5 to 30 ft below existing grades. The site vicinity is shown on Plate 1. The approximate boring locations are shown on the Plan of Borings, Plate 2. Boring 1 was abandoned at 1.5 ft due to auger refusal on concrete debris. Consequently, Boring 1A was drilled at an offset location to the west and south. Boring 4 was added when the southwest addition was included in the project.

Boring logs, presenting descriptions of the subsurface strata encountered and results of field and laboratory tests, are included as Plates 3 through 7. The ground surface elevation at each boring, as inferred from the available topographic information, is shown on the boring logs. It must be recognized that the elevations shown are approximate and actual elevations may vary. A key to the terms and symbols used on the logs is presented as Plate 8.

The sample borings were drilled with a track-mounted CME-55 rotary-drilling rig using dry-auger drilling procedures. Samples were typically obtained at 2-ft intervals using a 2-in.-diameter split-barrel sampler driven into the strata by the blows of a 140-lb safety hammer dropped 30 inches, in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to



drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger drilling procedures to facilitate groundwater observations. Observations regarding groundwater are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining final groundwater readings.

LABORATORY TESTING

Pertinent physical and engineering characteristics of the foundation and subgrade soils were evaluated by performing laboratory tests that included natural water content determinations and soil classification tests. A total of 21 natural water content tests were performed to develop a water content profile for each boring. Water contents are plotted on the logs in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, eight (8) liquid and plastic limit (Atterberg limits) determinations and 11 sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the logs as small pluses inter-connected with a dashed line using the water content scale. The percentage of soil passing through the No. 200 Sieve is noted in the "- No. 200 %" column on the log forms. Classification test results, as well as soil classification by the Unified Soil Classification System, are summarized in Appendix A. Grain-size distribution curves are also included in Appendix A.

SITE and SUBSURFACE CONDITIONS

Site Conditions

The project site is located at the southwest corner of the intersection of East Capitol Avenue and Cumberland Street in Little Rock, Arkansas. The existing building is a four-story structure with brick facade. It is reported that the existing building was constructed in the early 1970's and is supported on a footing foundation system. The available as-built information indicates the existing footings are founded between approximately El 294 to El 299. Landscaping and mature trees are present around the building exterior. The site terrain falls from south to north. The grades on the



north side of the building are transitioned to the East Capitol Avenue grade by existing masonry retaining walls. An existing drive-through service lane is on the east side of the building, and grades there are several feet higher than the grade of the existing Cumberland Street. A parking lot is located south of the building and extends to East 6th Street. Surface drainage is considered fair to good, in large part because of the existing pavements.

Seismic Conditions

The Pulaski County, Arkansas site is located in Seismic Zone 1, defined by the Arkansas Building Authority (2005) as the zone of least seismic potential. Based on the results of the borings, the local geology, and our experience in the area, a Seismic Site Class D (stiff soil profile) is considered suitable for the site in accordance with the criteria of IBC 2021.

Site Geology

The subject site is in the mapped outcrop of the Midway Group Formation. However, the subsurface conditions encountered are more typical of the nearby mapped Eocene age Wilcox Group. The Wilcox Group consists of variable sand, silty sand, clay, and gravel units with some lignite deposits. The sands are generally fine grained and the clays are often sandy or silty. The stratigraphy can vary widely over relatively short horizontal and vertical distances. The Wilcox unconformably rests on the Midway Group. The thickness of the Wilcox Group ranges from a few feet to 1000 feet, with an average thickness of about 850 feet. The results of the borings drilled on this site indicates that the top of the Midway Group is in excess of the 25- to 30-ft exploration depth of the borings.

Subsurface Conditions

Based on the results of the borings performed for this study, the subsurface stratigraphy at the building location may be generalized into the following primary strata.

Pavements: Pavements cover some areas of the ground surface of the site. Approximately 3.5 to 6 inches of asphalt cement concrete, 6 inches of Portland cement concrete, and 4 inches of crushed stone base were encountered in the borings.

Stratum I: Variable on-site fill extends to about 6- to 13-ft depth over the site. The fill varies from very soft to stiff gray, brown, and tan fine sandy clay and silty clay to loose to dense brown, reddish brown, tan, gray, and dark gray silty fine sand, clayey fine to coarse sand, fine sandy silt, and clayey fine to coarse gravel. The on-site fill contains a variable content of syenite fines, fine to coarse gravel, cinders, brick and concrete debris, and silt pockets. Auger refusal on apparent concrete was locally encountered at 1.5 ft on the north side of the building (see Boring 1A). The variable fill has low to medium plasticity with very poor to fair compaction and moderate to high



compressibility. The depth, content, and compaction of the on-site fill are likely to vary across the site.

Stratum II: The natural soils below the on-site fill are firm to very stiff light gray, tan, and reddish tan silty clay and fine sandy clay with fine to coarse gravel. The silty clay and sandy clay exhibit low plasticity, low to medium shear strength, and low to high compressibility.

Stratum III: The cohesive soils of Stratum II are underlain by medium dense to very dense red, tan, yellowish tan, gray, reddish brown, and reddish tan silty fine to coarse sand, clayey fine to medium sand, clayey fine to coarse gravel, and sandy fine to coarse gravel. The silty sand, clayey sand, clayey gravel, and sandy gravel exhibit low plasticity, medium to high relative density, and low compressibility. Relative density typically increases with depth and compressibility decreases in Stratum III. Localized strata of the stiff to very stiff fine sandy clay (Stratum II) are interbedded with the granular units of Stratum III (see Boring 1A). In this case, the interbedded sandy clay contains a variable content of gravel and has moderate shear strength with low compressibility.

Groundwater was encountered at 19 to 27 ft below existing grades in December 2024 and January 2025. Perched groundwater may be present in the on-site fill (Stratum I). In addition, groundwater levels will vary, depending on seasonal precipitation and surface runoff and infiltration.

ANALYSES and RECOMMENDATIONS

Foundations

Foundations for the additions must satisfy two (2) basic and independent design criteria: (a) the maximum bearing pressure transmitted to the foundation soils must not exceed the allowable bearing pressure based on an adequate factor of safety with respect to soil shear strength; and (b) foundation movements resulting from consolidation, shrinkage or swelling of the supporting soils should be within tolerable limits for the structure. Construction factors such as installation of foundation units, excavation procedures, and surface and groundwater conditions must also be considered.

Given the deep, variable fill and the depths of the existing footings, there is significant potential for differential settlement between the new additions and the existing building with the use of shallow foundations supporting the additions. To reduce the settlement potential, deep foundation systems consisting of micropiles or helical piles are recommended for support of the structural loads of the two- to four-story additions. The below-grade walls of the elevator shaft should also be supported on micropiles or helical piles. Very lightly-loaded canopies, landscape retaining walls, and other isolated structures may be supported on shallow footings.



An at-grade floor slab is considered suitable for the additions. However, some undercut of the existing fill will be warranted for adequate floor slab support. Recommendations for deep and shallow foundation systems, floor slabs, below-grade wall, and retaining walls are discussed in the following report sections.

Micropiles

Foundation loads of the new two- and four-story additions may be supported on micropiles. Micropiles are small-diameter (i.e., less than about 12 in.) deep foundation elements comprised of grouted columns with a central reinforcing bar. It is anticipated that the micropiles will need to extend into the medium dense sand and gravel and stiff sandy clay units below about 18 ft below existing grade to develop suitable capacity.

Preliminary allowable micropile capacities are summarized in Appendix B for nominal 6- and 8-in.-diameter micropiles. Other micropile sizes can be evaluated, if desired. These capacities include a minimum factor of safety of 2.5 for compression and 3.0 for uplift with respect to static axial loads. Where as-built micropile capacity is verified by a load test program, use of a factor of safety of 2.0 may be considered.

A minimum micropile spacing of three (3) diameters is recommended, center-to-center, between micropiles. We also recommend that the bearing capacity of a micropile-supported footing be based on the capacities of the micropiles alone with no contribution from the footings. Post-construction settlement of properly installed micropiles is expected to be less than 1.0 inch. Differential settlement should be less than 0.5 inch.

We recommend that the micropile design be confirmed by verification testing. Verification test results should be reviewed by the Engineer and Geotechnical Engineer. We also recommend that a minimum of 10 percent of production micropiles be proof-tested to at least 1.3 times the design load.

Micropile design and installation must be provided by a competent and experienced specialty contractor. The Micropile Contractor should select the most suitable pile type and installation method for the particular system being utilized. Example specifications for micropiles are provided in Appendix C. The Micropile Contractor may provide their own specifications if acceptable to the Engineer. The Micropile Contractor's micropile design, including the specifications, verification test program, proposed micropile layout, corrosion protection details, connection to the mat, and the work plan should be reviewed by the Design Team and approved by the Owner and Engineer prior to the start of work.



Helical Piles

A foundation system utilizing helical piles could also be used to support the foundation loads of the new two- and four-story additions. Helical pile elements are comprised of a central shaft with one (1) or more helix plates located on the shaft with the axis of the helix plates oriented parallel to the length of the shaft. Capacity of helical anchors is developed by “screwing” anchors into suitable bearing strata. The as-built anchor capacity can be correlated based on the torque reading during anchor installation.

Helical anchors must extend through the on-site fill (Stratum I) and firm silty clay (Stratum II) to develop capacity in the medium dense sand and gravel (Stratum III) and stiff to very stiff sandy clay (interbedded Stratum II) units. A conceptual detail of a helical pile is provided in Appendix D.

Specific anchor capacity will vary with the number and size of plates utilized and the installation torque. For a helical pile using two (2) plates with 8- and 10-in.-diameters, an allowable preliminary capacity on the order of 35 kips per helical pile is estimated. However, the anchor capacity must be based on the specific anchors used for the project. Estimated helical pile lengths and tip elevations for a calculated allowable helical pile capacity of 35 kips per helical pile are summarized in Table 1 below.

Table 1: Estimated Helical Pile Lengths and Tip Elevations

Structure	Estimated Bottom of Pile Cap Elevation, ft	Estimated Pile Tip Elevation, ft	Estimated Pile Length, ft
NW Addition	298	282	16
East Addition	298	276	22
Elevator Pit	291	271	20
SW Addition	298	274	24

Note: Depths shown above are estimates only based on 35-kip piles.

As noted, the helical pile lengths and tip elevations shown in the table above are estimates only. These preliminary capacities and depths have been developed based on the results of the borings, the inferred footing/pile cap elevations, and an assumed helical pile plate configuration. Actual lengths will depend on the helical pile sections selected and the project requirements. A minimum helical pile spacing of three (3) lower plate diameters clear spacing is recommended. For lateral loads, battered piles may be utilized.

The specific plan for helical piles, including the proposed length, plate configuration, pile capacity, required installation torque, layout, and connection to footings/pile caps, as well as a work



plan, must be developed by the Helical Pile Contractor. This information should be reviewed by the Engineer and approved by the Owner and Engineer prior to acceptance and the start of work. Example specifications for helical piles are provided in Appendix E. The Helical Pile Contractor may provide their own specifications if acceptable to the Engineer.

We recommend that final helical pile design include the use of heavy helix plates suitable for installation in gravel, typically minimum 0.5-in.-thick plates. We also recommend a minimum helical pile spacing between piles of three (3) diameters of the largest helix plate, center-to-center. Since torque is monitored as helical piles are installed, it is not expected that a load test program or proof-testing will be warranted during installation.

Footings

For support of the single-story canopies and other very lightly loaded, elements which will be fully isolated from the existing building, support on shallow footings or mats may be considered. All parties must be aware of the potential for differential settlement between small addition elements supported on footings or mats and the existing building. For elements which are sensitive to settlement, which will be connected to the existing building, or which have partitions or walls extending from the existing building to the addition, we recommend that deep foundations be utilized.

Individual or continuous footings or isolated mats should be supported in the compact on-site fill (Stratum I), natural stiff fine sandy clay (Stratum II), or in compacted select fill. Landscape retaining walls may be supported on continuous footings bearing the compact on-site fill (Stratum I), natural stiff fine sandy clay (Stratum II), or in compacted select fill.

The suitability of the bearing subgrade must be verified by the Geotechnical Engineer by observation of foundation excavations. Where noncompact or weak and highly-compressible soils are encountered at the plan footing or mat bottom elevation, improved bearing may be developed by selective undercut, use of geosynthetics, and backfilling with select granular fill.

Footings for canopies and other very lightly loaded elements founded in the compact on-site fill (Stratum I), natural stiff fine sandy clay (Stratum II), or in compacted select fill as recommended above may be designed with respect to maximum net allowable soil bearing pressures of 1250 and 1000 lbs per sq ft for individual and continuous footings, respectively. For mats supported in the compact on-site fill (Stratum I), natural stiff fine sandy clay (Stratum II), or in compacted select fill, foundations may be designed for a maximum net allowable bearing pressure of 1000 lbs per sq foot.



Continuous footings supporting landscape retaining walls may be designed with respect to a maximum net allowable bearing capacity of 1250 lbs per sq foot. This allowable value includes a factor of safety of 2.0. Given the potential for differential settlement of continuous footings founded in the on-site fill, we recommend frequent control joints in retaining walls.

With the exception of retaining wall footings, the recommended bearing values include a minimum factor of safety of 2.5 with respect to the measured shear strength of the stiff sandy clay and medium dense silty and clayey sand fill, natural stiff sandy clay, and the anticipated shear strength of properly compacted select fill and compact on-site fill. Where support in the on-site soils is anticipated, we recommend designing all footings and mats as rigid elements to minimize differential settlement. Post-construction settlement of foundations founded in the on-site fill cannot be quantified. However, for elements with small footprints, differential settlement is estimated to be less than 1.0 inch.

Undercuts on the order of 2 to 4 ft below existing grades, more or less, may be warranted for foundation construction. Given the wide variation in the depth of the on-site fill, we recommend that foundation undercuts be limited to the depth required to backfill to the plan foundation bottom elevation with select granular fill. Foundations must not be founded in noncompact or debris-laden fill. Foundation undercuts backfilled with select fill or select granular fill should have a minimum width determined by a 1-horizontal to 2-vertical (1H:2V) projection from the edge of footings to the undercut bottom. Care must be taken not to undermine existing building footings, floor slabs, landscape features, or pavements with foundation construction.

Uplift resistance of foundations will be developed by structure dead loads and the weight of the foundation units. Resistance to lateral forces will be developed by the passive resistance of the foundation soils and sliding resistance at the footing bottom. The passive resistance of the soil within the upper 1 ft should be neglected. Below 1-ft depth, an ultimate passive resistance value of 250 lbs per sq ft may be assumed for the stable on-site soils and compacted select fill. Resistance to sliding may also be evaluated using an ultimate friction value ($\tan \delta$) of 0.30 for concrete on the recommended bearing strata. Where select granular fill is utilized for foundation support, an increased ultimate friction value ($\tan \delta$) of 0.40 may be utilized for footings. An appropriate factor of safety must be included in analysis of sliding.

Continuous footings should have a minimum width of 24 inches and individual footings should have a minimum dimension of 30 inches. Perimeter footings and footings in unheated areas should extend a minimum of 1.5 ft below final grade for embedment and frost protection. Interior



footings or thickened sections can be founded in compacted fill at shallower depths consistent with structural requirements for thickness. Mat foundations may be supported at shallower depths consistent with the required mat thickness. However, the mat should be underlain by crushed stone aggregate base (ARDOT Standard Specifications Section 303, Class 7) extending to at least 1.5 ft below lowest adjacent grade.

The Geotechnical Engineer should observe all foundation excavations and any undercuts to verify suitable bearing. Where undercut, use of a geotextile, and backfilling with select granular fill or select fill is used to improve bearing and reduce the settlement potential, the depth of undercut should be as directed by the Geotechnical Engineer.

Floor Slabs

Slab-on-grade construction will be suitable for the addition floor slabs. Thorough proof-rolling of the on-site fill subgrade will be warranted to verify suitable subgrade support. The floor slabs must not be supported on unstable or marginal subgrade soils. Given the variable on-site fill and the potential for unstable, low-strength surface and near-surface soils, localized undercuts on the order of 2 to 4 ft, more or less, in conjunction with a heavy geotextile and select granular fill could be required to provide a stable subgrade below floor slabs.

We also recommend that at-grade floor slabs be supported on a 4- to 6-in.-thick clean crushed stone layer placed on a properly prepared subgrade. The granular layer should be densified with vibrating equipment prior to floor slab construction. Impervious sheeting should be placed between the slab and granular course to function as a vapor retarder.

Below-Grade Walls and Retaining Walls

Below-grade walls for the elevator pit are anticipated to extend about 6.5 ft below finished floor for the elevator shaft. Cantilevered retaining walls with 4- to 5-ft of height are planned to transition grades in landscape areas across the site. The elevator shaft walls will be fixed at the top by inside corners. Consequently, the elevator shaft walls will be acted upon by at-rest lateral earth pressures. Where walls are free to rotate about the base, such as the elevator pit during construction and in cantilevered landscape walls, active earth pressures will be mobilized. The elevator shaft walls are expected to be supported on either micropiles or helical piles. The landscape retaining walls are expected to be supported on continuous footings as previously recommended.

It is expected that the below-grade walls and retaining walls will be backfilled with clean crushed stone or low-plasticity select fill. For clean crushed stone a gradation complying with ASTM D448 Size 57 stone or locally-available “C”-ballast is considered suitable. As a minimum,



clean crushed stone wall backfill should extend in a zone extending from the back of the wall footing to daylight on a 1-horizontal to 1-vertical (1H:1V) configuration.

A summary of recommended equivalent fluid pressures is tabulated below for walls backfilled with either clean, crushed stone or low-plasticity select fill. These equivalent fluid pressures include both the at-rest (long term, restrained) and active (cantilevered walls).

Lateral Earth Pressure of Wall Backfill

Earth Pressure Condition	Free-draining crushed stone backfill, Equivalent Fluid Pressure, lbs per sq ft per ft depth	Low-plasticity select fill, lbs per sq ft per ft depth
At rest (restrained), drained	50	80
At rest (restrained), undrained	85	100
Active (unrestrained and rotating about wall base), drained	30	60
Active (unrestrained and rotating about wall base), undrained	75	90

Surcharge loads may be evaluated using earth pressure coefficients of 0.50 for the active condition and 0.65 for the at-rest condition for select fill wall backfill. For clean stone backfill, earth pressure coefficients of 0.27 for the active condition and 0.38 for the at-rest condition are recommended. Undrained conditions assume that the walls will be subject to full hydrostatic pressure. Drained conditions assume positive and continuous drainage of infiltrated water from the backfill. Where drainage cannot be assured, then undrained conditions should be assumed.

Crushed stone backfill should be placed in nominal 8- to 10-in.-thick lifts and densified by vibrating equipment or other suitable means. Crushed stone backfill must be separated from the on-site soils and weathered shale by a suitable filter fabric. A fabric such as Mirafi 140N or an approved equivalent is recommended.

Low-plasticity select backfill should be compacted to a minimum of 95 percent of the maximum dry density as determined by Standard Proctor (ASTM D698) methods. Approximately the top 12 in. of wall backfill should consist of low-permeability clayey soils compacted to the Standard Proctor density recommended above. This top layer should limit significant infiltration of surface water into backfill. Compaction within 5 ft of walls should be achieved with hand compaction equipment. Overcompaction of backfill soils can result in damage to walls.



To reduce lateral earth pressures and maintain proper drainage, a drainage system can be provided for backfill behind walls. Where backfilled with low-plasticity select fill, the zone behind walls extending at least 18 in. back of walls should be backfilled with clean, free-draining crushed stone fully encapsulated in filter fabric. To allow drainage of perched water from below-grade wall backfill, a perimeter drain consisting of a continuous, perforated PVC pipe wrapped in geotextile fabric should be provided within the granular course behind retaining walls. Water should be discharged from retaining wall backfill by a system of regularly-spaced, functioning weep holes.

It must be recognized that there will be some settlement of below-grade wall and retaining wall backfill. The magnitude of post-construction settlement can be reduced by utilizing clean crushed stone backfill. Concrete flatwork and other architectural features constructed over wall backfill will be subject to variable amounts of post-construction settlement. Locating foundation elements in wall backfill should be avoided. We recommend that this situation be evaluated by the Structural Engineer and the Geotechnical Engineer on a case-by-case basis.

Site Grading

Site preparation is expected to begin with demolition of some existing pavements, clearing and grubbing any trees on the addition sites, and stripping all weak and/or organic-containing soils. The stripping depth is expected to be on the order of 6 inches. All stump holes should be properly backfilled.

We recommend that existing pavements which will be covered by at least 12 in. of fill be left in place wherever possible to facilitate construction operations and to minimize the potential for undercuts. However, where additional fill is placed over existing pavements, the pavement should be randomly perforated to prevent trapping infiltrated water. All abandoned underground utilities in the addition areas should be completely removed unless specifically accepted by the Architect. Foundation elements must not be placed over underground utilities. If pavements are left in place under a new floor slab, we recommend a minimum of 12 in. of crushed stone aggregate base or approved alternate material over the concrete and below the slab subgrade elevation.

Following required pavement demolition, stripping and any cut, and prior to any fill placement, the subgrade should be proof-rolled with a loaded tandem-wheel dump truck or similar equipment or otherwise evaluated by the Geotechnical Engineer. All unstable, soft, or otherwise unsuitable soils encountered in the project areas should be excavated, reprocessed and recompacted or replaced with select fill, whichever is appropriate. Depending on seasonal site conditions and final



grading plans, localized undercut depths on the order of 2 to 4 ft below existing grades, more or less, are anticipated. Undercuts should extend at least 5 ft outside addition areas to the extent possible.

The on-site soils are not recommended for use as select fill or backfill due to the wide variability and the presence of debris. Imported borrow for select fill or backfill should consist of an approved silty clay and shale fragment blend, low-plasticity clayey sand (SC), sandy clay (CL), or clayey gravel (GC) with a liquid limit less than 40 and a maximum plasticity index (PI) of 18, or an approved alternate. Select granular fill placed below foundation elements or slabs should consist of crushed stone aggregate base (ARDOT Class 7), well-graded crusher fines classifying as “SW” as per ASTM D2487 (Granite Mountain Industrial Sand), or approved alternates. The geotextile utilized with select granular fill should have properties equal to or exceeding Mirafi HP270. A maximum particle size of 3 in. is recommended for all fill and backfill. Fill and backfill should be free of organics and debris with a maximum PI of 18. Maximum particle size in fill and backfill should be limited to about 3-in. dimension, with a maximum particle size of 1.5 inches in the top 18 inches of fills. All fill and backfill should be approved by the Geotechnical Engineer.

With the exception of below-grade wall backfill, all fill, backfill, and recompacted soils should be compacted to a minimum of 95 percent of the Modified Proctor (ASTM D1557) maximum dry density. Low-plasticity soils (clayey sand, sandy clay, or clayey gravel) should be compacted within a water content range of 2 percent below to 3 percent above the optimum value. Shale fragment blends should be watered as necessary to obtain a water content ranging from optimum to 3 percent above optimum during compaction. If a silty clay-shale fragment blend fill is used, particular attention should be given to compaction and placement procedures.

Fill and backfill should be placed in horizontal, nominal 6- to 8-in.-thick loose lifts. Fills placed against existing slopes should be benched into the existing slope face as the new fill is constructed. Each lift of backfill and fill should be tested and approved prior to placing subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Positive surface and subsurface drainage should be established at the start of construction, maintained during the work, and incorporated into final design to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until the footings and floor slabs are completed. Subgrade soils that become saturated by ponding water or runoff should be excavated to suitable material.



Groundwater was encountered at 19 to 27 ft in December 2024 and January 2025. Seepage into shallow excavations could occur, particularly during wet seasons of the year, due to the development of shallow perched water in the on-site fill or infiltration through these granular soils. Limited seepage can typically be controlled by a sump-and-pump system. For areas where steady seepage of shallow groundwater is encountered, the seepage should be directed to positive discharge by French drains or blanket drains.

Micropiles and helical piles should be installed by an experienced specialty Contractor. Pile installation and all verification tests and proof-tests should be observed by the Geotechnical Engineer. The specialty Contractor for micropile or helical pile installation must demonstrate their experience and qualifications for construction of these foundations in similar subsurface conditions. A pre-construction meeting should be scheduled by the Engineer and be held prior to the start of micropile construction. The Engineer, Prime Contractor, Micropile Specialty Contractor, and Geotechnical Engineer should attend the meeting.

Micropile load testing and installation should be observed by the Geotechnical Engineer. The Specialty Subcontractor should have appropriate equipment with sufficient energy capabilities to install piles to the plan tip elevation.

All foundation excavations and undercuts should be observed by the Geotechnical Engineer to verify suitable bearing and adequate undercut. Installation of deep foundations should also be observed by the Geotechnical Engineer. Care must be taken to avoid undermining existing foundations, slabs, pavements, or utilities with foundation excavations or undercuts. Concrete should be placed in foundation excavations expeditiously following final clean up and approval to limit changes in foundation conditions. Foundation excavations should be clean and dry at the time of concrete placement. Where foundation excavations will be left open for extended periods, the bearing stratum should be protected with a thin layer of seal concrete.

CLOSING

Site preparation, grading work, undercuts, and all foundation and floor slab construction should be monitored by the Engineer or a designated representative thereof. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the latest information.



The following attachments are included and complete this submittal.

Plate 1	Site Vicinity
Plates 2a and 2b	Plan of Borings
Plates 3 through 7	Boring Logs
Plate 8	Key to Terms and Symbols
Appendix A	Classification Test Results
Appendix B	Micropile Capacity Curves
Appendix C	Example Micropile Specifications
Appendix D	Concept for Typical Helical Pile
Appendix E	Example Helical Pile Specifications

* * * * *

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or if we may be of further assistance during final design or construction, please call on us.

Sincerely,

**GRUBBS, HOSKYN,
BARTON & WYATT, LLC**

Vellela M. Scott, P.E.
Principal Engineer

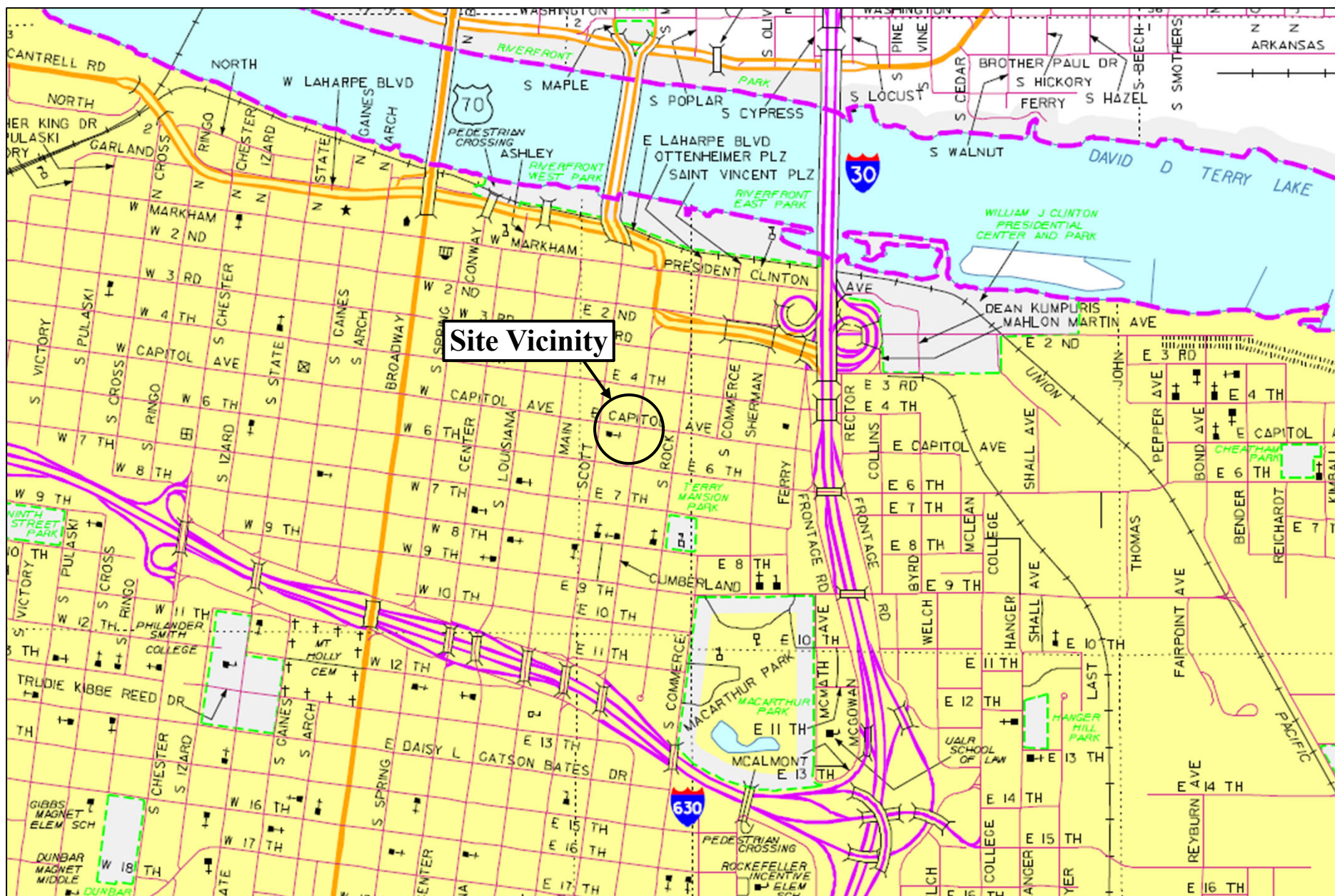
Mark E. Wyatt, P.E.
President

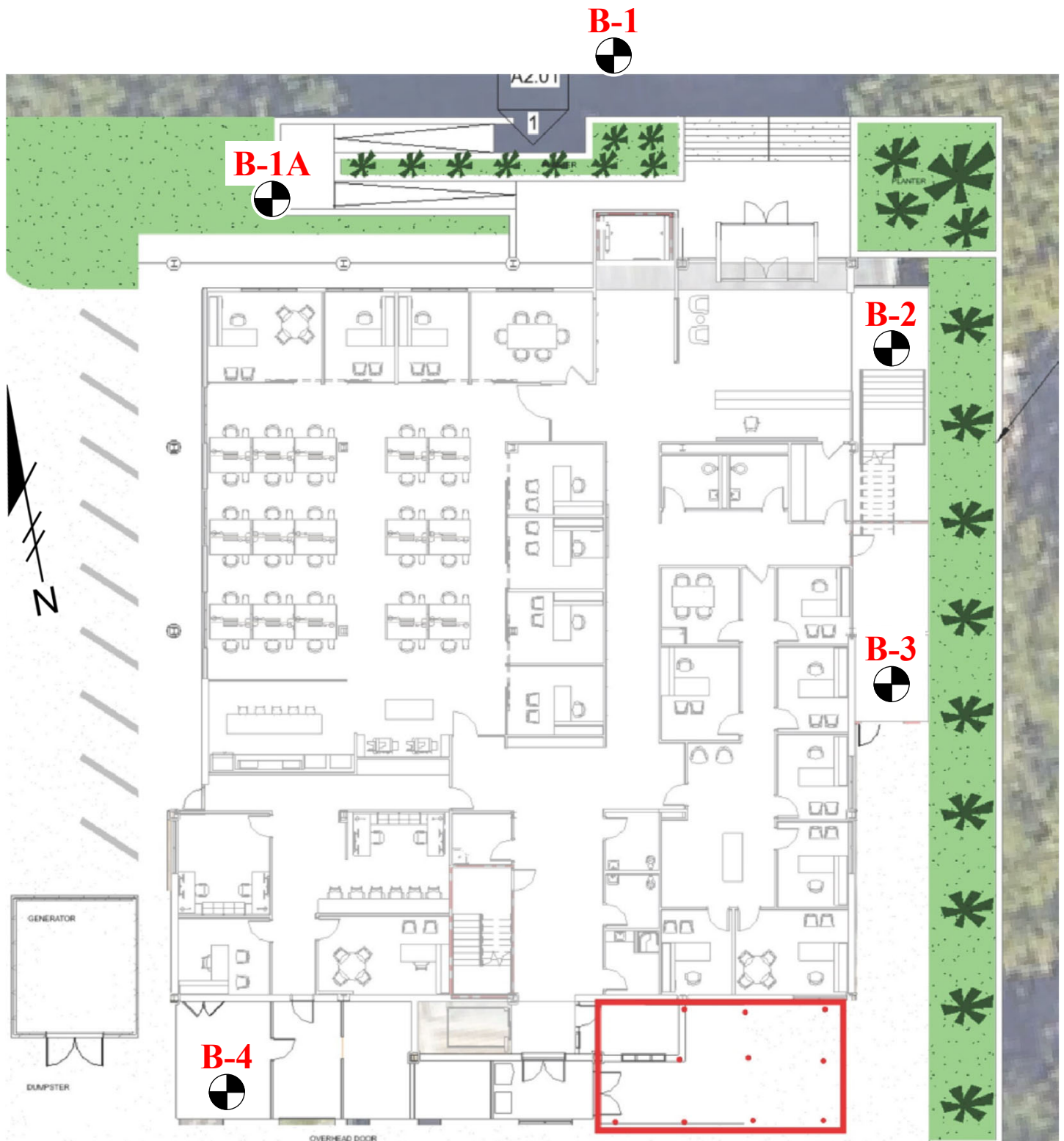


VMS/MEW:jw

Copies submitted: WER Architects
Attn: Mr. Russ Fason, AIA LEED AP (1-email)

Cromwell Architects Engineers
Attn: Mr. Michael Callahan, P.E. (1-email)
Attn: Mr. Matthew Kitsch, P.E. (1-email)





Site plan of 02-18-25

10 0 10 20 ft



**Grubbs, Hoskyn,
Barton & Wyatt, LLC**
CONSULTING ENGINEERS

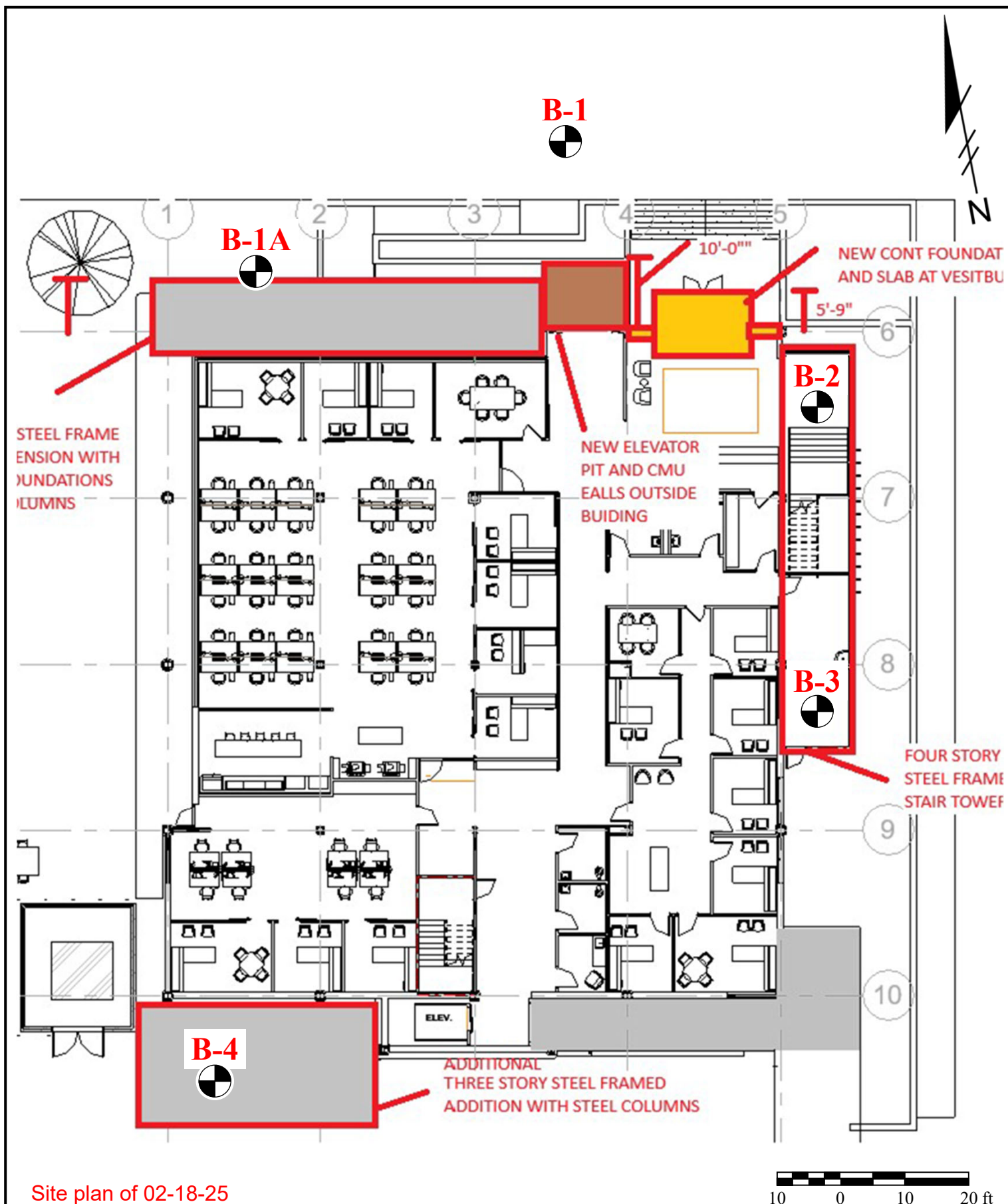
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PLAN of BORINGS
CAW Headquarters Additions
Little Rock, Arkansas

Scale: As Shown

Job No. A24184.00536

Plate 2a



**Grubbs, Hoskyn,
Barton & Wyatt, LLC**
CONSULTING ENGINEERS

A UES Company

PLAN of BORINGS
CAW Headquarters Additions
Little Rock, Arkansas

Scale: As Shown

Job No. A24184.00536

Plate 2b



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. 1

CAW Headquarters Additions Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 2

[illegible]

COMPLETION DEPTH: 1.5 ft
DATE: 12-20-24

DEPTH TO WATER
IN BORING: Dry

DATE: 12/20/2024



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. 1A

CAW Headquarters Additions
Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 2

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 299±			PLASTIC LIMIT +			WATER CONTENT ●			LIQUID LIMIT +	
						10	20	30	40	50	60	70	
			Loose gray silty fine sand (syenite fines - fill)	4									
5			Firm to stiff tan and gray fine sandy clay, silty w/syenite fines and trace fine gravel (fill)	10		●							
			- stiff with dark brown silt pockets and more fine sand below 4 ft	18		●	++						47
				14		●							
10			Firm tan and reddish tan fine sandy clay w/trace fine to coarse gravel	8		●	+		+				60
15			Dense reddish tan and yellowish tan clayey fine to coarse gravel	35									
20			Stiff tan and reddish tan fine sandy clay w/a little fine to coarse gravel	15									
25			- very stiff with some gravel below 23 ft	32									
30			Medium dense reddish tan clayey fine to coarse gravel	24									
			Note: Drilled with CME-55										
COMPLETION DEPTH: 30.0 ft				DEPTH TO WATER				DATE: 1/7/2025					
DATE: 1-7-25				IN BORING: 27 ft									

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**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. 2

CAW Headquarters Additions Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 2 - Stair Tower

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2 0.4 0.6 0.8 1.0 1.2 1.4							
						PLASTIC LIMIT +	WATER CONTENT ●					LIQUID LIMIT +	
SURF. EL: 297±						10	20	30	40	50	60	70	
5 <													



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. 3

CAW Headquarters Additions
Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 2 - Stair Tower

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 298±										
			6 in. Asphalt Cement Concrete										
			4 in. Crushed Stone Base	22									
			Medium dense dark gray fine to medium sandy silt w/asphalt concrete debris and trace fine gravel (fill)	16		●							53
5			Dense reddish brown and tan clayey fine sand w/some fine to coarse gravel (fill)	33		●	+	-	+				29
			Loose to medium dense brown fine sandy silt, slightly clayey w/some cinders and occasional brick debris (fill)	10		●							
10				10		●	+						49
			Stiff to very stiff light gray silty clay w/occasional ferrous stains	24			●						
15													
			Medium dense reddish brown sandy fine to coarse gravel, slightly clayey w/ferrous nodules and stains	23		●							9
20													
			Dense tan sandy fine to coarse gravel	46									
25													
			- dense to very dense below 28 ft	50/6"									
30			Note: Drilled with CME-55										
COMPLETION DEPTH: 30.0 ft													
DATE: 12-20-24													
DEPTH TO WATER													
IN BORING: 23 ft													
DATE: 12/20/2024													

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**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. 4

CAW Headquarters Additions
Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 2

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 300±										
			3.5 in. Asphalt Cement Concrete										
			4 in. Crushed Stone Base										
			Loose brown fine sandy silt w/silty clay pockets and cinders (fill)	7									
			- with trace fine to coarse gravel below 2 ft	6									
5			Very soft to soft light brown silty clay, slightly sandy w/occasional brick fragments (fill)	4									78
			Stiff reddish tan, red, and gray fine sandy clay w/a little fine to coarse gravel	11									
10			Medium dense reddish tan, red, and gray clayey fine to medium sand, silty w/trace fine gravel	27									24
			Firm gray silty clay w/ferrous stains	7									
15													
			Medium dense light brown silty fine to coarse sand w/some fine to coarse gravel	12									
20													
			Dense tan silty fine to coarse gravel, sandy	52									
25													
			- medium dense below 28 ft										
30				26									
			Note: Drilled with CME-55										
COMPLETION DEPTH: 30.0 ft				DEPTH TO WATER				DATE: 1/20/2025					
DATE: 1-20-25				IN BORING: 19 ft									

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SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

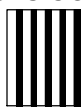
(SHOWN IN SYMBOLS COLUMN)



Gravel



Sand



Silt

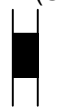


Clay

Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



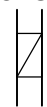
Shelby
Tube



Rock
Core



Split
Spoon



No
Recovery



Cutting

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (1) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM

N-VALUE

RELATIVE DENSITY

VERY LOOSE

0-4

0-15%

LOOSE

4-10

15-35%

MEDIUM DENSE

10-30

35-65%

DENSE

30-50

65-85%

VERY DENSE

50 and above

85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM

UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.

VERY SOFT

Less than 0.25

SOFT

0.25-0.50

FIRM

0.50-1.00

STIFF

1.00-2.00

VERY STIFF

2.00-4.00

HARD

4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.

FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

LAMINATED - composed of thin layers of varying color and texture.

INTERBEDDED - composed of alternate layers of different soil types.

CALCAREOUS - containing appreciable quantities of calcium carbonate.

WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.

POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

APPENDIX A

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: CAW Headquarters Additions

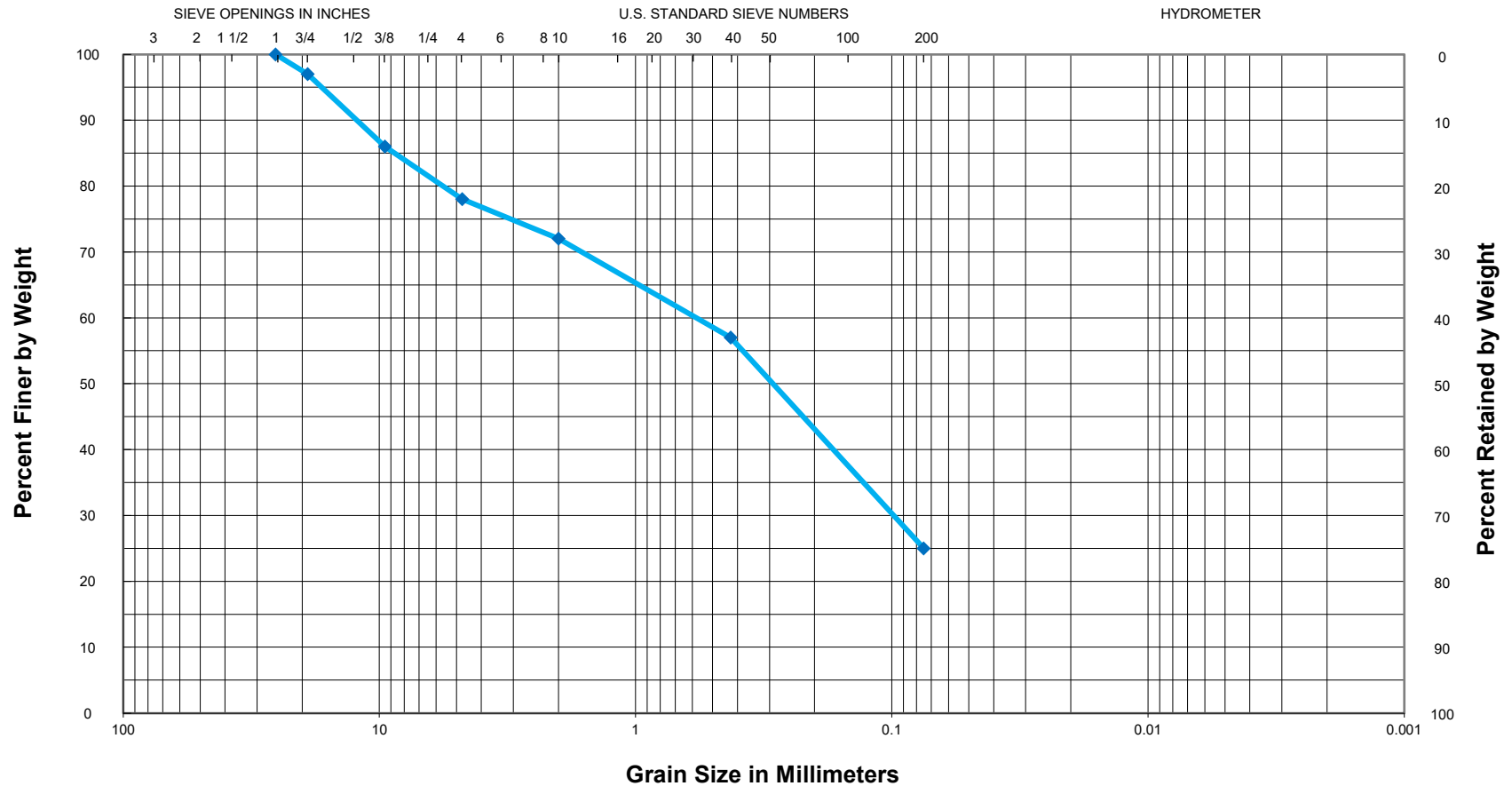
LOCATION: Little Rock, Arkansas

GHBW JOB NUMBER: A24184.00536

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			PERCENT RETAINED #4	PERCENT PASSING #200	USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX				
1A	4.5-5.5	15	26	23	3	16	47	SM	A-4
1A	9-10	17	39	15	24	19	60	CL	A-6
2	4.5-5.5	7	---	---	---	22	25	SM	A-2-4
2	6.5-7.5	6	31	13	18	46	29	GC	A-2-6
2	14-15	17	34	19	15	0	91	CL	A-6
3	2.5-3.5	8	---	---	---	6	53	ML	A-4
3	4.5-5.5	7	25	16	9	32	29	SC	A-2-4
3	9-10	9	24	23	1	20	49	SM	A-4
3	19-20	5	---	---	---	69	9	GP-GC	A-2-6
4	4.5-5.5	22	37	20	17	0	78	CL	A-6
4	9-10	13	63	34	29	15	24	SM	A-2-7

A24184.00536

GRAIN SIZE CURVE



GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

Sample: Boring 2, 4.5-5.5 ft

Description: Gray silty fine to medium SAND w/cinders, silty clay pockets, and concrete debris (syenite fines - fill)

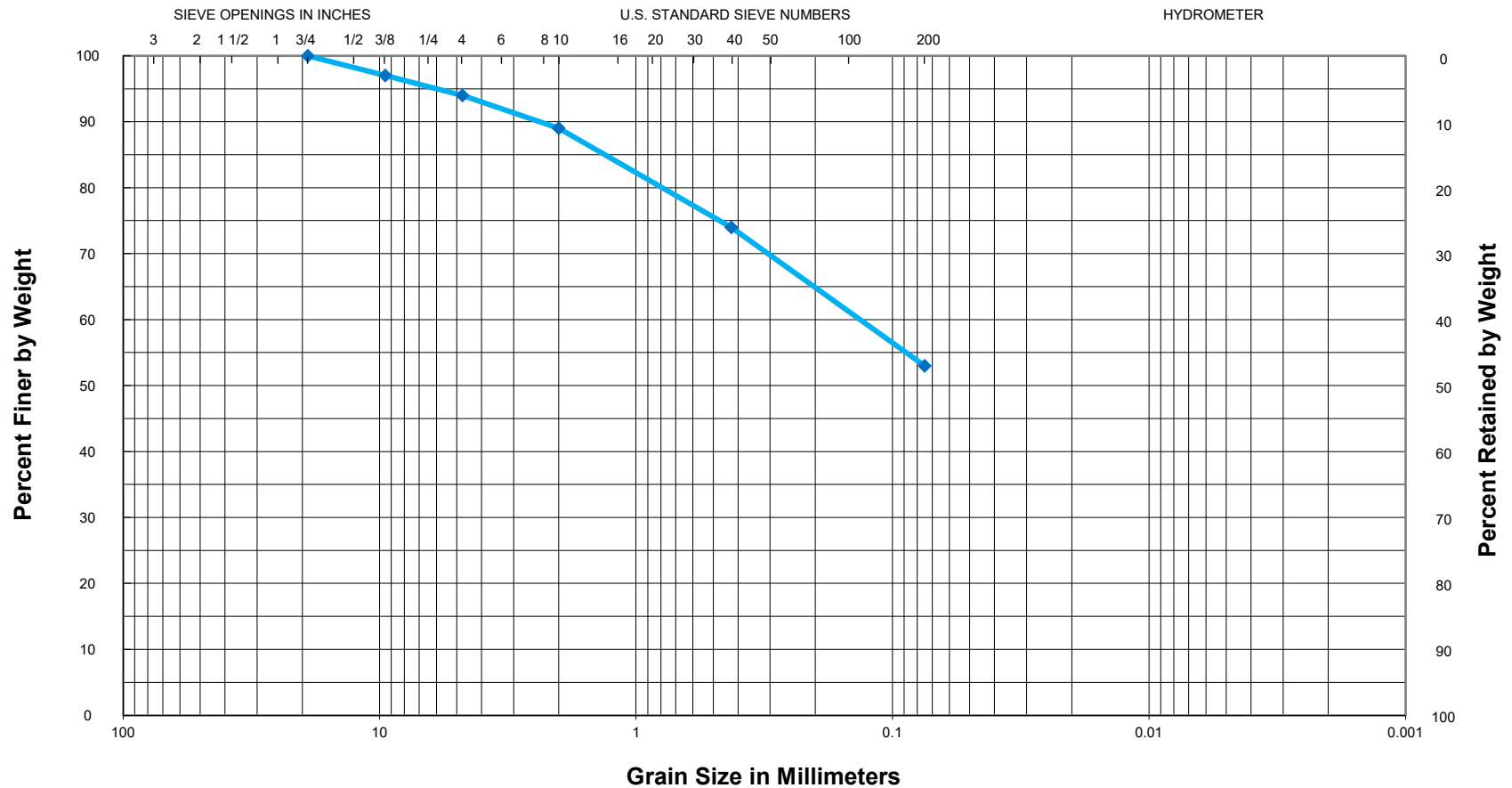
USCS Classification = SM
AASHTO Classification = A-2-4

A24184.00536

GRAIN SIZE CURVE



A UES Company



GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

Sample: Boring 2, 4.5-5.5 ft

Description: Dark gray fine to medium sandy SILT w/asphalt concrete debris and trace fine gravel (fill)

USCS Classification = ML

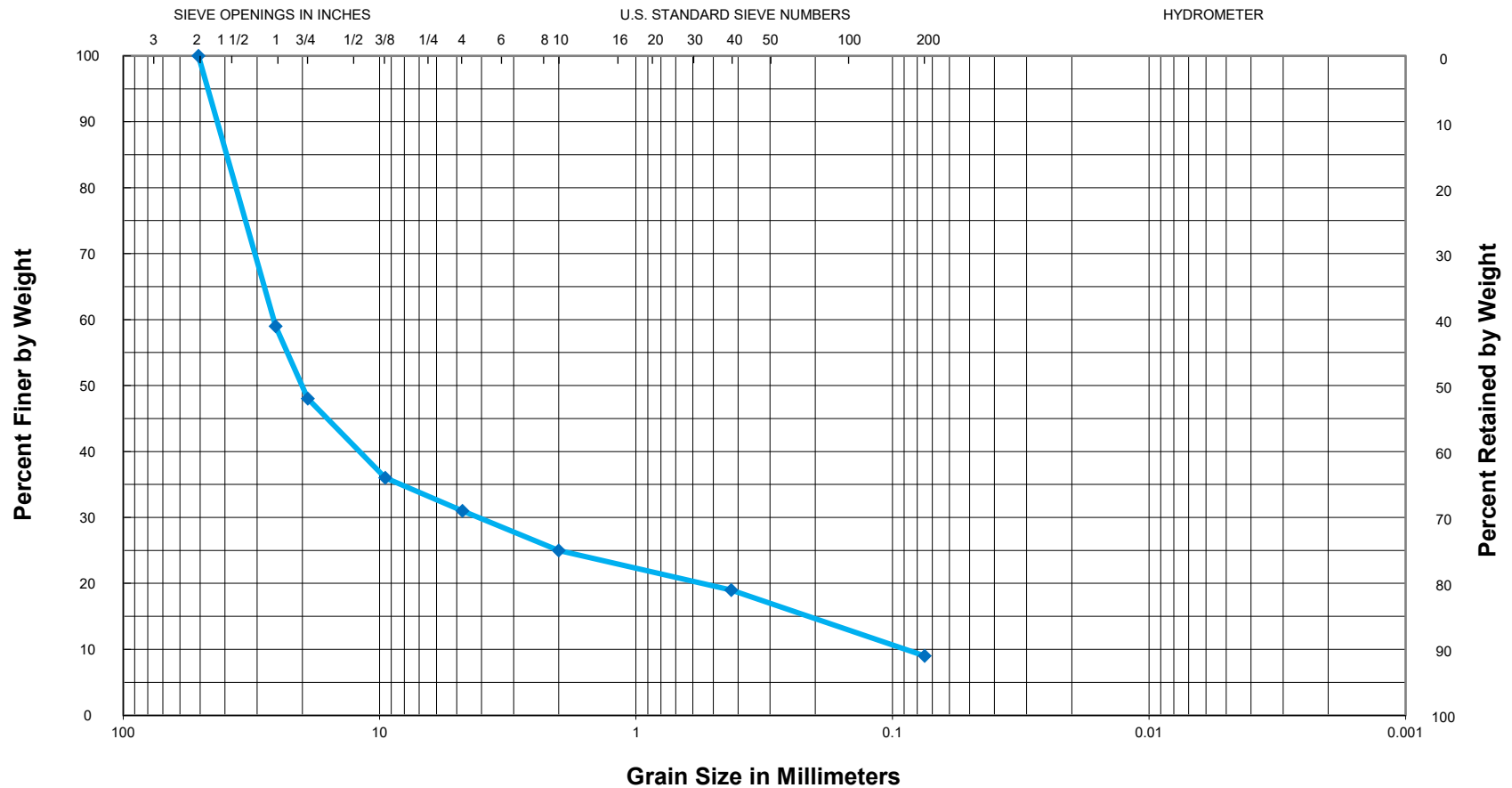
AASHTO Classification = A-4

A24184.00536

GRAIN SIZE CURVE



A UES Company



GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

Sample: Boring 3, 19-20 ft

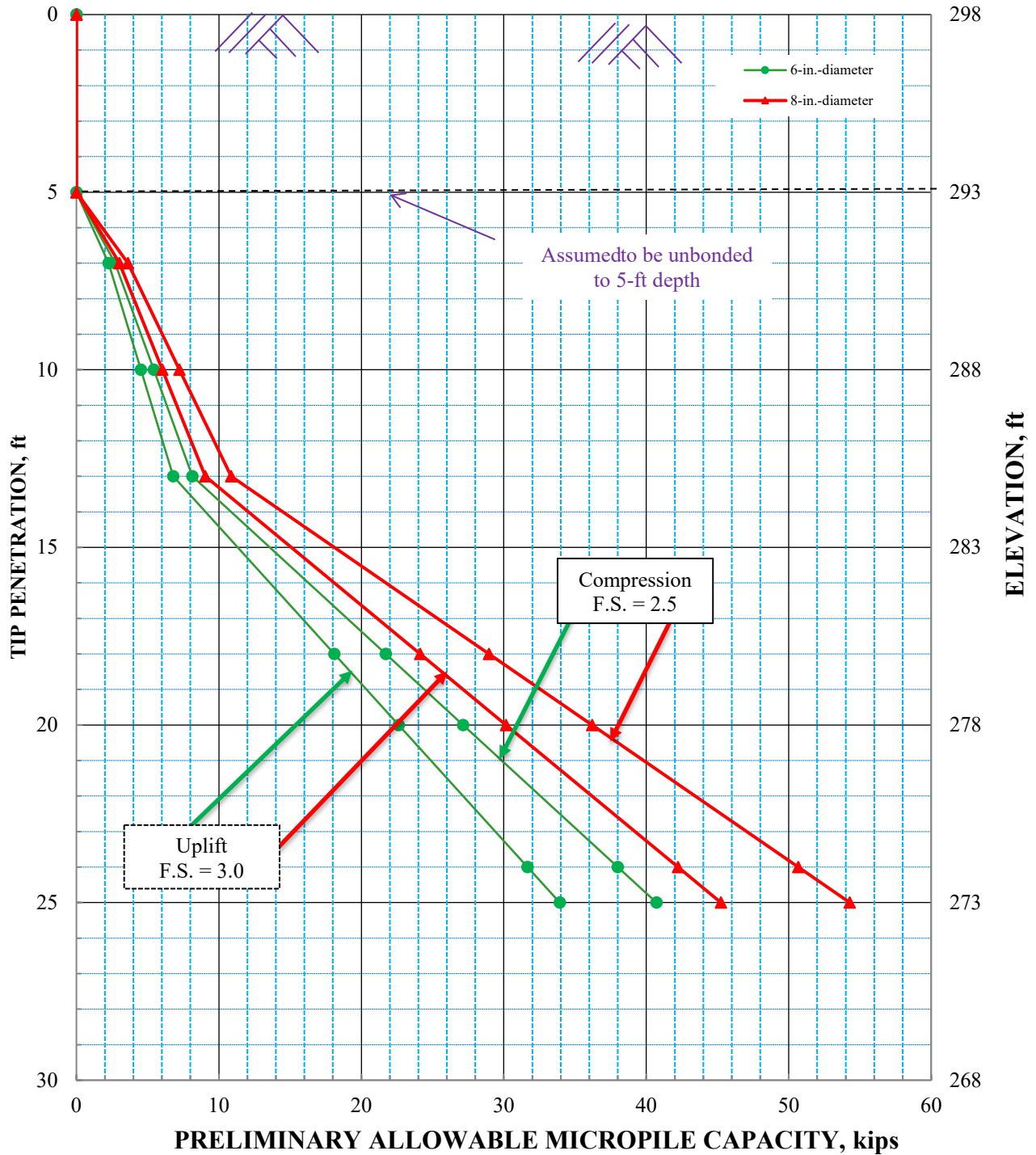
Description: Reddish brown sandy fine to coarse GRAVEL, slightly clayey w/ferrous nodules and stains

USCS Classification = GP-GC

AASHTO Classification = A-2-6

APPENDIX B

PRELIMINARY ALLOWABLE SINGLE MICROPILE CAPACITY, kips



PRELIMINARY ALLOWABLE MICROPILE CAPACITY, kips

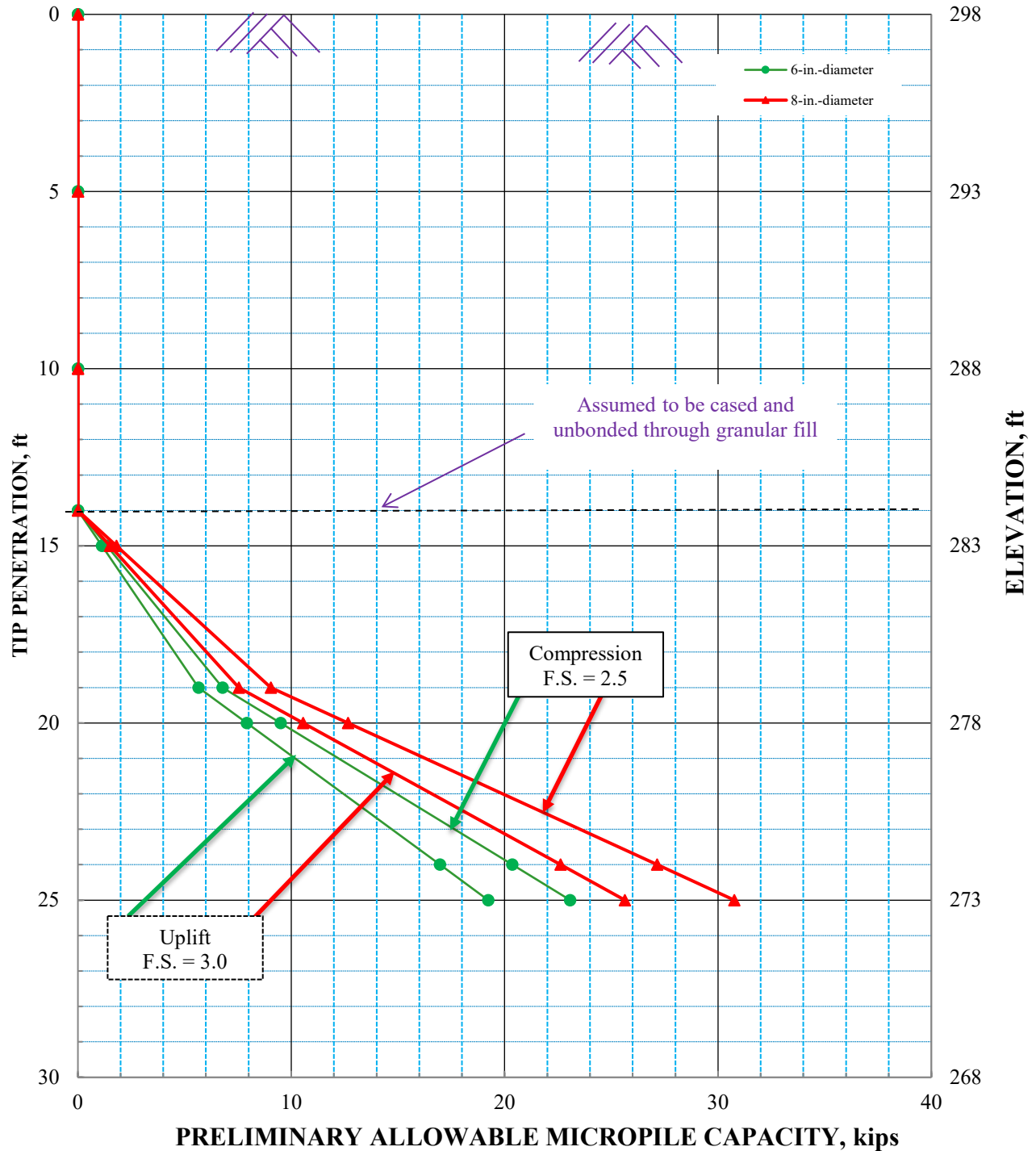
CAW Headquarters Northwest Addition

Little Rock, Arkansas

GHBW Job No. A24184.00357

Note: Pile cap has been assumed to be approximately 3 ft below finish floor (El 301)
(assumed pile cap bottom at El 298)

PRELIMINARY ALLOWABLE SINGLE MICROPILE CAPACITY, kips

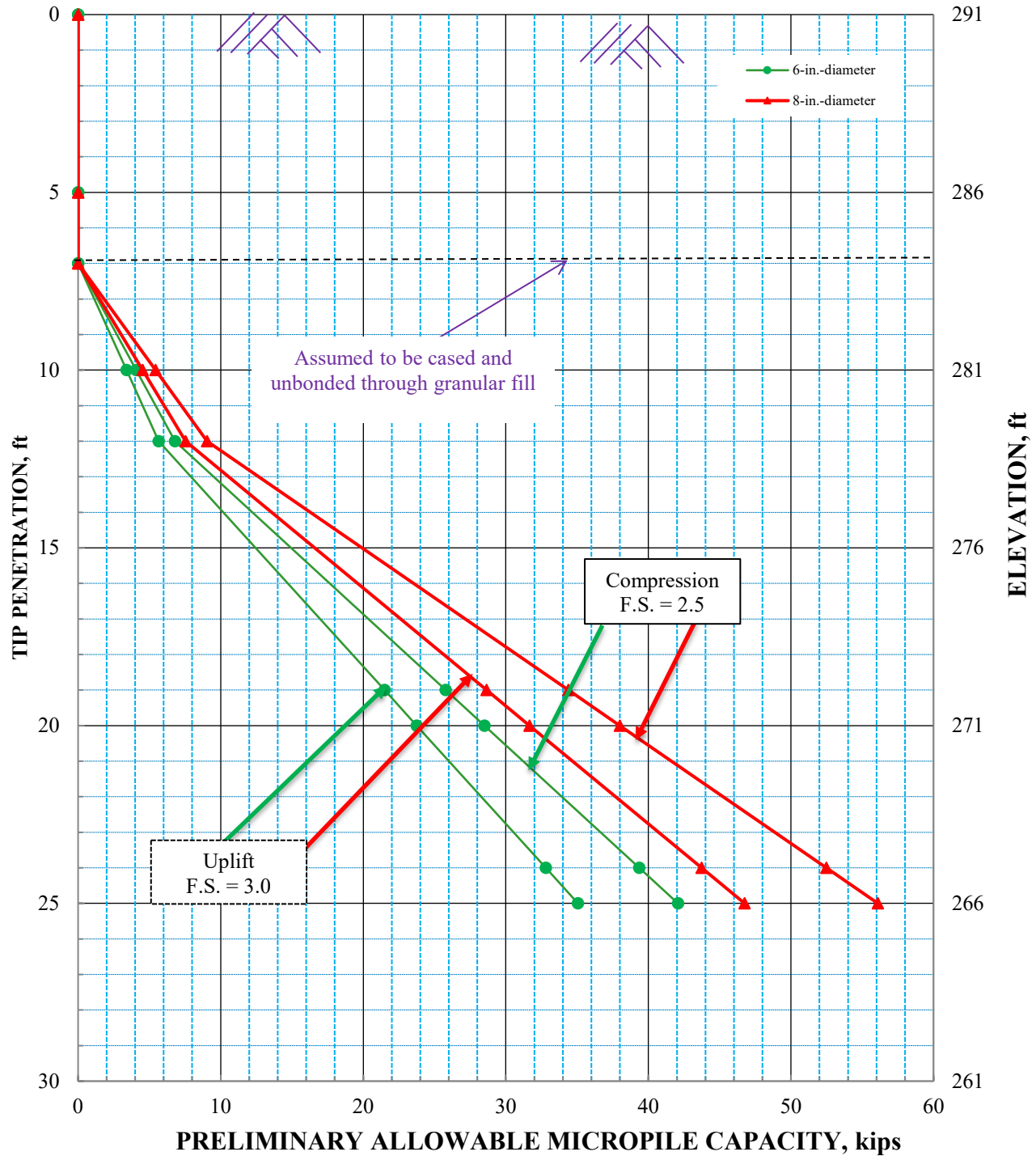


PRELIMINARY ALLOWABLE MICROPILE CAPACITY, kips

CAW Headquarters Four Story East Addition
Little Rock, Arkansas
GHBW Job No. A24184.00357

Note: Pile cap has been assumed to be approximately 3 ft below finish floor (El 301)
(assumed pile cap bottom at El 298)

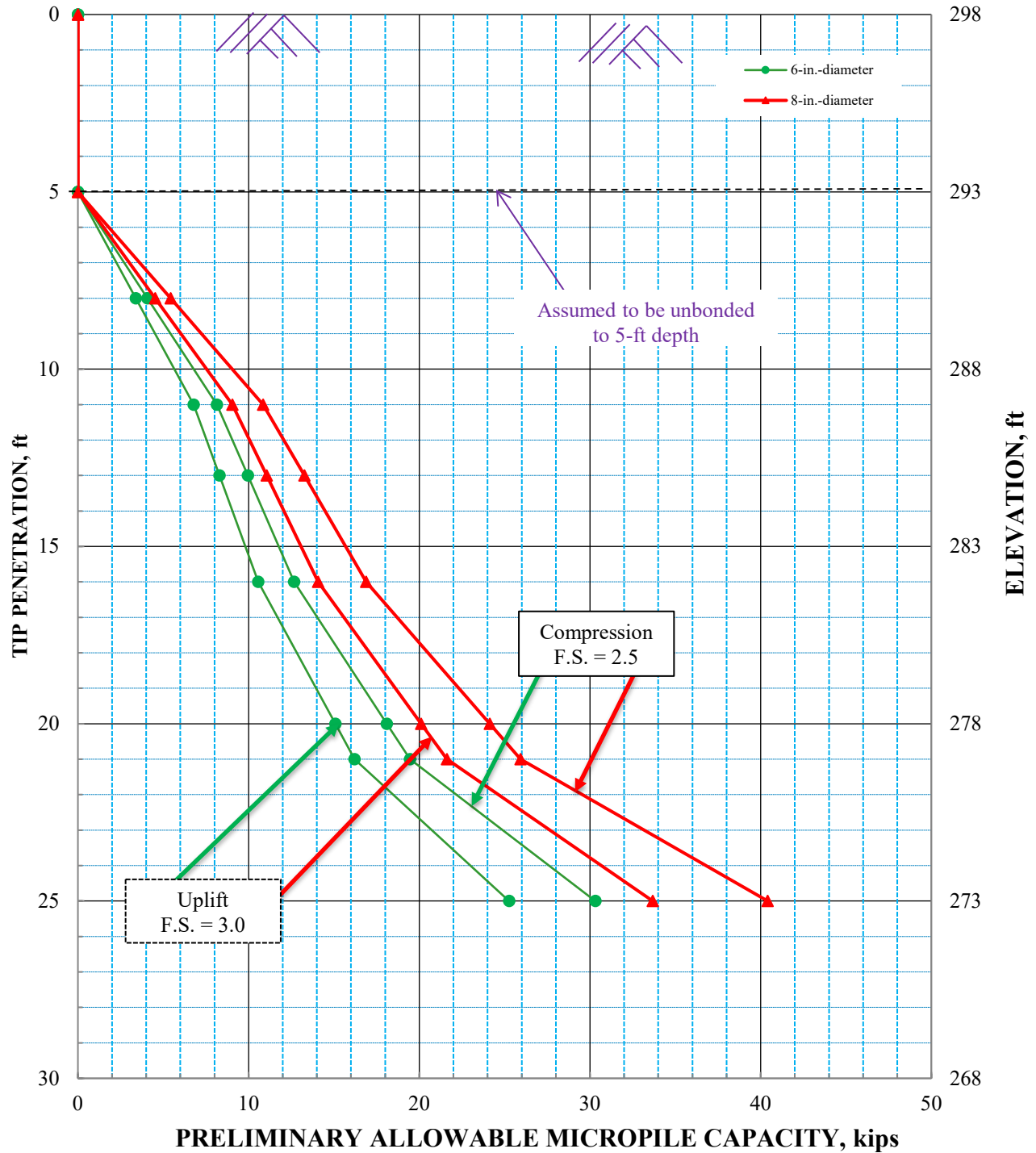
PRELIMINARY ALLOWABLE SINGLE MICROPILE CAPACITY, kips



CAW Headquarters Elevator Pit Addition
Little Rock, Arkansas
GHBW Job No. A24184.00357

Note: Pile cap has been assumed to be approximately 3 ft below top of slab (El 294.5)
(assumed pile cap bottom at El 291)

PRELIMINARY ALLOWABLE SINGLE MICROPILE CAPACITY, kips



PRELIMINARY ALLOWABLE MICROPILE CAPACITY, kips

CAW Headquarters Southwest Addition
Little Rock, Arkansas
GHBW Job No. A24184.00357

Note: Pile cap has been assumed to be approximately 3 ft below finish floor (El 301)
(assumed pile cap bottom at El 298)

APPENDIX C

MICROPILES

1.0 GENERAL

The Contractor shall select the micropile type, size, and determine the required grout bond length and final micropile diameter. The Contractor shall design and install micropiles that will develop the allowable loads indicated on the drawings. The micropile design compression and tension load capacity shall be verified by testing as required and shall meet the test acceptance criteria specified herein. The Owners Engineer will be responsible for micropile cap design and connections from the micropile to existing footing. The Contractor's micropile design, including the load test program, proposed micropile layout, corrosion protection details, connection to footings, and the work plan should be reviewed by the design team and approved by the Engineer prior to acceptance and the start of work.

The Contractor shall allow for all necessary operations including cutting through concrete slabs, pavements, or other obstructions, scaffolding, platforms, handling equipment, tools machinery etc necessary for the expeditions handling of the work.

1.1 Setting Out

The Contractor shall be required to employ an approved Licensed Surveyor who will set up the positions of the micropiles as shown in the micropile layout plans of the detailed design. The Contractor will be responsible for the accuracy of location and positioning of each micropile. Any errors in setting out and any consequential loss to the Owner will be made good by the Contractor to the satisfaction of the Engineer.

The Contractor shall preserve the pegs set out by the Surveyor. Should any peg be displaced or lost it must be replaced by a Licensed Surveyor to the approval of the Engineer. Upon completion of all piling works, the Contractor shall produce as-built Drawings showing the positions of all micropiles as installed. The positions of micropiles shall be verified by a Licensed Surveyor.

1.2 Tolerances

Position

The micropile heads shall be positioned as shown on the Drawings within a maximum deviation of 1.5 in. in either direction from correct center point.

Verticality

For micropiles, the maximum permitted deviation of the finished micropile from the vertical at any level is 1 in 150. The contractor shall demonstrate to the satisfaction of Engineer the micropile verticality is within the allowable tolerance.

Correction

Should micropiles be installed outside these tolerances affecting the design and appearance of the structure, the Contractor shall propose and carry out immediate remedial measures to the approval of the Engineer.

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1.3 Person in Charge

The piling work is to be carried out by full-time operators and supervisory staff who must be experienced in the installation of the proposed type of micropiles.

The Contractor shall submit to the Engineer for approval, written evidence to show that the persons who will be engaged in the works have had such experience.

1.4 Piling Equipment and Accessories

The equipment and accessories must be capable of safely, speedily and efficiently installing micropiles to the design requirements at the project site.

Sufficient units of equipment and accessories must be provided to keep to the agreed construction schedule.

1.5 Sequence of Installation of Production Micropiles

The Engineer reserves the absolute right and the Contractor shall recognize such right to direct the installation of working micropiles in any sequence the Engineer deems necessary for the satisfactory completion of the works.

2.0 SCOPE OF WORK

The contract comprises the provision of all labor, materials, tools, plant, etc. necessary for the following work:

- a. Supply and installation of micropile foundations to carry the loads as specified in the drawings.
- b. Stripping and cutting the micropiles to cut off levels specified and preparation of the micropile head as shown on the drawings.
- c. Carrying out standard proof tests as specified.

3.0 MATERIALS

3.1 Reinforcement

The type of reinforcement to be used, the diameter and/or thickness, grade, yield strength and stress shall be as specified or as shown on the Approved Design.

3.2 Grout

Unless otherwise specified, the grout shall be non-shrink cement grout. The grout mix design such as the water-cement ratio, the minimum cement and grout strength at 7 and 28 days shall be as specified and shown on the Drawings. Grout at placement shall have a specific gravity (G_s) within the range of 1.65 to 1.85. All grout shall have a minimum compressive strength of 4000 psi at 28 days. Grout shall be tested in accordance with ASTM C109 at a frequency of no less than one set of three (3) grout cubes from each grout plant each day of operation.

If admixtures are used, details of admixtures shall be submitted to the Engineer for approval before commencement of works. The use of the admixture shall fully comply with the manufacturer's instructions.

If the grout as tested fails to satisfy the criteria as prescribed in Specification and drawings, the micropiles constructed using this batch of grout shall be rejected. The Contractor shall undertake

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all necessary additional and consequential remedial/compensatory work to the approval of the Engineer.

4.0 SITE AND ADJACENT PROPERTIES

4.1 Subsurface Information

The subsurface information is provided only for information and guidance to the Contractor and shows the approximate nature of the strata as known to the Engineer. The Owner and Engineer shall not be liable for the accuracy of the data given and the Contractor may carry out his own subsurface investigation to obtain additional information.

4.2 Site Visit

The Contractor is advised to visit the site to acquaint himself with the site conditions and no claims for inadequate information regarding site conditions will be entertained at a later date. The system or systems put forward by the Contractor shall be well known. The adequacy of any system and its approval shall be at the discretion of the Engineers.

4.3 Underground Services and Adjacent Property

The Contractor shall take care to ensure the safety of underground services and adjacent properties during the installation of micropiles. The Contractor will be liable to any claims of damage due to the piling operations.

5.0 DRILLING OPERATIONS

5.1 Diameter of Micropiles

The diameter of micropiles shall not be less than the designed diameter at any level throughout its length.

5.2 Drilling

The Contractor shall submit to the Engineer details of drilling equipment and drilling procedure for approval before commencement of works. Drilling operations shall be carried out in accordance with the relevant requirements as follows:

(a) Boring near recently Cast Micropiles

Micropiles shall not be bored within three (3) diameters (center-to-center) of other micropiles which have recently been cast less than 24 hours or contain unset grout, whichever longer, to avoid damage to any of these micropiles.

(b) Stability of Drill holes

It is held that the Contractor has allowed in the unit rate of the micropile for the implementation of all necessary measures, including the provision of all materials, labour and plant, for maintaining the stability of the sides of boreholes during micropile installation and successful completion of the micropiles. The Contractor shall submit his proposed methods for agreement prior to commencement of boring operations.

Irrespective of the presence of groundwater, the sides of all boreholes shall be kept intact and no loose material shall be permitted to fall into the bottom of the boreholes. The Contractor's boring equipment shall be able to advance a steel casing to support the sides of all boring.

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If the sides of boreholes are found to be not stable, temporary steel casing shall be driven into stable stratum. The borehole shall be filled with drilling fluid to a level sufficiently to stabilize the boreholes.

If groundwater is found in any hole in sufficient quantity or gushing out as to affect boring operations or excavations and removal of soil from the boreholes, or the sides of boreholes collapse, then a steel casing of appropriate size and length in conjunction with stabilizing fluid or other alternatives of sufficient strength shall be used to support the sides of the borehole and permit boring operations to proceed smoothly and safely. The proposed drilling fluid mix must be submitted to the Engineer for approval.

Excavations shall not be exposed to the atmosphere longer than is necessary and shall be covered at all times when work is not in progress. Micropiles excavated shall be cast that same work day unless otherwise agreed by the Engineer.

In the event of a rapid loss of drilling fluid from the borehole excavation and caused instability of bore, the excavation shall be backfilled without delay or other appropriate and approved remedial measures taken by the Contractor like installing temporary casing prior to resuming boring at that location. The cost of redrilling of the hole shall be borne by the Contractor.

(c) Stability of bore by Temporary Casing Method

Where the use of a temporary casing is required to maintain the stability of a bore, the bottom of casing shall be kept a minimum of 3 ft or more below the unstable strata to prevent the inflow of soil and the formation of cavities in the surrounding ground.

Temporary casings shall be thin walled mild steel cylindrical casing. The dimensions and quality of the casing shall be adequate to withstand without damage or distortion all handling, construction and ground stresses to which they will be subjected. The casings shall have an internal diameter not less than the specified micropile diameter. They shall be free of significant distortion, of uniform cross-section throughout each continuous length and free from internal projections and encrusted grout which might prevent the proper formation of micropiles. The joints of casings shall be watertight.

If temporary casings are damaged during installation in a manner which prevents the proper formation of the micropile, such casings shall be withdrawn from the bore before grout is placed, repaired if necessary, or other action taken as may be approved to continue the construction of the micropile.

6.0 GROUTING OPERATIONS

6.1 Mixing and Placing Grout

The Contractor shall provide details of the method and equipment used in grout mixing. Further information such as grouting pressure, grouting procedure, grouting equipment and technique employed in grouting underwater shall also be furnished for approval.

Grout shall be mixed on site and shall be free from segregation, clumping and bleeding. Grout shall be pumped into its final position in one continuous operation as soon as possible and in no case more than half an hour after mixing.

Micropile shall be grouted in one continuous process. If there is significant loss of grout, the Contractor may choose to carry out pre-grouting in stages as necessary to prevent further loss of grout for the construction of micropiles. A method statement of pre-grouting, including details of equipment, materials and procedures, shall be submitted, reviewed, and approved by the Engineer. If after the process of pre-grouting, re-drilling of the hole is required the Contractor shall bear the cost and time of the pre-grouting and re-drilling.

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6.2 Grout Falls

The loss of flushing mediums of either water or drilling mud drilling will demonstrate potential for excessive grout loss or falls. Depending on its seriousness, the Contractor can decide to carry out a water tightness test to decide whether pregrouting is required. The cost and time of the test will be borne by the Contractor. Pregrouting and re-drilling shall be carried out if results of the test shown that leakage exceeds 1.3 gal per min at an excess head of 14.5 psi, measured over a period of 10 minutes.

7.0 CONSTRUCTION OF MICROPILE HEADS

7.1 Lengthening of Micropiles

Where lengthening is required, the micropile reinforcement unit shall be connected on site as per the details shown in the approved Contractor's work plan.

Other means of jointing reinforcement shall be to the approval of the Engineer.

7.2 Cutting and Preparation of Micropile Heads

Micropile heads shall be constructed to the details as shown as per the approved Contractor's work plan and/or on the Drawings.

8.0 STANDARDS

All materials shall be of the best quality and new. All piling work shall be executed in accordance with the approved designs prepared by the Contractor and to the approval of the Engineer.

8.1 Standard Verification Test

A verification test of at least two-and-one-half (2.5) times the working load shall be performed if such is included in the approved work plan. The intent of the verification test shall be to verify geotechnical capacity of the test micropile. The number and location of test micropiles shall be as stated in the approved work plan. The Contractor shall submit a detailed proposal of the verification tests to the Engineer and shall obtain his approval in writing before performing verification tests. On completion of the test(s), the Contractor shall submit to the Engineer the results including graphs showing load and settlement versus time and settlement versus load.

The test procedure shall be as specified in the approved work plan or Specifications.

The acceptance criteria for micropile verification load tests are:

- a. The micropile shall sustain the compression and/or tension design loads (1.0 DL) with no more than 0.50 in. total vertical movement at the top of the micropile as measured relative to the top of the micropile prior to the start of testing. If an Alignment Load is used, then the allowable movement shall be reduced by multiplying by a factor of (DL-AL)/DL. (This conservatively accounts for the movement in reaching AL).
- b. At the end of a 2.0DL creep test load increment, test micropiles shall have a creep rate not exceeding 1mm per log cycle time (1 to 10 minutes) or 2mm per log cycle time (6 to 60 minutes). This creep rate shall be linear or decreasing throughout the creep load hold period.
- c. Failure does not occur at the 2.5DL maximum compression and tension loads. Failure is defined as the load at which attempts to further increase the test load simply result in continued micropile movement.

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8.2 Proof-Testing

Production proof-tests will be performed on at least 10 percent of the production micropiles. The maximum test load for production micropile proof-testing is 1.3 times the design load (DL x 1.3). Proof-tests shall be made by incrementally loading the micropile in accordance with the following schedule, to be used for both compression and tension loading.

AL = Alignment Load, DL = Design Load		
	LOAD	HOLD TIME (MIN)
1	AL	1
2	0.25 DL	1
3	0.50 DL	1
4	0.75 DL	1
5	1.00 DL	1
6	1.33 DL	10 or 60 min creep test
7	1.33 DL (maximum test load)	1
8	AL	1

The acceptance criteria for micropile proof tests are:

- d. The micropile shall sustain the compression and/or tension design loads (1.0 DL) with no more than 0.50 in. total vertical movement at the top of the micropile as measured relative to the top of the micropile prior to the start of testing. If an Alignment Load is used, then the allowable movement shall be reduced by multiplying by a factor of (DL-AL)/DL. (This conservatively accounts for the movement in reaching AL).
- e. At the end of the 1.33DL creep test load increment, test micropiles shall have a creep rate not exceeding 1mm per log cycle time (1 to 10 minutes) or 2mm per log cycle time (6 to 60 minutes). This creep rate shall be linear or decreasing throughout the creep load hold period.
- f. Failure does not occur at the 1.33DL maximum compression and/or tension loads. Failure is defined as the load at which attempts to further increase the test load simply result in continued micropile movement.

9.0 TEST REPORT

The report shall contain the following: -

- A. Micropile designation, date completed, weather condition, micropile length, micropile size, volume of grout intake, time of drilling at intervals not greater than 4m and time to grout the micropile.
- B. Description of the apparatus used for testing, loading system and procedure for measuring settlement.
- C. Field data.
- D. Time/Settlement Curve.
- E. Load/Settlement Curve.
- F. Remarks explaining unusual events or data and movement of micropiles.
- G. Calibration certificates of dial gauges and pressure gauges.
- H. The format of record shall be approved by the Engineer.

For information only

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10.0 DAMAGED OR DISPLACED MICROPILES

Should the deviation exceed the tolerance provided in this specification, the contractor shall submit this remedial proposal for the approval for the Engineer. Failing this, the faulty micropile shall be replaced by additional micropiles as necessary in positions as determined by the Engineer at no cost to the Owner. The cost of modification to micropile cap etc., if any, shall be borne by the Contractor. The same will also apply to any piling work rejected by the Engineer for not truly constructed and installed in accordance with the specification.

Where a micropile has been damaged during installation, testing or by other causes, the damaged micropile shall be considered and treated as a faulty micropile and should be replaced by additional micropiles as approved by the Engineer at the Contractor's expense.

10.1 Forcible Correction Not Permitted

Where micropiles have not been positioned within the specified limits no method of forcible correction will be permitted.

11.0 PAYMENT

11.1 Unconcreted (Empty) Bore

The unit rate of the micropile shall be deemed to include whatever empty bore above the cut-off level of the micropile and re-drilling after pre-grouting. No claims will be considered for any empty bore and re-drilling, and the Contractor shall allow in Contract for the cost of these processes due to the sequence of construction.

11.2 PAY LENGTH

For all proposed micropiles, the Contractor shall be paid only for the length of installed micropile measured from tip of the micropile to the cut-off level. The same applies for the grout. Pregrout, grout loss, over drill, re-drilling will have to be borne by the Contractor and shall be deemed to have included in the rate.

12.0 PILING RECORDS

Complete piling records shall be kept by the Contractor during micropile installation. The Contractor shall submit the following in duplicate to the Engineer:

- A. Records of all micropiles as the work proceeds.
- B. Upon completion, a record of the work as carried out and as-built drawing.

The format of the record shall be approved by the Engineer.

The record shall contain all information required by the Engineer which includes the following where applicable.

- reference number and position of micropile
- type and dimension
- date of boring and nature of strata where each micropile is bored
- details of equipment used
- ground level and base of excavation level
- total penetration
- time of drilling at intervals not exceeding 15 ft
- details of all splicing or jointing operations, locations of sleeves, etc.
- details of grouting operation for tremie grouting and time tables
- weather
- top level of micropile immediately after completion

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- errors in position and inclination
- grout specific gravity
- amount of grout and the pressure used
- size and position of obstructions, if any, in each micropile
- detailed drilling speed (ft/min)
- description of drilled material

12.1 As-Built Drawings

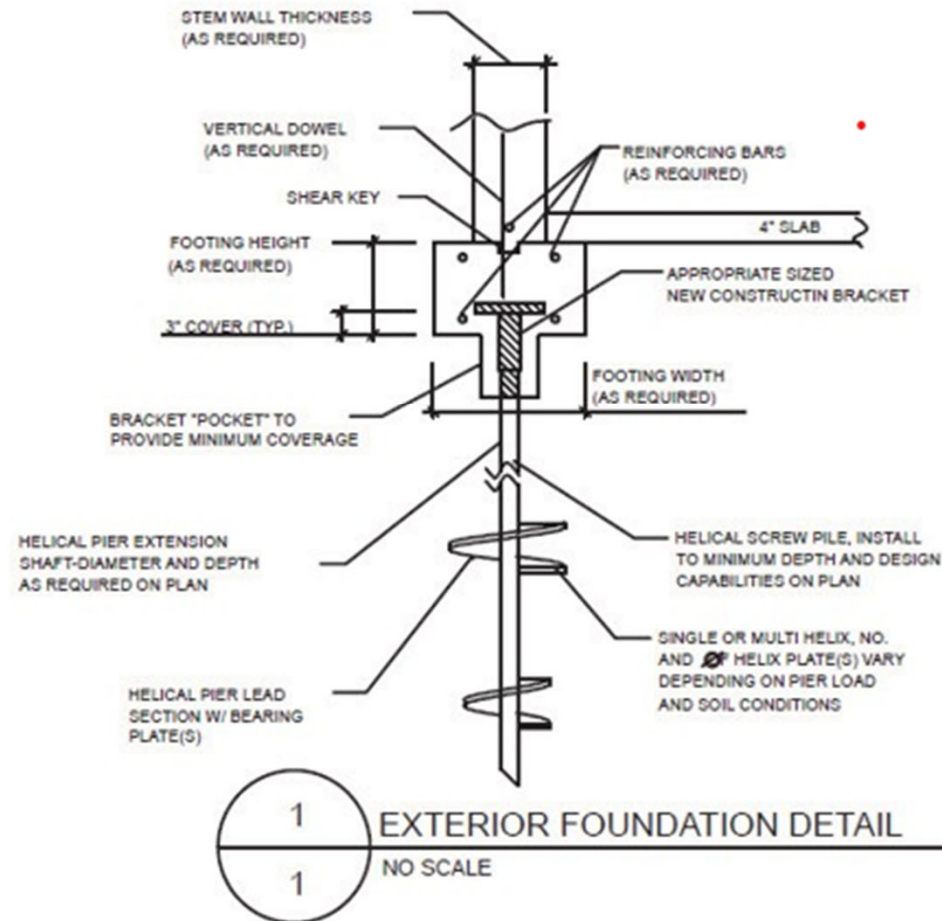
After completion of the piling, the Contractor shall submit an as-built drawing. This drawing should include the following:

- a. Size and type of micropiles
- b. Eccentricities in both directions
- c. Depth of penetration of each micropile or reduced level of tip of each micropile and cut-off level of each micropile.

APPENDIX D

HELICAL PIER FOUNDATION PLAN

NO SCALE



Notes:

1. For information only; not for construction
2. Specific helical pile design to be provided by Helical Pile Subcontractor

APPENDIX E

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HELICAL PILE INSTALLATION

1.0 SCOPE

This item pertains to the installation of helical piles at the locations shown on the Plans or staked by the Owner or General Contractor. These specifications and the Plans shall be used in conjunction with a standard contract to procure the work.

2.0 ACCESS

Owner will provide for right of entry of Helical Pile Contractor, all necessary personnel, and equipment for conducting the helical pile installation work. Owner or General Contractor will remove and replace any structures, utilities, pavements, landscaping and other improvements in the work area to facilitate helical pile installation. Reasonable care shall be exercised by Helical Pile Contractor to avoid damage to existing structures, utilities, pavements, landscaping and other improvements during the course of the helical pile installation work.

3.0 UTILITIES

Owner or General Contractor will locate all underground structures and utilities. Any such underground structures and utilities in and nearby areas of the helical pile installations will be clearly marked prior to helical pile installation work. Any utility or underground structure within a horizontal distance of three feet of a planned helical pile location or within the average helix diameter plus one foot, whichever is greater, will be located by hydro vacuum excavation.

4.0 SAFETY

In accordance with generally accepted construction practices, the Helical Pile Contractor shall conduct construction operations in such a manner as to assure maximum safety of persons and property in the immediate vicinity of helical pile installation work. Helical Pile Contractor shall provide and utilize personal protective equipment such as hard hats, safety glasses, steel-toe boots, ear protection, leather gloves, and other safety clothing and equipment in accordance with General Contractor's safety plan and all applicable OSHA Standards.

5.0 INSURANCE

Helical Pile Contractor shall obtain and maintain general liability insurance to the limits described in the Owner's contract and adequate Worker Compensation Insurance as prescribed by the Worker's Compensation Act. This insurance shall cover all of the Helical Pile Contractor's personnel on site at any time.

6.0 CAPACITY

Loads shown on the Plans must be design allowable loads. A Minimum Factor of Safety of 2.0 should be used to determine the required ultimate capacity of the helical piles with regard to geotechnical capacity, torque correlations, and their interaction with soil. Helical pile capacity in soil depends on the geometric configuration of the helical bearing plates, the subsurface conditions, and the torque applied during installation. Manufacturer's recommendations should be followed regarding the ultimate bearing/pullout capacity to torque relationship for the particular helical piles selected. The capacity to torque relationship typically depends on shaft diameter. The ratio of required ultimate helical pile capacity to the total area of the helical blades shall not exceed the ultimate subsurface material bearing capacity provided by the Geotechnical Engineer.

7.0 MATERIALS

Helical piles shall be manufactured following an ISO9001:2008 accredited quality program. Helical piles shall have the required number of helical blades so as to provide for adequate load carrying capacity. Only round central pile shafts will be allowed. The strength of the helical bearing plates, connections and hub, and the hub itself shall be sufficient to support the design allowable loads

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specified on the Plans. Factors of safety and/or load and resistance factors for mechanical strength shall be as specified by the most recent edition of AISC 360. Allowance shall be made for a minimum of 50 years of corrosion as per ICC-ES AC358. Except for temporary use only, if any portion of the helical pile extends above ground or if ground conditions are determined to represent a severe corrosive environment defined in ICC-ES AC358, helical piles shall be protected from corrosion by hot-dip galvanizing per ASTM A153/A123.

Minimum and maximum installation torques shall be specified by the helical pile manufacturer. The minimum installation torque shall be high enough to achieve the required bearing capacity, including a minimum safety factor of 2. The maximum installation torque shall not exceed the allowable torsional capacity of the pile shafts. Helical piles shall be designed and manufactured to resist all stresses induced by installation.

8.0 TOLERANCE

Unless otherwise noted on the Plans, standard tolerance for helical pile positioning is ± 3 in., elevation is $\pm \frac{1}{4}$ in., and angle is ± 3 degrees. Locations of piles shall not be changed without written approval from the Engineer.

9.0 INSTALLATION

Connect the lead section to the torque motor using the drive tool and drive pins. Position and align the lead section at the location and to the inclination shown on the drawings and crowd the pilot point into the soil. Advance the lead section and continue to add extension sections to achieve the termination criteria. Connect extensions using bolts shown on drawings. Bolts shall be "snug-tight" per the AISC. This is defined as "the snug-tightened condition is the tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the connected plies into firm contact". Bolts do not require a specific torque, do not over torque bolts. All sections shall be advanced into the soil in a smooth, continuous manner at a rate of rotation between 10 and 30 revolutions per minute. Constant axial force (crowd) shall be applied while rotating the helical piles/anchors into the ground. The crowd applied shall be sufficient to ensure that the helical pile advances into the ground a distance equal to at least 80% of the blade pitch per revolution during normal advancement. The torsional strength rating of the helical pile shall not be exceeded during installation.

Helical piles/anchors shall be advanced until both of the following criteria are satisfied:

1. Final installation torque is achieved. Final installation torque is shown on the Plans summary table or pile schedule.
2. Minimum depth is obtained. The minimum depth shall be as shown on the Plans, that which corresponds to the planned bearing stratum, or the depth at which the final installation torque is measured, whichever is greater.

If maximum torque has been reached or augering occurs prior to achieving the minimum depth, contractor shall have the following options:

1. Reverse the direction of torque, back-out the helical pile a distance of 1 to 2 feet and attempt to reinstall by decreasing crowd and augering through the obstruction.
2. Terminate the installation at the depth obtained subject to the review and acceptance of the Engineer.
3. Remove the helical pile and install a new one with fewer and/or smaller diameter helical bearing plates. The new helical configuration shall be subject to review and acceptance of the engineer.
4. Remove the helical pile and pre-drill a pilot hole in the same location and reinstall the anchor/pile. Pilot hole diameter shall match the diameter of the helical pile shaft.

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5. If the obstruction is shallow, remove the helical pile and remove the obstruction by surface excavation. Backfill and compact the resulting excavation and reinstall the pile/anchor.

If the final installation torque is not achieved at the contract length, the contractor shall have the following options:

1. Until the maximum depth is achieved, if any, install the helical pile deeper using additional extension sections.
2. Remove the helical pile and install a new one with additional and/or larger diameter helical bearing plates.
3. Decrease the rated load capacity of the helical pile and install additional helical piles/anchors. The rated capacity and additional unit location shall be subject to the review and acceptance of the Engineer.

If the minimum depth has been obtained but the final installation torque is not achieved due to augering on an obstruction under maximum crowd (refusal):

1. Record "refusal" on installation logs in place of final torque.
2. Submit installation logs to the Engineer of record for review and approval.

The pile/anchor may be deemed acceptable if one of the following conditions are met:

- a) The boring logs indicate suitable bearing stratum at the approximate depth of refusal.
- b) The piles, on either side of the pile(s) in question, achieved torque at similar depths
- c) Pile capacity is verified by dynamic or static load test.

Otherwise, the pile shall be downgraded based on last credible torque reading obtained prior to refusal and additional piles/anchors shall be installed. The rated capacity and additional pile/anchor location shall be subject to the review and acceptance of the Engineer.

10.0 MODIFICATIONS

Field welding, if required, shall be in accordance with the "Code for Welding in Building Construction" of the American Welding Society. Welding of galvanized steel can produce toxic gases and should be done in adequate ventilation and with adequate gas detection, breathing gear, and other safety equipment. Cutting of manufactured helical pile blades is prohibited and shall not be performed without first consulting the Engineer.

11.0 INSPECTION

Installation of helical piles shall be observed by the Engineer or Geotechnical Engineer to verify the depth and installation torque. The Helical Pile Contractor shall notify the Engineer or Geotechnical Engineer at least 24 hours prior to installation work. The Engineer or Geotechnical Engineer shall observe all installation and document the Helical Pile Contractor's method and materials used. The Engineer or Geotechnical Engineer shall log installation depth and torque at 3-ft intervals during installation and record final depth and torque. Installation logs shall be submitted to the Design Team for review prior to completion of the project. The Helical Pile Contractor shall provide the Engineer or Geotechnical Engineer with recent calibration information for the instrument used to measure torque.

Special inspection of the helical pile installation shall be performed in accordance with applicable sections of the International Building Code 2021. The following shall be recorded as part of the special inspection:

1. installation date.
2. pile manufacturer.
3. installation contractor.
4. identification of installation equipment.

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5. minimum allowable installation torque.
6. maximum allowable installation torque.
7. central shaft diameter of each pile.
8. helix plate configuration of each pile.
9. actual tip embedment of each pile.
10. actual installation torque of each pile.
11. ultimate capacity of each pile as specified by Manufacturer.
12. allowable capacity of each pile as specified by Manufacturer.
13. record "refusal" on installation logs in place of final torque.

12.0 DRAINAGE

The General Contractor shall provide proper site drainage in the area of all installed helical piles at all times during and after construction. Proper site drainage shall conduct surface water runoff away from the structure and helical piles.

13.0 CLEANLINESS

Immediately upon completion of the work, the Helical Pile Contractor shall remove any and all equipment, tools, building materials, rubbish, unused materials, concrete forms, and other like materials belonging to him or used under his direction. Also, during the work, the site occupied by the Helical Pile Contractor and his material stockpiles shall be kept in a reasonable state of order and cleanliness.

SECTION 01 1000 SUMMARY

PART 1 GENERAL V.22

1.01 PROJECT

- A. Project Name: _____.
- B. Owner's Name: _____.
- C. The Project consists of the construction of Existing building of Central Arkansas Water.

1.02 WORK BY OWNER

- A. The Owner, without sacrificing their right to do so, does not plan to undertake significant work with their own forces within the construction site prior to Substantial Completion. Refer to the responsibility maxtrix following this section for components being performed by Owner.
- B. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items include:
- C. Owner will supply and install the following:
- D. Owner will supply the following for installation by Contractor:
- E. Items and equipment noted to be Contactor Furnished and Contractor Installed is to be purchased new by the Contractor and all cost associated with the handling, installation and connection should be included turn-key in the project. All items and equipment noted to be Contractor Installed shall be coordinated with provider and the Contractor shall include all costs for handling, installation and connection in the project.
- F. Cooperate fully with the Owner's own forces or separate contractors, if any, so work on those contracts may be carried out smoothly, without interfering with or delaying work under this contract.

1.03 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.04 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
 - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Arrange use of site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Others.
 - 3. Work by Owner.
- C. Do not unreasonably encumber site with materials or equipment. Confine stockpiling of materials to areas authorized by Owner.
- D. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- E. Workers on the jobsite are to be reminded that adjunct areas are occupied and in use on the campus. **Workers will maintain a respectful attitude toward all people for the duration of the construction project. Abusive language or gestures will result in immediate dismissal from the project.**
- F. Existing building spaces may not be used for storage.

G. Time Restrictions:

1. Limit conduct of especially noisy exterior work to the hours of 7:00 am through 4:00 pm.

H. Utility Outages and Shutdown:

1. Limit disruption of utility services to hours the building is unoccupied.
2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
3. Prevent accidental disruption of utility services to other facilities.

END OF SECTION

**SECTION 01 2000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES

- A. Use Schedule of Values Form: AIA G-702 Application and Certificate for Payment.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- F. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- G. Revise schedule to list approved Change Orders, with each Application For Payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Authorized Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Percentage of Completion.
 - 9. Balance to Finish.
 - 10. Retainage.
- F. Execute certification by signature of authorized officer.
- G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- I. Submit one electronic and three hard-copies of each Application for Payment.

1.04 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 15 days.
- D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
- E. Substantiation of Costs: Provide full information required for evaluation.
 - 1. Provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
- F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.
- H. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- I. Promptly enter changes in Project Record Documents.

1.05 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 7000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2100 ALLOWANCES

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Cash allowances.
- B. Payment and modification procedures relating to allowances.

1.02 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts.
- B. Costs Not Included in Cash Allowances: Product delivery to site and handling at the site, including unloading, uncrating, and storage; protection of products from elements and from damage; product mark-up; cost of installation materials; and labor for installation and finishing. All the aforementioned costs shall be included in the base bid for the project, unless noted otherwise in the Allowances Schedule below..
- C. Architect Responsibilities:
 - 1. Consult with Contractor for consideration and selection of products, suppliers , and installers.
 - 2. Select products in consultation with Owner and transmit decision to Contractor.
 - 3. Prepare Change Order.
- D. Contractor Responsibilities:
 - 1. Assist Architect in selection of products, suppliers , and installers.
 - 2. Obtain proposals from suppliers and installers and offer recommendations.
 - 3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
 - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
 - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Differences in costs will be adjusted by Change Order.

1.03 ALLOWANCES SCHEDULE

- A. DIRT Wall Allowance: Include the stipulated sum/price of \$580,000 for the purchase, delivery and installation of DIRT walls by Evo.
- B. Elevator Cab Finish Allowance: Include the stipulated sum/price of \$15,000 for the purchase, delivery and installation of elevator cab wall and ceiling finishes.
- C. Exterior Signage Allowance: Include the stipulated sum/price of \$50,000 for the purchase, delivery and installation of Exterior Signage.
- D. Interior Signage Allowance: Include the stipulated sum/price of \$100,000 for the purchase, delivery and installation of Interior Signage, Wayfinding, and Graphics.
- E. Water Feature Allowance: Include the stipulated sum/price of \$45,000 for the purchase and delivery of Midwest Tropical Wall Feature in Lobby. Allowance does not include cost for installation and required electrical and plumbing.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 2200
UNIT PRICES**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. List of unit prices, for use in preparing Bids.
- B. Measurement and payment criteria applicable to Work performed under a unit price payment method.

1.02 COSTS INCLUDED

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.03 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.04 MEASUREMENT OF QUANTITIES

- A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
- B. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect.
- C. Assist by providing necessary equipment, workers, and survey personnel as required.
- D. Measurement Devices:
 - 1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
 - 2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
 - 3. Metering Devices: Inspected, tested and certified by the applicable state department within the past year.
- E. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- F. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
- G. Measurement by Area: Measured by square dimension using mean length and width or radius.
- H. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- I. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.
- J. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
- K. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes, calculate and certify quantities for payment purposes.

1.05 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
- B. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.

3. Products not completely unloaded from the transporting vehicle.
4. Products placed beyond the lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected Products.
7. Products placed and concealed prior to assessment of quantity or volume.

1.06 SCHEDULE OF UNIT PRICES

A. Item: _____; Section _____.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Electronic document submittals.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Change Order requirements.
- G. Contractor Liability requirements.
- H. Coordination drawings.
- I. Submittals for review, information, and project closeout.
- J. Number of copies of submittals.
- K. Submittal procedures.

1.02 PROJECT COORDINATION

- A. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for construction & delivery access, traffic, and parking facilities.
- B. During construction, coordinate use of site and facilities through the Project Coordinator.
- C. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- D. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
- E. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- F. Make the following types of submittals to Architect:
 - 1. Requests for interpretation.
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Manufacturer's instructions and field reports.
 - 6. Applications for payment and change order requests.
 - 7. Progress schedules.
 - 8. Coordination drawings.
 - 9. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTALS

- A. Any documents transmitted for purposes of administration of the contract will be in electronic (PDF) format and transmitted via an Internet-based e-mail service.
 - 1. In addition to submittals for review, information, and closeout, this procedure will apply to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, proposal requests, change orders), applications for payment, field reports and meeting minutes, and any other document the Contractor or Architect wish to make part of the project electronic record.

2. Contractor and Architect will use conventional e-mail for this service, subject to the limitations of the service provider (file size).
 3. It is the Contractor's responsibility to submit documents in PDF format via file attachment to e-mail directed to WER Architects. Addressee will be determined at the pre-construction conference. Documents shall be reviewed and stamped by the contractor prior to submission. PDF documents without contractors stamp, signature and/or initials, & date will not be reviewed. Each scan or PDF copy, especially large format documents or drawings, shall be individually stamped, if transmitted as individual files. Assembled documents in a single file need only be stamped once.
 4. Subcontractors, suppliers, and Architect's consultants are required to use the e-mail transmission of review documents, and provide copies directed to the Architect and Contractor.
 5. Users of the electronic document submission process shall provide an email address and Internet access. PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), is encouraged, unless scan to PDF file capability is provided by the document generator / provider.
 6. Paper documents & transmittals of electronic submissions will not be reviewed; emailed PDF documents without transmittal letters / forms from the contractor will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to physical samples or color selection charts.
- B. Cost: The cost of the electronic document submittal(s) is to be paid by Contractor; include the cost of the submittals in the contract sum.
- C. Project Closeout: Architect will determine which project electronic document files shall be archived for the Owner. The contractor shall provide these documents electronically and physical components as part of the close out document submission.

3.02 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor.
- C. Agenda:
1. Distribution of Contract Documents.
 2. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
 3. Designation of personnel representing the parties to Contract, the Owner and Architect.
 4. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 5. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect, Owner, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

- A. Architect will schedule a meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's Superintendent.
 5. Major Subcontractors.

- C. Agenda:
 - 1. Use of premises by Owner and Contractor.
 - 2. Owner's requirements .
 - 3. Construction facilities and controls provided by Owner.
 - 4. Temporary utilities provided by Owner.
 - 5. Security and housekeeping procedures.
 - 6. Schedules.
 - 7. Application for payment procedures.
 - 8. Procedures for testing.
 - 9. Procedures for maintaining record documents.
 - 10. Requirements for start-up of equipment.
 - 11. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will impede, planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Maintenance of progress schedule.
 - 7. Corrective measures to regain projected schedules.
 - 8. Planned progress during succeeding work period.
 - 9. Maintenance of quality and work standards.
 - 10. Effect of proposed changes on progress schedule and coordination.
 - 11. Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 3216

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

3.06 COORDINATION DRAWINGS

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

3.07 DIGITAL DOCUMENT FILES AND RELEASES

- A. BIM Models: Projects are created by Architect and Engineers using Building Information Modelling software and not all projects will have these files available for Contractor's use. The final model is a composite of multiple models that will require separate models from consultants. Contact Architect and Engineers for specific availability and cost.
- B. AutoCAD files: Do not exist for architectural plans. Architect has capability to generate AutoCAD files that resemble the sheets as seen in the Construction Documents as well as generate entire floor plans of the building. This service can be provided at a cost to the Contractor per sheet/floor plan desired. See end of section for Digital Release form.
- C. Portable Digital Format (PDF): PDF of issued drawings can be provided to Contractor at no cost. Contact Architect for availability.
- D. Other documents: Contractor will have to directly contact consultants for trade specific files, such as AutoCAD files for topographical layout, etc.

3.08 REQUESTS FOR CHANGE ORDERS

- A. In order to facilitate checking of quotations for extras or credits, all proposals, except for those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and subcontracts. Labor and materials shall be itemized in manner prescribed above. Where major cost items are subcontracts, they shall be itemized also.

3.09 CONTRACTOR LIABILITY REQUIREMENTS

- A. The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect Engineer and the Architect Engineer's consultants as additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations. The Architect / Engineer, Engineer, and their respective Consultants are responsible for their own Professional Liability coverage.

3.10 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
 - 5. Delegated Design Deferred submittals.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - CLOSEOUT SUBMITTALS.

3.11 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated.

- B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

3.12 SUBMITTALS FOR PROJECT CLOSEOUT

- A. When the following are specified in individual sections, submit them at project closeout:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- B. Submit for Owner's benefit during and after project completion.

3.13 NUMBER OF COPIES OF SUBMITTALS

- A. Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Documents for Information: Submit one electronic copy.
- C. Documents for Project Closeout: Make electronic reproductions of submittal files originally reviewed. Include electronic files of any submittals for information. All hard copies of Operational Manuals included with products and equipment should be collected and retained for close out documentation.
- D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates required for jobsite use & verification.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated. Digital documentation of approved samples will be provided.

3.14 SUBMITTAL PROCEDURES

- A. Transmit each submittal with approved form and Contractors transmittal form. Transmittal shall be numbered sequentially and revised submittals should include original number and a sequential alphabetic suffix. Transmittal shall include list of each specification section or sections that are included in the submittal contents. Send transmitted submittal as one complete PDF; multiple files will not be reviewed and will need to be reassembled by Contractor.
- B. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number.
- C. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- D. Deliver physical submittals to Architect at business address. In some instances, larger physical samples can be coordinated to be delivered to the construction site, typically for use in a mock-up.
- E. Schedule submittals to expedite the Project, and coordinate submission of related items. Transmit higher priority submittals first and provide date for anticipated return of submittal.
- F. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor. When large quantities of submittals are transmitted in a short time frame, review time may take longer. Mark high priority submittals on transmittal to notify / assist in an expedited review.
- G. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work. Any proposed change or deviation from Contract Document plans or specifications must be clearly noted and easily identifiable on the submittal. Any change must be identified and specifically requesting approval of proposed deviation by Architect or Engineer of Record. Failure to follow this requirement results in submitted deviation bearing the complete responsibility of the contractor.

- H. Comments made in submittals by Architect or Engineer that change contract costs need to be submitted to Architect as a Potential Change Order for Claims for review and approval by Owner prior to the change to project scope. Failure to follow this requirement, whether a cost savings or cost increase, results in the submitted cost change bearing the complete responsibility of the providing contractor.
- I. Provide space for Contractor and Architect review stamps. Submittals must be reviewed and stamped by Contractor, unstamped submittals will not be reviewed and will be returned.
- J. Submittals to be as complete, comprehensive and accurate as possible. Include all components requested to be reviewed in Submittal section 1.03 of the specifications. Do not split up a single specification section into multiple submittals (ie product data, samples, shop drawings, etc.). Avoid grouping unrelated specifications sections together in a submittal.
- K. Each submittal will only be reviewed two times; once for original review and then a second time for a potential revised submittal. Any further additional reviews must include General Contractor's explanation for their inability to conform with requirements. Additional reviews beyond aforementioned may have costs associated to complete additional reviews.
- L. When revised for resubmission, identify all changes made since previous submission. Cloud all changes and revised details / notes. Address all comments and/or questions posed in previous submission; lack of addressing all previous review comments are grounds for rejection of submittal. Only submit new or revised items. For revised items, clearly cloud or identify changed components.
- M. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- N. Submittals not requested will not be recognized or processed.

3.15 AUTOCAD RELEASE FORM

- A. At your request, Witsell Evans Rasco, P.A. (WER) will provide electronic files for your convenience and use in the preparation of a bid or shop drawings related to Project: _____ subject to the following terms and conditions.
- B. WER's electronic files are compatible with AutoCad as a dwg. file. WER makes no representation as to the compatibility of these files with your hardware or your software beyond the specified release of the referenced specifications.
- C. Data contained on these electronic files is part of WER's instruments of service and shall not be used by you or anyone else receiving this data through or from you for any purpose other than as a convenience in the preparation of bids or shop drawings for the referenced project. Any other use or reuse by you or by others, will be at your sole risk and without liability or legal exposure to WER. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against WER, its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with your use of the electronic files.
- D. Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold harmless WER from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from your use of these electronic files.
- E. **These electronic files are not contract documents.** Differences may exist between these electronic files and corresponding hard copy contract documents due to addenda, change orders or other revisions. WER makes no presentation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed contract documents prepared by WER and electronic files, the signed contract documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including and without limitations, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.
- F. Because of the potential that the information presented on the electronic files can be modified, unintentionally or otherwise, WER reserves the right to remove all indications of its ownership and/or involvement from each electronic display.
- G. WER will furnish you electronic files at a cost of **\$150.00** per building floor or sheet, for the following:
1. _____
 2. _____
 3. _____
- A service fee of \$ (_____) shall be remitted to WER prior to delivery of the electronic files.
- H. Under no circumstances shall delivery of the electronic files for use by you be deemed a sale by WER and WER makes no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall WER be liable for any loss of profit or any consequential damages.

SIGNED:

WITSELL EVANS, RASCO PA CONTRACTOR NAME / TITLE

DATE: _____

ADDRESS / PHONE NUMBER

END OF SECTION

**SECTION 01 3216
CONSTRUCTION PROGRESS SCHEDULE**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.02 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. Within 10 days after joint review, submit complete schedule.

1.03 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.04 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Diagram Sheet Size: Maximum 22 x 17 inches. Provide electronic file(s) in PDF format.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Provide sub-schedules to define critical portions of the entire schedule.
- D. Include conferences and meetings in schedule.
- E. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- F. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- G. Indicate delivery dates for owner-furnished products.
- H. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.04 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.05 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities. Revised schedules should show original baseline start and finish dates for activities in comparison with actual work started and completed.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.
- G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

3.06 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

**SECTION 01 4000
QUALITY REQUIREMENTS**

PART 3 EXECUTION

1.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

1.02 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

SECTION 01 4533
SPECIAL INSPECTIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, may apply to this Section.
- B. Section 01 4000 - Quality Requirements. Requirements for Contractor performed independent tests and inspections that are normally Contractor's responsibility and are not specifically indicated within the requirements of this section.

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements required for compliance with the International Building Code, Chapter 17, Special Inspections and Tests.
- B. Special inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Construction Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the construction document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this section.
- C. The Owner will engage one or more qualified special inspectors and / or testing agencies to conduct special inspections and tests specified in this section and related sections and as maybe specified in other divisions of these specifications.
- D. Refer to Statement of Special Inspections and forms following the end of this section for the inspection and testing requirements and forms to be utilized by the Contractor and inspectors.
- E. Related Sections include but are not limited to the following:
 - 1. 032000 - Concrete Reinforcing
 - 2. 033000 - Cast-in-Place Concrete
 - 3. 042900 - Engineered Unit Masonry
 - 4. 051200 - Structural Steel Framing
 - 5. 053100 - Steel Decking
 - 6. 054000 - Cold-Formed Metal Framing
 - 7. 055100 - Metal Stairs
 - 8. 055213 - Pipe and Tube Railings
 - 9. 310916.21 - Pile Load Tests
 - 10. 316333 - Micropiles
 - 11. 316615 - Helical Foundations

1.03 RELATED STANDARDS

- A. ASTM E 329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2021
- B. ICC (IBC) - International Building Code; 2021
- C. SEAoAR SI GL 03 - 01/01/2023; Arkansas Special Inspections Guidelines; www.SEAoAR.org.
- D. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2016

1.04 DEFINITIONS

- A. **Approved Agency:** An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the building official.
- B. **Construction Documents:** Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building permit. Construction Documents include all supplemental instructions, sketches, addenda, and revisions to the drawings and specifications issued by the registered design professional beyond those issued for a building permit.
- C. **Registered Design Professional in Responsible Charge:** The individual that prepares the Statement of Special Inspections including a Schedule of Special Inspection Services as part of the general requirements Section 1704 of the Building Code. The Registered Design Professional for special inspections is typically the project architect. The architect will take input from the structural, mechanical, electrical, civil and fire protection engineers and act as the overall Registered Design Professional in Responsible Charge of preparing the Statement of Special Inspections.
- D. **Shop Drawings / Submittal Data:** Written, graphic and pictorial documents prepared and / or assembled by the contractor based on the Construction Documents.
- E. **Special Inspector:** A qualified person who demonstrating competence, to the satisfaction of the code enforcement official and registered design professional in responsible charge, for inspection of the particular type of construction or operation requiring special inspection. The special inspector shall be a licensed professional engineer or engineering intern or a qualified representative from the testing agency.
- F. **Special Inspection, Continuous:** The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.
- G. **Special Inspection, Periodic:** The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.
- H. **Testing Agency:** A qualified materials testing laboratory under the responsible charge of a licensed professional engineer, approved by the code enforcement official and the registered design professional in responsible charge, to measure, examine, test, calibrate, or otherwise determine the characteristics or performance of construction materials and verify confirmation with construction documents.

1.05 QUALITY ASSURANCE

- A. **Testing Agency Qualifications:**
 - 1. Minimum qualifications of inspection and testing agencies and their personnel shall comply with ASTM E 329 Standard Specification for Agencies in the Testing and / or Inspection of Materials Used in Construction.
 - a. Inspectors and individuals performing tests shall be certified for the work being performed as outlined in the appendix of the ASTM E329. Certification by organizations other than those listed must be submitted to the Building Official for consideration before proceeding with work.
 - 2. In addition to these requirements, local jurisdiction may have additional requirements. It is the responsibility of the testing and inspection agencies to meet local requirements and comply with local procedures.

1.06 CONFLICTING REQUIREMENTS, REPORTS, AND TEST RESULTS

- A. **General:** If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the registered design professional in responsible charge for a decision before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the registered design profession in responsible charge for a decision before proceeding.
- C. The special inspector's reports and testing agencies results shall have precedence over reports and test results provided by the Contractor.
- D. Where a conflict exists between the Construction Documents and approved shop drawings / submittal data, the Construction Documents shall govern, unless the approved shop drawings / submittal data are more restrictive. All conflicts shall be brought to the attention of the Registered Design Professional in Responsible Charge.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SPECIAL INSPECTOR (TESTING AGENCIES) RESPONSIBILITIES

- A. The Special Inspectors shall:
 - 1. Provide written documentation to the Building Official demonstrating their qualifications.
 - 2. Notify the Contractor of their presence and responsibilities at the job site.
 - 3. Observe assigned work for which they are responsible for conformance with the plans and specifications and approved submittals for work designed by the Contractor.
 - 4. Report nonconforming items to the immediate attention of the Contractor for correction.
 - 5. Write a discrepancy report about each nonconforming item containing:
 - a. Description and exact location.
 - b. Reference to applicable drawings and specifications.
 - c. Resolution or corrective action taken and the date.
 - 6. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and to the Registered Design Professional In Responsible Charge prior to the completion of that phase of the work.
 - 7. Provide special inspection reports directly to the Design Professional, the Contractor and the Building Official at the intervals indicated on the Statement of Special Inspections. The reports should:
 - a. Describe the special inspection and tests made, with locations.
 - b. Indicate nonconforming items and their resolution.
 - c. List unresolved items and parties notified.
 - d. Itemize any changes authorized by the Design Professional.
 - 8. Initial and date the "Date Completed" box in the Schedule of Special Inspection Services as the inspection and testing activities are completed.
 - 9. Submit a signed Final Report of Special Inspections stating that all required special inspections and testing were fulfilled and reported and that any outstanding discrepancies have been corrected.

3.02 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall be familiar with Chapter 17 of the International Building Code.
- B. The Contractor shall coordinate the inspection and testing services with the progress of the work. The Contractor shall provide sufficient notice to allow proper scheduling of all personnel. The Contractor shall provide safe access for performing inspection and on site testing.
- C. The Contractor shall provide and maintain project schedules to the Owner, Registered Design Professionals and testing and inspecting agencies. Project schedules shall indicate milestones and durations of time for materials requiring structural tests and special inspections, including retesting or reinspections required.
- D. Notify special inspectors 72 hours prior to expected time for operations requiring testing/inspection services.

- E. Provide Special Inspectors direct access to the approved plans and specifications for the project, including modifications.
- F. Deliver samples for testing when needed.
- G. Cooperate with special inspectors, and provide access to the Work .
- H. Provide incidental labor and facilities:
 - 1. To provide access to Work to be tested/inspected.
 - 2. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - 3. To facilitate tests/inspections.
 - 4. To provide storage and curing of test samples.
- I. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified special inspection requirements.
- J. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified special inspection requirements.
- K. Maintain the Schedule of Special Inspection Services at the project site and submit a copy to the Design Professional and the Building Official when all the services are complete.
- L. The Contractor shall submit certification as an Approved Fabricator prior to any shop fabrication of load-bearing members and assemblies, where the fabricator requests to perform such work without special inspection.
- M. Each contractor responsible for the construction of a seismic-force-resisting system, or component listed in the Statement of Special Inspections Requirements for Seismic Resistance shall submit a written Contractor's Statement of Responsibility to the Building Official and to the Owner prior to the commencement of work on the system or component. The Contractor's Statement of Responsibility shall contain the following:
 - 1. Acknowledgement of the awareness of the special requirements contained in the Statement of Special Inspections.
 - 2. Acknowledgement that control shall be exercised to obtain conformance with the construction documents approved by the Building Official.
 - 3. Procedures for exercising control within the Contractor's organization, the method and frequency of reporting and the distribution of the reports.
 - 4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.
- N. The Contractor shall repair and / or replace work that does not meet the requirements of the Construction Documents.
 - 1. Contractor shall engage an engineer / architect to prepare repair and / or replacement procedures.
 - 2. Engineer / architect shall be registered in the State in which the Project is located. Engineer / architect shall be acceptable to the Registered Design Professional in Responsible Charge, Building Official, and Owner.
 - 3. Procedures shall be submitted for review and acceptance by the Registered Design Professional in Responsible Charge, Building Official, and Owner before proceeding with corrective action.
- O. The Contractor shall be responsible for costs of:
 - 1. Re-testing and re-inspection of materials, work, and / or products that do not meet the requirements of the Construction Documents and shop drawings / submittal data.
 - 2. Review of proposed repair and / or replacement procedures by the Registered Design Professional in Responsible Charge and the inspectors and testing agencies.
 - 3. Repair or replacement of work that does not meet the requirements of the Construction Documents.
- P. The Contractor shall submit Certificates of Compliance and test reports in accordance with IBC Section 1704.5 to the Owner, Registered Design Professional in Responsible Charge and Building Official after completion of fabrication.

- Q. The Contractor shall submit Manufacturer's Certificates of Compliance, specific to the project location, for all mechanical and electrical equipment indicated to be seismically qualified.
- R. The Contractor shall maintain one copy of all required manufacturer's equipment Certificates of Compliance, for special inspector's use, at the jobsite.
- S. The Contractor shall maintain one copy of all shop drawings indicating seismic restraint design for all designated seismic systems, for special inspector's use, at the jobsite.

3.03 INSPECTION AND TESTING

- A. Inspection and Testing shall be in accordance with the attached Schedule of Special Inspection Services.
- B. Reference related specifications for the minimum level of inspections and testing. Provide additional inspections and testing as necessary to determine compliance with the construction drawings and as required by reference standards indicated in IBC Chapter 17.

3.04 SCHEDULES AND FORMS (INCLUDED FOLLOWING THE END OF THIS SECTION)

- A. STATEMENT OF SPECIAL INSPECTIONS.
 - 1. The Statement of Special Inspections is included as an attachment to this section. This form provides the general project information. It identifies the project location, the architect of record, the structural, mechanical, and electrical engineers, the Registered Design Professional in Responsible Charge, and Special Inspection Requirements for Seismic or Wind Resistance.
 - 2. The Contractor shall submit the Statement of Special Inspections with the application for the building permit and have the Building Official sign, date, and shall add the building permit number to the statement. The Contractor shall send a copy of the completed document to the Architect Engineer, Owner, Building Official, and keep a copy in the job site office.
- B. SCHEDULE OF SPECIAL INSPECTION SERVICES.
 - 1. The Schedule of Special Inspection Services is included as an attachment to this section. This form provides a detailed and itemized list of which special inspection activities are required for the specific project and which individuals, firm, or agency will be performing the special inspection services associated with each required task.
 - 2. The Contractor shall maintain the schedule at the project site. When an individual special inspection task in the schedule is completed for the last time on the project and the special inspector performed their final review, inspection, or test of that item for the project, the special inspector shall initial and date the cell in the "Completed" column adjacent to the task. The schedule shall be maintained by the Contractor at the project site.
 - 3. At the conclusion of the project a copy of the Schedule of Special Inspection Services form with the initials and date in the "Completed" column for each task relevant to the project shall be submitted, by the Contractor, to the Design Professional in Responsible Charge and the Building Official for comparison with the Final Reports of Special Inspections.
- C. FINAL REPORT OF SPECIAL INSPECTIONS.
 - 1. The form for the final report of Special Inspections is included as an attachment to this section. This form is submitted by each inspector when all the special inspection requirements they are responsible for on the project have been fulfilled and all noted deficiencies have been corrected. Each special inspector corresponding to an agent number in the Schedule of Special Inspection Services will be required to complete a copy of this form.
 - 2. The special inspectors shall provide 3 bound copies of the special inspection interim reports with the final report of special inspections serving as the cover sheet. The copies shall be submitted to the Design Professional in Responsible Charge and Building Official within 2 weeks of completion of the special inspection program. The special inspection program will not be considered complete until forms from all agents have been submitted and received.
- D. CONTRACTOR'S STATEMENT OF RESPONSIBILITY.

1. The form for the Contractor's Statement of Responsibility is included as an attachment to this section.
 2. Each contractor responsible for the construction or fabrication of a seismic force resisting system, designated seismic system or component, listed in the Statement of Special Inspections - Requirements for Seismic Resistance, shall submit a written statement of responsibility to the Building Official and Design Professional in Responsible Charge prior to the commencement of work on the system or component.
 3. Each contractor responsible for the construction or fabrication of a main wind force resisting system or a wind force resisting component listed in the Statement of Special Inspections - Requirements for Tornado Resistance, shall submit a written statement of responsibility to the Building Official and Design Professional in Responsible Charge prior to the commencement of work on the system or component.
 4. Contractor's Statements of Responsibility shall be submitted to the Design Professional in Responsible Charge for approval along with the design submittal for the associated work.
- E. APPROVED FABRICATOR'S CERTIFICATE OF COMPLIANCE.
1. The form for the approved Fabricator's Certificate of Compliance is included as an attachment to this section.
 2. Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per IBC Section 1704.2.5 must submit Fabricator's Certificate of Compliance at the completion of fabrication to the Contractor.
 3. The Contractor shall submit Fabricator's Certificates of Compliance for approved fabricators to the Design Professional in Responsible Charge and the Building Official.
- F. CERTIFICATES OF COMPLIANCE
1. These forms shall be completed by the fabricator or contractor responsible for each system or component and submitted to the owner, Design Professional and Building Official. These forms are included as an attachment to this section.
 - a. Nonstructural Components Certificate of Compliance in accordance with IBC Section 1705.14.2
 - b. Certificate of Compliance for Designated Seismic Systems in accordance with IBC Section 1705.14.3
 - c. Preconstruction Tests for Shotcrete in accordance with ACI 318
 - d. Steel Joist Fabricator's Certificate of Compliance in accordance with IBC Section 2207.5
 - e. Certificate of Compliance of Material Properties for Weldability of Reinforcement with a Standard Other than ASTM A706
 - f. Certificate of Compliance for Reports of Mill Tests for A615 Reinforcement Used in Seismic Force-Resisting Systems
- G. MINIMUM SPECIAL INSPECTOR QUALIFICATIONS.
1. This document is included as an attachment to this section.
 2. This document lists the Structural Engineers Association of Arkansas (SEAoAR)'s recommended minimum qualifications for special inspectors.
 3. The final approval of an inspector shall be determined by the building official.
- H. OTHER SPECIAL INSPECTION REPORT AND NOTICE FORMS.
1. Forms for Special Inspection Reports and Discrepancy Notices are included as attachments to this section.

END OF SECTION

STATEMENT OF SPECIAL INSPECTIONS

(Completed by the Registered Design Professional in Responsible Charge)

PROJECT: CAW Headquarters Renovation

LOCATION: Little Rock, Arkansas

PERMIT APPLICANT: _____

APPLICANT'S ADDRESS: _____

ARCHITECT OF RECORD: _____

STRUCTURAL ENGINEER OF RECORD: Matthew Kitsch

MECHANICAL ENGINEER OF RECORD: Nathan Helms

ELECTRICAL ENGINEER OF RECORD: Ali Honarmand

REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE: Ali Honarmand

This Statement of Special Inspections is submitted in accordance with Section 1704.3 of the 2021 Arkansas Fire Prevention Code. It includes a *Schedule of Special Inspection Services* applicable to the above-referenced Project as well as the identity of the individuals, agencies, or firms intended to be retained for conducting these inspections. If applicable, it includes *Requirements for Seismic Resistance* and/or *Requirements for Tornado Resistance*.

Are Requirements for Seismic Resistance included in the Statement of Special Inspections?

☒ Yes ☐ No

Are Requirements for Tornado Resistance included in the Statement of Special Inspections?

☐ Yes ☒ No

The Special Inspector(s) shall keep records of all inspections and shall furnish interim inspection reports to the Building Official and to the Registered Design Professional in Responsible Charge at a frequency agreed upon by the Design Professional and the Building Official prior to the start of work. Discrepancies shall be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge prior to completion of that phase of work. A *Final Report of Special Inspections* documenting required special inspections and corrections of any discrepancies noted in the inspections shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge at the conclusion of the project.

Frequency of interim report submittals to the Registered Design Professional in Responsible Charge:

☐ Weekly

☒ Bi-Weekly

☐ Monthly

Other; specify: _____

The Special Inspection program does not relieve the Contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Statement of Special Inspections Prepared by:

Type or print name

Signature

Date

Building Official's Acceptance:

Signature

Date

Permit Number: _____

Preparer's Seal

Frequency of interim report submittals to the Building Official:

☐ Monthly

☐ Bi- Monthly

☐ Upon Completion

Other; specify: _____

Statement of Special Inspections Requirements for Seismic Resistance

See the Schedule of Special Inspections for inspection and testing requirements.

Seismic Design Category: C

Statement of Special Inspection for Seismic Resistance Required (Yes/No): Yes

Description of seismic force-resisting system subject to special inspection and testing for seismic resistance:

(Required for Seismic Design Categories B, C, D, E or F in accordance with Building Code Section 1705.13.1 through 1705.13.3, and 1705.14.1). Some systems not required in SDC B, see section 1705.13.

Not Applicable

Description of designated seismic systems subject to special inspection, testing and qualification for seismic resistance:

(Required for architectural, electrical and mechanical systems and their components that require design in accordance with ASCE 7-16 Chapter 13, have a component importance factor, I_p , greater than one and are in Seismic Design Categories C, D, E or F, in accordance with Building Code Section 1705.13.4 and 1705.14.3.)

Fire protection sprinkler systems.

Egress stairways and emergency signage.

Components conveying hazardous materials.

Description of additional components and systems requiring special inspections, testing and qualification for seismic resistance:

(Required for systems noted in Building Code Sections 1705.13.5 through 1705.13.9 and 1705.14.2 1705.11).

Installation and anchorage of piping carrying hazardous materials and their associated mechanical units.

Installation and ductwork designed to carry hazardous materials.

Installation of mechanical and electrical equipment including duct work, piping systems and their structural supports, where automatic sprinkler systems are installed.

Statement of Responsibility:

Each contractor responsible for the construction or fabrication of a system or component described above must each submit a Statement of Responsibility (pg C1) in accordance with Building Code Section 1704.4.

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	(Completed by the Registered Design Professional in Responsible Charge)				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
1705.2 Structural Steel Construction					
1. Review the material test reports and certificates as listed in AISC 360-16, Section N3.2 for compliance with the construction documents	Submittal review		Each submittal		
2. Material verification of structural steel	Shop (3) and field inspection		Periodic		
3. Anchor Rods and other Embedment(s) (Verify diameter, grade, type, length, embedment. See 1705.3 for anchors)	Field inspection		Continuous		
4. Verify member locations and application of joint details at each connection comply with construction documents	Field inspection		Periodic		
5. Structural steel welding:					
a. Inspection tasks Prior to Welding (Observe, or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-1)	Shop (3) and field inspection		Observe or Perform as noted (4)		
b. Inspection tasks During Welding (Observe, or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-2)	Shop (3) and field inspection		Observe (4)		
c. Inspection tasks After Welding (Observe, or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-3)	Shop (3) and field inspection		Observe or Perform as noted (4)		
d. Nondestructive testing (NDT) of welded joints: <i>see Commentary</i>					
1) Complete penetration groove welds at joints in materials 5/16" or greater in Risk Category II	Shop (3) or field ultrasonic testing - 10% of welds minimum		Periodic		
2) Fabricator's NDT reports when fabricator performs NDT	Verify reports		Each submittal (5)		
6. Structural steel bolting:	Shop (3) and field inspection				
a. Inspection tasks Prior to Bolting (Observe, or perform tasks for each bolted connection, in accordance with QA tasks listed in AISC 360-16, Table N5.6-1)			Observe or Perform as noted (4)		
b. Inspection tasks During Bolting (Observe the QA tasks listed in AISC 360-16, Table N5.6-2)			Observe (4)		
1) Pre-tensioned and slip-critical joints					
a) Turn-of-nut with matching markings			Periodic		
b) Twist-off type tension control bolt			Periodic		
c) Calibrated wrench			Continuous		
2) Snug-tight joints			Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	(Completed by the Registered Design Professional in Responsible Charge)				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
c. Inspection tasks After Bolting (Perform tasks for each bolted connection in accordance with QA tasks listed in AISC 360, Table N5.6-3)			Perform (4)		
7. Inspection of steel elements of composite construction prior to concrete placement in accordance with SDI QA/QC tasks listed in Section 1705.2.2 for steel deck and AISC 360-16, Table N5.4-2 Section N5 for welding Headed stud anchors	Shop (3) and field inspection and testing		Observe or Perform as noted (4)		
a. Placement and installation of steel headed stud anchors			Periodic		
1705.2.2 Cold-formed Steel Deck (shall be performed according to the requirements of SDI QA/QC)					
1. Inspection or Execution Tasks Prior and After Deck Placement according to Table 1.1 & 1.2 of SDI QA/QC:					
a. Identification markings	Field inspection		Periodic		
b. Manufacturer's certified test reports, deck profile and thickness	Submittal Review		Each submittal		
c. Verify deck installation per construction documents	Field inspection		Periodic		
2. Inspection Prior, During & After Welding of Steel Floor Deck according to Table 1.3, 1.4 & 1.5 of SDI QA/AC:					
a. Prior (Table 1.3): Welding procedure Specifications (WPS) available, Manufacturer's certifications for welding consumables available, Material identification (type/grade), welding equipment check.	Field inspection		Periodic		
b. During (Table 1.4): Qualified welders, Environmental Conditions, WPS followed	Field inspection		Periodic		
c. After (Table 1.5): Verify size and location of welds, including support, sidelap, and perimeter welds	Field inspection		Periodic		
d. After (Table 1.5): Welds meet visual acceptance criteria	Field inspection		Periodic		
e. After (Table 1.5): Verify repair activities and Document acceptance or rejection of welds	Field inspection		Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	(Completed by the Registered Design Professional in Responsible Charge)				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
3. Inspection Prior, During & After Mechanical Fastening of Steel Roof Deck according to Table 1.6, 1.7 & 1.8 of SDI QA/AC:					
a. Prior (Table 1.6): Manufacturer installation instructions available for mechanical fasteners, Proper tools available for fastener installation, Proper storage for mechanical fasteners	Field inspection		Periodic		
b. During (Table 1.7): Fasteners are positioned as required and fasteners are installed according to manufacturer's instructions	Field inspection		Periodic		
c. After (Table 1.8): Check spacing, type, and installation of support, sidelap, and perimeter fasteners.	Field inspection		Periodic		
d. After (Table 1.8): Verify repair activities and Document acceptance or rejection of mechanical fasteners	Field inspection		Periodic		
1705.3 Concrete Construction					
1. Inspection of reinforcement and verify placement. Placement includes reinforcing bar size, shape, spacing, cover, embedment, orientation, bar length, and splices per the construction documents and approved placement drawings.	Field inspection		Periodic		
2. Inspection of anchors cast in concrete	Shop (3) and field inspection		Periodic		
3. Inspection of anchors and reinforcing steel post-installed in hardened concrete: Per research reports requirements	Field inspection		Periodic or as required by the research report issued by an approved source		
a. Adhesive anchors installed horizontally or in upwardly inclined orientations to resist sustained tension loads.	Field inspection		Continuous		
b. Mechanical anchors and adhesive anchors not defined in 4.a.	Field inspection		Periodic		
4. Verify use of approved design mix	Shop (3) and field inspection		Periodic		
5. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests and determine temperature of concrete	Shop (3) and field inspection		Continuous		
6. Inspection for maintenance of specified curing temperature and techniques	Shop (3) and field inspection		Periodic		
7. Inspection of formwork for shape, lines, location and dimensions	Field inspection		Periodic		
15. Concrete strength testing and verification of compliance with construction documents	Field testing and review of laboratory reports		Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	(Completed by the Registered Design Professional in Responsible Charge)				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
1705.4 Masonry Construction					
(A) Level 1, 2 and 3 Quality Assurance:					
1. Prior to construction, verification of compliance of submittals	Submittal review		Periodic		
(B) Level 2 Quality Assurance:					
1. Verification of f'm prior to construction	Testing by unit strength method or prism test method		Periodic		
2. Verification of Slump Flow and Visual Stability Index (VSI) of selfconsolidating grout as delivered to the project	Field testing		Continuous		
3. Verify proportions of site-mixed mortar and grout	Field Inspection		Periodic		
4. Verify location, grade, type, and size of reinforcement and anchor bolts	Field Inspection		Periodic		
5. Verify sample panel construction	Field Inspection		Periodic		
6. Verify placement of masonry units and mortar joint construction	Field Inspection		Periodic		
7. Verify placement of reinforcement, connectors, and anchorages	Field Inspection		Periodic		
8. Verify grout space prior to grouting	Field Inspection		Periodic		
9. Verify size and location of structural members	Field Inspection		Periodic		
10. Verify type, size, and location of anchors, including details of anchorage of masonry to structural members, frames, or other construction.	Field inspection		Periodic		
11. Verify preparation, construction, and protection of masonry during cold weather (temperature below 40° F) or hot weather (temperature above 90° F)	Field inspection		Periodic		
12. Verify compliance of materials and procedures with the approved submittals	Field inspection		Periodic		
13. Observe preparation of grout specimens, mortar specimens, and/or prisms	Field inspection		Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	(Completed by the Registered Design Professional in Responsible Charge)				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
1705.6 Soils					
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	Field inspection		Periodic		
2. Verify excavations are extended to proper depth and have reached proper material.	Field inspection		Periodic		
3. Perform classification and testing of controlled fill materials.	Field inspection		Periodic		
4. During fill placement, verify use of proper materials and procedures in accordance with the provisions of the approved geotechnical report. Verify densities, and lift thicknesses during placement and compaction of compacted fill	Field inspection		Continuous		
5. Prior to placement of controlled fill, observe subgrade and verify that site has been prepared properly	Field inspection		Periodic		
1705.8 Micropiles Deep Foundations					
1. Inspect drilling operations and maintain complete and accurate records for each element	Field inspection		Continuous		
2. Verify placement locations and plumbness, confirm element diameters, lengths, and adequate end-bearing strata capacity. Record concrete or grout volumes	Field inspection		Continuous		
3. For concrete elements, perform additional inspections in accordance with Section 1705.3	See Section 1705.3		See Section 1705.3		
1705.9 Helical Pile Foundations					
1. Verify installation equipment, pile dimensions, tip elevations, final depth, final installation torque and other data as required	Field inspection		Continuous		
2. Perform additional inspections and tests in accordance with the construction documents	Field Inspection and testing		In accordance with construction documents		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	(Completed by the Registered Design Professional in Responsible Charge)				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
1705.13.4 Designated Seismic System Verification					
Inspect and verify that the component label, anchorage or mounting conforms to the certificate of compliance in accordance with 13.2.2 of ASCE 7-16	Field inspection		Periodic		
1. Mechanical & Electrical Designated Seismic Systems (per ASCE 7-16)					
a. Mechanical and Electrical Components					
1) Elevator components	Field Inspection		Periodic		
2) Generators, batteries, invertors, motors, transformers, and other electrical components constructed of high deformability materials	Field Inspection		Periodic		
3) Motor control centers, panel boards, switch gear, instrumentation cabinets, and other components constructed of sheet metal framing	Field Inspection		Periodic		
4) Communication equipment, computers, instrumentation and controls	Field Inspection		Periodic		
c. Distribution Systems					
1) Piping and tubing including in-line components	Field Inspection		Periodic		
2) Plumbing	Field Inspection		Periodic		
3) Fire Protection Sprinkler Pipe System	Field Inspection		Periodic		
1705.13.6 Plumbing, Mechanical and Electrical Components Special Inspections for Seismic Resistance					
1. Inspection during the anchorage of electrical equipment for emergency systems.	Field inspection		Periodic		
2. Inspection during installation and anchorage of piping systems designed to carry hazardous materials, and their associated mechanical units	Field inspection		Periodic		
3. Inspection during the installation and anchorage of ductwork designed to carry hazardous materials	Field inspection		Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	(Completed by the Registered Design Professional in Responsible Charge)				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
4. Inspection during the installation of mechanical and electrical equipment, including duct work, piping systems and their structural supports, where automatic fire sprinkler systems are installed to verify on of the following:					
a. Minimum clearances have been provided as required by Section 13.2.3 ASCE 7	Field inspection		Periodic		
b. A nominal clearance of not less than 3 inches has been provided between fire protection sprinkler system drops and sprigs and; structural members not used collectively or independently to support the sprinklers; equipment attached to the building structure; and other systems piping	Field inspection		Periodic		
1705.18 Fire-Resistant Penetrations and Joints					
1. Inspect penetration firestop	Field testing		Per ASTM E 2174		
2. Inspect fire-resistant joint systems	Field testing		Per ASTM E 2393		
1705.19 Smoke Control Systems					
1. Leakage testing and recording of device locations prior to concealment.	Field testing		Periodic		
2. Prior to occupancy and after sufficient completion, pressure difference testing, flow measurements, and detection and control verification.	Field testing		Periodic		
Other					
1. Grouting steel column baseplates - verify proper material is used, mixed and placed per manufacturer's instructions and construction documents	Field Inspection		Continuous		
2. Site Grading - develop stripping techniques suitable to site condition - review and advise on size of earth moving equipment - verify that soils will not loose strength during earth movemeng operations - observe grading	Field Inspection		Periodic		

SCHEDULE OF SPECIAL INSPECTION SERVICES					
PROJECT	(Completed by the Registered Design Professional in Responsible Charge)				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
DATE:					

FINAL REPORT OF SPECIAL INSPECTIONS

(Completed by each Special Inspector)

PROJECT: _____

LOCATION: _____

PERMIT APPLICANT: _____

APPLICANT'S ADDRESS: _____

ARCHITECT OF RECORD: _____

STRUCTURAL ENGINEER OF RECORD: _____

MECHANICAL ENGINEER OF RECORD: _____

ELECTRICAL ENGINEER OF RECORD: _____

REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE: _____

To the best of my information, knowledge, and belief, which are based upon observations or diligent supervision of our inspection services for the above-referenced Project, I hereby state that the special inspections or testing required for this Project, and designated for this Agent in the *Schedule of Special Inspection Services*, have been completed in accordance with the Contract Documents and approved design revisions.

The Special Inspection program does not relieve the Contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Interim reports submitted prior to this final report and numbered ___ to ___ form a basis for, and are to be considered an integral part of this final report. The following discrepancies that were outstanding since the last interim report dated _____ have been corrected:

(Attach 8 1/2"x11" continuation sheet(s) if required to complete the description of corrections)

Prepared By:

Special Inspection Agent/Firm

Type or print name of Special Inspector

Signature

Date

Contractor's Statement of Responsibility

Each contractor responsible for the construction or fabrication of a main wind- or seismic force-resisting system, designated seismic system or a wind- or seismic-resisting component listed in the Statement of Special Inspections (Requirements for Seismic or Tornado Resistance) must submit a Statement of Responsibility, in accordance with the Building Code, Section 1704.4.

Project: _____

Contractor's Name: _____

Address: _____

License No.: _____

Description of building systems and components included in Statement of Responsibility:

Contractor's Acknowledgement of Special Requirements

I hereby acknowledge that I have received, read, and understand the Statement of Special Inspections and Special Inspection program:

I hereby acknowledge that control will be exercised to achieve conformance with the approved construction documents.

Name and Title (type or print)

Signature

Date

Contractor's Provisions for Quality Control

Procedures for exercising control within the contractor's organization, the method and frequency of reporting and distribution of reports is attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement

Project: _____

Address: _____

Certification Number: _____

Description of structural members and assemblies that have been fabricated:

[illegible]

Date _____

MINIMUM SPECIAL INSPECTOR QUALIFICATIONS

Category of Testing and Inspection	Minimum Qualifications (refer to key at end of Table)			
	Shop Inspection	Field Testing /Inspection	Review Submittals	Review Testing, Certification, & Lab Reports
1704.2.5 Inspection of Fabricators				
Pre-cast concrete	A, C, E			
Structural steel construction	C, F, G			
Wood construction	A, N			
Cold formed metal construction	A, N			
1705.2 Steel Construction				
Welding	C, F, G	C, F, G	A	A
High strength bolting, inspection of steel frame joint details		A, C	A	A
1705.2.2, 1705.2.3 and 1705.2.4 Steel Construction other than Structural Steel				
Welding	C, F, G	C, F, G	A	A
Cold-formed Steel Deck		C, F, G	A	A
Open-Web Steel Joist and Joist Girders		C, F, G	A	A
Cold-formed Steel Trusses spanning ≥ 60 ft		A, C	A	A
1705.3 Concrete Construction				
Reinforcing placement, cast-in-place bolts, concrete and shotcrete placement and curing operations		A, C, H		
Pre-stressing steel installation		A, C, D, E		
Erection of pre-cast concrete members		A, C, H, Q		
Concrete field testing		A, C, H, I, J		
Review certified mill reports and design mixes			A	
Verify use of required design mix		A, C, H, I, J		
Pre-stressed (pre-tensioned) concrete force application	A, C, E			
Post-tensioned concrete force application		A, C, D, H		
Review of in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs		A, C, D		
Reinforcing steel weldability, reinforcing welding, weld filler material		C, F, G		
Inspection of post-installed anchors in hardened concrete		A, C, S		
1705.4 Masonry				
Review f'_m prior to construction			A	
Mortar joint construction, grout protection and placement, materials proportion, type/size/location of reinforcement, structural elements, anchorage, and connectors		A, C		
Sampling/testing of grout/mortar specimens		A, C, K		
Observe preparation of masonry prisms for testing of compressive strength of masonry, f'_m		A, C, K		
Inspection of welding of reinforcing steel		C, F, G		
1705.5 Wood Construction				
Observe structural panel sheathing, size of framing members, fastener diameter and length, number of fastener lines, and spacing of fastener lines and fasteners for compliance with approved construction documents for the project		A, N		
Metal-plate-connected wood trusses: verify temporary and permanent truss bracing is installed per approved truss submittal package		A, N		

(Table continued on next page)

MINIMUM SPECIAL INSPECTOR QUALIFICATIONS *(continued)*

Category of Testing and Inspection	Minimum Qualifications (refer to key at end of Table)			
	Shop Inspection	Field Testing /Inspection	Review Submittals	Review Testing, Certification, & Lab Reports
1705.6 Soils				
Observe site preparation, fill placement and testing of compaction for compliance with the construction documents for the project		A, C, I, R		
Observe and test bearing materials below shallow foundations for ability to achieve design bearing capacity		A, L		
Review compaction testing for compliance with the construction documents for the project				A
1705.7, 1705.8 & 1705.9, 1705.10 Driven Deep, Cast-in-place Deep, and Helical Pile Foundations				
Observe installation		A, L, I		
Observe load tests		A, I		
1705.12 Special Inspection for Wind Resistance				
Structural wood		A, N		
Cold-Formed steel light-frame construction		A, N		
Inspect roof cladding		A, B, N		
Inspect wall cladding		A, B, N		
1705.13 Special Inspection for Seismic Resistance				
1705.13.1 Structural Steel				
Inspection of structural steel in the seismic force-resisting systems		A, C		
1705.13.2 Structural Wood				
Inspection of structural wood in the seismic force-resisting systems		A, N		
1705.13.3 Cold-Formed Steel Light-Frame Construction				
Inspection of cold-formed steel light-frame construction in the seismic force-resisting systems		A, N		
1705.13.4 Designated Seismic Systems				
Examine designated seismic systems requiring seismic qualification and verify that the label, anchorage or mounting conform to the certificate of compliance		A	A	A
1705.13.5 Architectural Components				
Inspection of exterior cladding, non-load bearing walls, veneer, and access floors		A, B	A, B	A, B
1705.13.6 Plumbing, Mechanical and Electrical Components				
Inspection of installation and anchorage of mechanical and electrical components		A	A	A
1705.13.7 Storage Racks				
Inspection of anchorage of storage racks 8 feet or taller		A		
1705.13.8 Seismic Isolation Systems				
Inspection of seismic isolation systems in seismically isolated structures	A	A		
1705.13.9 Cold-Formed Steel Special Bolted Moment Frames				
Inspection of cold-formed steel special bolted moment frames		A, N		
1705.14 Testing for Seismic Resistance				
Testing designated seismic systems requiring seismic qualification and verify that the label, anchorage or mounting conform to the certificate of compliance		A		
1705.15 Sprayed Fire-Resistant Materials				
Observe surface conditions, application, average thickness and density of applied material, and cohesive/adhesive bond		A, C		
<i>(Table continued on next page)</i>				

MINIMUM SPECIAL INSPECTOR QUALIFICATIONS <i>(continued)</i>				
Category of Testing and Inspection	Minimum Qualifications (refer to key at end of Table)			
	Shop Inspection	Field Testing /Inspection	Review Submittals	Review Testing, Certification, & Lab Reports
1705.16 Mastic and intumescent fire-resistant coatings				
Observe application compliance with AWCI 12-B		A, C		
1705.17 Exterior Insulation and Finish Systems				
Inspect EIFS systems		A, B, C, M		
1705.18 Fire-resistant penetrations and joints				
Inspection of Penetration firestops		A, C, P		
Inspection of Fire-resistant joint systems		A, C, P		
1705.19 Testing for Smoke Control	<i>See Requirements of Building Code Section 1705.19.2.</i>			
1705.20 Sealing of Mass Timber		A, C, P		
<i>(Table continued on next page)</i>				

MINIMUM SPECIAL INSPECTOR QUALIFICATIONS *(continued)*

KEY:

- A. Arkansas Professional Engineer (AR PE) competent in the specific task area or graduate of accredited engineering/engineering technology program under the direct supervision of an AR PE.
- B. Arkansas Registered Architect (AR RA) competent in the specific task area or graduate of accredited architecture/architecture technology program under the direction of an AR RA.
- C. International Code Council (ICC) Special Inspector Certification specific to the particular material and testing methodology applicable to each Category of Testing and Inspection listed in the table.
- D. Post-tensioning Institute (PTI) Certification, Level 2.
- E. Pre-stressed Concrete Institute (PCI) Plant Quality Personnel Certification – Level III.
- F. American Welding Society (AWS) Certified Welding Inspector (CWI) or AWS Certified Associate Welding Inspector working under the direct on-site supervision of a CWI.
- G. American Society for Nondestructive Testing (ASNT) Level II certification, or a Level III certification if previously certified as a Level II in the particular material and testing methodology applicable to each Category of Testing and Inspection listed in the table.
- H. American Concrete Institute (ACI) Concrete Construction Special Inspector.
- I. National Institute for Certification in Engineering Technologies (NICET) Level II or higher certification specific to the particular material and testing methodology applicable to each Category of Testing and Inspection listed in the table.
- J. ACI Concrete Field Testing Technician with Grade 1 certification or Center for Training Transportation Professionals (CTTP) Certified Concrete Field Testing Technician.
- K. American Concrete Institute (ACI) Masonry Field Testing Technician
- L. NICET Certified Engineering Technologist (CT) competent in the specific task area.
- M. Association of the Wall and Ceiling Industry (AWCI) EIFS Inspector Certification.
- N. International Code Council (ICC) Commercial Building Inspector Certification.
- O. International Code Council (ICC) Mechanical Inspector Certification.
- P. Inspector has passed either the Underwriters Laboratory (UL) Firestop Contractor Program Examination or the Factory Mutual (FM) Firestop Examination.
- Q. Pre-stressed Concrete Institute (PCI) Certified Field Auditor
- R. Center for Training Transportation Professionals (CTTP) Certified Soil Testing Technician.
- S. American Concrete Institute (ACI) Post-Installed Concrete Anchor Installation Inspector

Notes:

1. *The Special Inspector shall meet one of the minimum qualifications listed for the applicable Category of Testing and Inspection.*
2. *Materials testing shall be done by an Approved Testing Agency meeting the requirements of the Building Code Section 1703 and ASTM E 329.*

SPECIAL INSPECTION REPORT

(Completed by Special Inspector)

PROJECT NAME / ADDRESS:

DATE OF INSPECTION:

INSPECTION TYPE(S) COVERAGE

☐ CONTINUOUS

☐ PERIODIC

TIME BEGINNING INSPECTION:

TIME ENDING INSPECTION:

DESCRIBE INSPECTIONS MADE, INCLUDING LOCATIONS:

LIST TESTS MADE:

LIST ITEMS REQUIRING CORRECTIONS, CORRECTIONS OF PREVIOUSLY LISTED ITEMS AND PREVIOUSLY LISTED UNCORRECTED ITEMS: PROVIDE COPIES OF DISCREPANCY NOTICES:

COMMENTS:

TO THE BEST OF MY KNOWLEDGE, WORK INSPECTED WAS IN ACCORDANCE WITH THE APPROVED DESIGN DRAWINGS, AND SPECIFICATIONS, EXCEPT AS NOTED ABOVE.

PRINTED FULL NAME		
NOTE BY "SPECIAL INSPECTOR" OR PROVIDE NAME OF TESTING AGENCY		
SIGNED:		DATE:
CERTIFICATION:		NUMBER:

One copy of this report to remain at job site with the contractor for review upon request.

SPECIAL INSPECTION DISCREPANCY NOTICE

(Completed by Special Inspector)

PROJECT NAME / ADDRESS:		
INSPECTION TYPE(S) COVERAGE ☐ CONTINUOUS ☐ PERIODIC		
AREA INSPECTED	TYPE OF INSPECTION	
APPLICABLE DRAWING SHEET NUMBER(S) AND/OR SPECIFICATION SECTION:		
NOTICE DELIVERED TO: ☐ CONTRACTOR ☐ ENGINEER/ARCHITECT ☐ OWNER	DATE:	TIME:
MAKE THE FOLLOWING CORRECTIONS AND SECURE INSPECTION APPROVAL PRIOR TO PROCEEDING WITH THIS PHASE OF THE WORK.		
PRINTED FULL NAME		
NOTE BY "SPECIAL INSPECTOR" OR PROVIDE NAME OF TESTING AGENCY		
SIGNED:	DATE:	
CERTIFICATION:	NUMBER:	
DATE RE-INSPECTED AND APPROVED AND SIGNATURE OF SPECIAL INSPECTOR:		

One copy of this report to remain at job site with the contractor for review upon request.

**SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Project identification sign.
- I. Field offices.

1.02 TEMPORARY UTILITIES

- A. Owner will provide the following:
 - 1. Electrical power , consisting of connection to existing facilities.
 - 2. Water supply, consisting of connection to existing facilities.
- B. Provide and pay for all lighting, heating and cooling, and ventilation required for construction purposes.
- C. Existing facilities may not be used.
- D. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.03 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Provide telephone, cellular phone, and high-speed internet connection to jobsite.
- C. Provide on jobsite capacity of viewing and printing out physical copies of electronic versions of construction documents, submittals, RFIs, ASI, etc.

1.04 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

- A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.
- B. Used material may be used for construction fence. Provide duplicate keys of any gate lock to Owner. Contractor to be responsible for maintenance of fence for duration of project.

1.07 SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.08 VEHICULAR ACCESS AND PARKING

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.09 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.10 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction as detailed by Architect.
- B. Erect on site at location established by Architect.
- C. Project Identification Signs:
 - 1. One painted sign, 64 square feet area, bottom 3 feet above ground.
 - 2. Content:
 - a. Project title, logo and name of Owner as indicated on Contract Documents.
 - b. Names and titles of authorities.
 - c. Names and titles of Architect/Engineer.
 - d. Name of Prime Contractor.
 - 3. Graphic Design, Colors, Style of Lettering: Designated by Architect/Engineer.
- D. Sign Materials:
 - 1. Structure and Framing: New wood, structurally adequate.
 - 2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4-inch thick, standard large sizes to minimize joints.
 - 3. Paint and Primers: Exterior quality, two coats; sign background of color as selected.
 - 4. Lettering: Exterior quality paint, contrasting colors as selected.
- E. Installation:
 - 1. Install project identification signs within 15 days after date fixed by Notice to Proceed.
 - 2. Erect at location directed by the Architect.
 - 3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
 - 4. Install signs surface plumb and level, with butt joints. Anchor securely.
 - 5. Paint exposed surfaces of signs, supports, and framing.
- F. Maintenance: Maintain signs and supports clean, repair deterioration and damage.
- G. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore the area.
- H. No other signs are allowed without Owner permission except those required by law.

1.11 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5713
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 31 1000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- B. Section 31 2200 - Grading: Temporary and permanent grade changes for erosion control.
- C. Section 32 1123 - Aggregate Base Courses: Temporary and permanent roadways.

1.03 REFERENCE STANDARDS

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.
- B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2021.
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015.
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021a.
- F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).
- G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
- H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; 1995.
- I. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2015.

1.04 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Best Management Practices Standard: FHWA FLP-94-005.
- C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
 - 2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- E. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

- F. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- G. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.
 - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- H. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 - 1. Prevent windblown soil from leaving the project site.
 - 2. Prevent tracking of mud onto public roads outside site.
 - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- J. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- K. Open Water: Prevent standing water that could become stagnant.
- L. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
 - 1. Obtain the approval of the Plan by authorities having jurisdiction.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Mulch: Use one of the following:
 - 1. Straw or hay.

2. Wood waste, chips, or bark.
 3. Erosion control matting or netting.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Gravel Bags: Bags shall be constructed of a pervious, non-biodegradable material. When filled with gravel, bags shall be approximately 24" long by 12" wide by 6" high. Gravel shall be 1/2" to 1" diameter course aggregate.
- D. Bales: Air dry, rectangular straw bales.
1. Cross Section: 14 by 18 inches, minimum.
 2. Bindings: Wire or string, around long dimension.
- E. Bale Stakes: One of the following, minimum 3 feet long:
1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
 2. Wood, 2 by 2 inches in cross section.
- F. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 2. Permittivity: 0.05 sec^{-1} , minimum, when tested in accordance with ASTM D4491/D4491M.
 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D4632.
 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632.
 6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533/D4533M.
 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- G. Silt Fence Posts: One of the following, minimum 5 feet long:
1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
 2. Softwood, 4 by 4 inches in cross section.
 3. Hardwood, 2 by 2 inches in cross section.
- H. Gravel: See Section 32 1123 for aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
1. Width: As required; 20 feet, minimum.
 2. Length: 50 feet, minimum.
 3. Provide at each construction entrance from public right-of-way.
 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.

1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
 - c. Across the entrances to culverts that receive runoff from disturbed areas.
2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet..
 - b. Slope Between 2 and 5 Percent: 75 feet.
 - c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
 2. Gravel bag inlet sediment traps shall be constructed around sump inlets and upstream of on-grade curb inlets using gravel filter bags to impede silt from entering the inlets. Inlet sediment filters shall be constructed in accordance with the details and at the locations shown on the plans or as directed by the Architect-Engineer.
- E. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- F. Soil Stockpiles: Protect using one of the following measures:
 1. Cover with polyethylene film, secured by placing soil on outer edges.
 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
- G. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
 1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
- H. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:
 1. Excavate minimum of 6 inches.
 2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
 3. Place and compact at least 6 inches of 1 1/2 to 3 1/2 inch diameter stone.
- B. Silt Fences:
 1. Store and handle fabric in accordance with ASTM D4873/D4873M.
 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
 5. Install with top of fabric at nominal height and embedment as specified.
 6. Embed bottom of fabric in a trench on the upslope side of fence, with 2 inches of fabric laid flat on bottom of trench facing upslope; backfill trench and compact.
 7. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
 8. Fasten fabric to wood posts using one of the following:

- a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gauge, 0.083 inch shank diameter.
 - b. Five staples per post with at least 17 gauge, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
9. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
10. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
- C. Straw Bale Rows:
 1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
 2. Install bales so that bindings are not in contact with the ground.
 3. Embed bales at least 4 inches in the ground.
 4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
 5. Fill gaps between ends of bales with loose straw wedged tightly.
 6. Place soil excavated for trench against bales on the upslope side of the row, compacted.
- D. Mulching Over Large Areas:
 1. Dry Straw and Hay: Apply 2-1/2 tons per acre; anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
 2. Wood Waste: Apply 6 to 9 tons per acre.
 3. Erosion Control Matting: Comply with manufacturer's instructions.
- E. Mulching Over Small and Medium Areas:
 1. Dry Straw and Hay: Apply 4 to 6 inches depth.
 2. Wood Waste: Apply 2 to 3 inches depth.
 3. Erosion Control Matting: Comply with manufacturer's instructions.
- F. Temporary Seeding:
 1. When hydraulic seeder is used, seedbed preparation is not required.
 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
 3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
 4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
 5. Incorporate fertilizer into soil before seeding.
 6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
 7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
 8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Straw Bale Rows:
 1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.

2. Remove silt deposits that exceed one-half of the height of the bales.
 3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- E. Clean out temporary sediment control structures weekly and relocate soil on site.
 - F. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect Engineer.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

**SECTION 01 6000
PRODUCT REQUIREMENTS**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Procedures for Owner-supplied products.
- G. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 15 days after date of Agreement.
 - 2. For products specified only by reference standards, list applicable reference standards.
- B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, manufacturer warranties and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- C. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Made of wood from newly cut old growth timber.
- C. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions.
 - 2. If wet-applied, have lower VOC content.
 - 3. Are extracted, harvested, and/or manufactured closer to the location of the project.

4. Have longer documented life span under normal use.
 5. Result in less construction waste.
 6. Are made of recycled materials.
 7. Are Cradle-to-Cradle Certified.
 8. Have a published GreenScreen Chemical Hazard Analysis.
- D. Provide interchangeable components of the same manufacture for components being replaced.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

2.05 WARRANTY

- A. For all products, where no specific extended warranty period has been identified, provide no less than manufacturer's standard warranty for product line for quality grade specified.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

- A. Owner's Responsibilities:
 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 2. Arrange and pay for product delivery to site.
 3. On delivery, inspect products jointly with Contractor.
 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
 1. Review Owner reviewed shop drawings, product data, and samples. Notify Owner and Architect immediately if supplied product affects installed final work.
 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 3. Handle, store, install and finish products.
 4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.

- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- K. Prevent contact with material that may cause corrosion, discoloration, or staining.
- L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

**SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, and selective demolition.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.

1.04 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in the State of Arkansas and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities.

1.05 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.06 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 1. Review conditions of examination, preparation and installation procedures.
 2. Review coordination with related work.

- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, and ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
 - 2. Relocate items indicated on drawings.
 - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access

- or provide access panel.
- 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
- 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
- 4. Verify that abandoned services serve only abandoned facilities.
- 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- D. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
- E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- G. Refinish existing surfaces as indicated:
 - 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 - 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- H. Clean existing systems and equipment.
- I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- J. Do not begin new construction in alterations areas before demolition is complete.
- K. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- J. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.11 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.12 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion. When each item is completed, have each item initialled by Project Superintendent and dated when completed. Include in project closeout documentation.

END OF SECTION

**SECTION 01 7800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Project Completion Documents.
- B. Project Record Documents.
- C. Operation and Maintenance Manuals.
- D. Warranties and bonds.

1.02 SUBMITTALS

- A. Close Out Document Manuals: All information to be scanned to digital format and submitted to Architect. Retain all hard copies for one complete set for the Owner. Submit complete sets of the following:
 - 1. Project Completion Documents:
 - 2. Project Record Documents:
 - 3. Operation and Maintenance Manuals:
- B. Final Application for Payment: Submit fully executed

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT COMPLETION DOCUMENTS

- A. Project Directory: Include list of all Contractors, Owner, Architects, Engineers, Subcontractor and prime material suppliers. List to include trade involved, primary contact name, phone number, mailing address and email address.
- B. Waiver of Liens: Provide for all trades and prime material suppliers.
- C. Warranties: Submit for contractors installation warranty, manufacturer's warranties and warranties for equipment or component parts of equipment. Warranty begins on the date of acceptance
 - 1. Submit for contractors installation warranty, manufacturer's warranties and warranties for equipment or component parts of equipment.
 - 2. Warranties begin on the Date of Substantial Completion, unless delayed or specifically excluded.
 - 3. For items of Work for which acceptance is delayed beyond the Date of Substantial Completion, the listing date of acceptance is the beginning of the warranty period.
 - 4. Verify that documents are in proper form, contain full information, and are notarized.
 - 5. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
- D. Certificate of Substantial Completion: Provide fully executed form with punch list attached.
- E. Contractor's Punch List: Provide completed list of items requiring completion or correction. Include any attachments for revisions provided by Architect and/or Engineer. Punch list should be noted that all items were corrected and completed with trade responsible identified.
- F. Certificate of Occupancy: Provide form as issued for authority having jurisdiction.
- G. Consent of Surety: Provide fully executed surety letter when project has associated bonds provided by contractor.

3.02 PROJECT RECORD DOCUMENTS

- A. Record Drawings : Legibly mark construction drawings with each item to record actual construction including the following:
 - 1. Measured depths of foundations in relation to finish first floor datum.

2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract drawings.
 6. Changes made by Addenda and Change Orders.
 7. Record information concurrent with construction progress.
- B. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda, Change Orders and other modifications.
- C. Addenda: Insure all addenda items have been included and posted to record documents.
- D. Change Orders: Include all executed Change Orders, Allowance purchases and other modifications to the contract.
- E. Submittals, Shop Drawings, Product Data and Samples:
1. Shop Drawings: Include records of manufacturer's instruction for assembly, installation and adjusting.
 2. Product Data: Include list of all products and model number provided.
 3. Samples: Include material samples of all selected interior finishes. Samples to include label indicating manufacturer, product model number, color, finish and other identifying elements. Full color photographs are acceptable for larger samples.
- F. Test Reports and Special Inspections:
- G. Maintain on site a complete set of record documents; record actual revisions to the Work:
- H. Ensure entries are complete and accurate, enabling future reference by Owner.
- I. Store record documents separate from documents used for construction.
- J. Record information concurrent with construction progress.

3.03 OPERATION AND MAINTENANCE MANUAL GENERAL

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.04 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 1. Product data, with catalog number, size, composition, and color and texture designations.
 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.05 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. Provide schedule of all equipment that require instruction on operation and/or continual maintenance. Coordinate instruction for all equipment with Owner and/or Owner's Representative and record name and contact information of all in attendance. Video recording of instructions provided is recommended.
- B. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- D. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Additional Requirements: As specified in individual product specification sections.

3.06 CLOSE OUT DOCUMENT MANUALS

- A. Provide all Close Out information in digital format, saved in PDF files, and neatly organized for ease of navigation. Arrange by Specification Sections as Table of Contents. Architect can provide file format for use as needed.
- B. Where paper documents are provided by manufacturers, scan into records and combine and include into Hard Copy Close Out Documents.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by systems under specification section numbers and sequence of Table of Contents of this Project Manual.

- I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - 1. Operating instructions.
 - 2. Maintenance instructions for equipment and systems.
 - 3. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 4. Air and water balance reports.
 - 5. Certificates.
 - 6. Photocopies of warranties and bonds.
- J. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
- K. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect , Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- L. Arrange digital PDF copies of documents in similar fashion using file folders. Name file type with simple explanation of contents using shortest file names type possible. Provide digital files on flash USB drives.
- M. Provide owner training videos saved electronically and transmitted in USB drives. Provide sign-in sheets for all attendees for Owner Training sessions and include in closeouts.

END OF SECTION

**SECTION 02 7320
SELECTIVE DEMOLITION**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of building or structure.

1.03 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 - 5. Means of protection for items to remain and items in path of waste removal from building.
- B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- C. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Predemolition Conference: Conduct conference at Project site to comply with requirements. Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.06 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area.
Conduct selective demolition so Owner's operations will not be disrupted.
 - 1. Comply with requirements specified in Division 1 Section "Summary."
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify the Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: None Known.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.07 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to the Architect.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.02 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
 - 1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary."
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Building manager will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

4. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.03 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Comply with requirements for access and protection specified in Division 1 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 3. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 1 Section "Temporary Facilities and Controls."

3.04 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 2. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 3. Dispose of demolished items and materials promptly.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.06 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.03 RELATED REQUIREMENTS

- A. Section 01 4533 - Code-Required Special Inspections and Procedures: Code required special tests and inspections.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 04 2900 - Engineered Unit Masonry: Reinforcement for engineered masonry.

1.04 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. ACI MNL-66 - ACI Detailing Manual; 2020.
- C. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- F. CRSI (DA4) - Manual of Standard Practice; 2009.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, location of splices, and mechanical splices and connections. Show additional reinforcing required to hold reinforcing in place.
- C. Plans shall be at 1/8" = 1'-0" or larger scale.
- D. Shop drawings shall be reviewed and stamped by the general contractor prior to submittal. Incomplete shop drawings and shop drawings that have not been reviewed by the general contractor will be returned without review by the architect/engineer.
- E. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI SPEC-301.
 - 1. Maintain one copy of each document on project site.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Deformed billet-steel bars.
 - 2. Unfinished.
- B. Deformed Bar Anchors: Deformed Bar Anchors, A496 or A1064, minimum yield strength 75 KSI
- C. Steel Welded Wire Reinforcement (WWR): Plain type; ASTM A1064/A1064M.

1. Form: Flat Sheets.
 2. Mesh Size and Wire Gage: As indicated on drawings.
- D. Reinforcement Accessories:
1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 3. Provide plastic components for placement within 1-1/2 inches of weathering surfaces.

2.02 RE-BAR SPLICING:

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing 125% of the full steel reinforcing design strength in tension and compression.

2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Welding of reinforcement is not permitted.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress.
- D. Deformed Bar Anchors: The anchors are welded to plates in accordance with Chapter 7 of AWS D1.1, using a stud welding gun. Do not fillet weld deformed bar anchors.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position. All reinforcing bars shall be supported and wired together to prevent displacement by construction loads or the placing of concrete beyond the tolerances noted below.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Welded wire fabric shall have lapped splices made so that the overlap measured between the outermost cross wires of each fabric sheet is not less than the spacing of the cross wires plus 2 inches.
- D. Do not displace or damage vapor barrier.
- E. Accommodate placement of formed openings.
- F. Conform to drawings for concrete cover over reinforcement.
- G. Placement Tolerances: Bars should be placed to the following tolerances: Concrete cover to formed surface: plus or minus 1/4 inch; Minimum spacing between bars: 1/2 inch; Crosswise of members: plus or minus 2 inches; Lengthwise of members: plus or minus 2 inches. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to approval by the Architect/Engineer.
- H. Grouting of dowels into existing concrete shall be done with cement based non-shrink grout mixed and installed as required by the manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 4533 - Code-Required Special Inspections and Procedures, will inspect installed reinforcement for conformance to contract documents before concrete placement.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete formwork.
- B. Concrete for composite floor construction.
- C. Floors and slabs on grade.
- D. Concrete footings, grade beams, elevator shaft wall, foundation walls and site retaining walls.
- E. Joint devices associated with concrete work.
- F. Miscellaneous concrete elements, including equipment pads and light pole bases.
- G. Post-installed anchors
- H. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 01 4533 - Special Inspections: Code required special tests and inspections.
- B. Section 03 2000 - Concrete Reinforcing.
- C. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- D. Section 07 9005 - Joint Sealers: Sealants for saw cut joints and isolation joints in slabs.
- E. Section 09 0561 - Common Work Results for Flooring Preparation: Remediation of slabs with excessive moisture or pH.

1.03 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- C. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.
- D. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- E. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- F. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- G. ACI PRC-308 - Guide to External Curing of Concrete; 2016.
- H. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- I. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- J. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- K. ACI 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary; American Concrete Institute; 2019
- L. ACI 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary; American Concrete Institute; 2019
- M. ASTM C138/C138M - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete; 2017a.
- N. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.
- O. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2021a.

- P. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- Q. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.
- R. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
- S. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.
- T. ASTM C138/C138M - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete; 2017.
- U. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- V. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.
- W. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2016.
- X. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.
- Y. ASTM C231/C231M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method; 2014.
- Z. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- AA. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.
- AB. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2019.
- AC. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.
- AD. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2021.
- AE. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete; 2012.
- AF. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2017.
- AG. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2019.
- AH. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.
- AI. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a, with Editorial Revision (2013).
- AJ. ASTM C 1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012
- AK. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- AL. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.
- AM. COE CRD-C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.
- AN. NSF 61 - Drinking Water System Components - Health Effects; 2020.
- AO. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section. At least the following shall be in attendance at the meeting: Contractor's superintendent, testing agency

responsible for concrete mix design, ready mix concrete manufacturer, concrete subcontractor, floor finishing subcontractor, independent testing agency, special inspector, architect engineer construction administrator, and the structural engineer of record.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
 - 1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
- C. Mix Design: Submit proposed concrete mix designs.
 - 1. Indicate proposed mix designs complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 - 2. Submit mix design for each concrete mix including test results documenting average compressive strength in accordance with ACI 301. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Include manufacturer's data for admixtures included in the mix. Include suppliers data and tests for aggregates and cementitious materials including portland cement, fly ash, and ground granulated blast-furnace slag as applicable.
 - a. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Samples: Submit samples of underslab vapor retarder to be used.
- E. Test Reports: Submit report for each test or series of tests specified.
- F. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.
- G. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
- H. Concrete Delivery Ticket: Submit a sample concrete delivery ticket in accordance with the requirements of ANSI/ASTM C94-03a "Standard Specification for Ready-Mix Concrete."
- I. Concrete Test Results: Submit copies of all concrete test results signed by the testing laboratory.
- J. Concrete Installers and Finishers Qualifications: Submit documentation for ACI certification for concrete flatwork finishers.
- K. Testing Agency Qualifications: Submit qualifications for testing laboratory including certification for field testing technicians and laboratory testing technicians.

1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
 - 1. Maintain at least one copy of each document on site.
- B. Follow recommendations of ACI PRC-305 when concreting during hot weather.
- C. Follow recommendations of ACI PRC-306 when concreting during cold weather.
- D. Testing Agency Qualifications: an independent testing and inspection lab, acceptable to the Architect/Engineer, shall perform specified tests and inspections. The testing lab shall be 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.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- E. Concrete Installers and Finishers Qualifications: Concrete flatwork shall be performed utilizing high quality techniques conforming to American Concrete Institute Standards in ACI Publication

CP-10, Concrete Flatwork Technician and Flatwork Finisher, and ACI Publication CCS-1, Concrete Craftsman Series, Slabs on Grade.

1. All concrete placing and finishing shall be performed by a crew lead by at least one ACI certified Concrete Flatwork Finisher or ACI certified Advanced Concrete Flatwork Finisher.
- F. Concrete Manufacturer: Furnish concrete from a plant complying with the requirements of ASTM C94, Sections 8 & 9 with a current certificate from the National Ready Mixed Concrete Association.
- G. Mix Design Engineer: Licensed to practice engineering in the state where the project is located with a minimum of 3 years experience in preparing concrete mix designs.
- H. Cooperate with the Testing Agency and any special inspectors and provide them with free access to the work.
- I. The testing agency shall verify the correct concrete mix design is being provided at the ready mix plant prior to going to the job site.
- J. For floor slabs, verify concrete admixtures and sealants used are compatible with the applicable designated floor coverings and adhesives.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI PRC-347 to provide formwork that will produce concrete complying with tolerances of ACI SPEC-117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
 2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
 3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
 4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT MATERIALS

- A. Comply with requirements of Section 03 2000 - Concrete Reinforcing.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type 1 - Normal or Type 1L - Blended Portland-Limestone Portland type.
1. Acquire cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C 33, Class 3M.
1. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Stockpile aggregates in a manner that will prevent segregation or contamination with other materials or other size aggregates. Alkali-Silica Reactive (ASR) aggregates are not allowed.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Water: Potable, clean and not detrimental to concrete, conforming to ASTM C 1602/C1602M.

2.04 ADMIXTURES

- A. Chemical Admixture:
1. Manufacturers:
 - a. Euclid.

- b. Sika.
 - c. WR Grace.
 - d. BASF Masterbuilders.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- C. Air Entrainment Admixture: ASTM C260/C260M.
- D. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- E. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- F. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- G. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- H. Accelerating Admixture: ASTM C494/C494M Type C.
- I. Retarding Admixture: ASTM C494/C494M Type B.
- J. Water Reducing Admixture: ASTM C494/C494M Type A.
- K. Store admixtures to avoid contamination, evaporation, or damage. Protect liquids from freezing or other adverse temperatures. Agitate all admixtures used in form of suspension or non stable solutions prior to use. Follow manufacturer's directions.
- L. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.

2.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder: Complying with ASTM E1745, Class A; with a water vapor permeance ratings of 0.01 perms or less when tested in accordance with ASTM E 154 and stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
- B.
 - 1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 - a. Where void forms are used, use tape which also mechanically bonds the vapor retarder to the bottom of the concrete slab, per the manufacturer's instructions.
 - 2. Products:
 - a. Henry Company; Moistop Ultra 15: www.henry.com/#sle.
 - b. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com/#sle.
 - c. Poly-America; Husky Yellow Guard Class A 15-mil Vapor Barrier: www.yellowguard.com/#sle.
 - d. Stego Industries, LLC; Stego Wrap Vapor Barrier (15-mil): www.stegoindustries.com.
 - e. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm): www.wrmeadows.com/#sle.
 - f. Viaflex; VaporBlock VB15: www.viaflex.com
 - g. Substitutions: See Section 01 6000 - Product Requirements.
- C. Non-Shrink Cementitious Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Grout: Comply with ASTM C1107/C1107M.
 - 2. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.
 - 3. Flowable Products:
 - a. Five Star Products, Inc; Five Star Fluid Grout 100: www.fivestarproducts.com/#sle.
 - b. US MIX Co.; US Spec MP Grout: www.usspec.com .
 - c. BASF Corporation - Construction Systems; MasterFlow 928: www.buildingsystems.basf.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

4. Low-Slump, Dry Pack Products:
 - a. Five Star Products, Inc; Five Star Grout: www.fivestarprouducts.com/#sle.
 - b. US MIX Co.; US Spec MP Grout: www.usspec.com.
 - c. BASF Corporation - Construction Systems; MasterFlow 100: www.buildingsystems.basf.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- D. Capillary Water Barrier/Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2 inch sieve and 0 to 5 percent passing a No. 8 sieve.
- E. Dovetail Anchor Slots: Hot-dip galvanized steel sheet not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- F. Post-Installed Anchors
 1. Mechanical Anchors: Tested and qualified for use in accordance with ACI 355.2 and ICC-ES AC193 for cracked and uncracked concrete recognition. Acceptable products include:
 - a. SIMPSON STRONG-TIE "TITEN-HD" and "TITEN HD ROD HANGER" (ICC-ES ESR-2713)
 - b. SIMPSON STRONG-TIE "STAINLESS STEEL TITEN-HD" (IAPMO UES ER-493)
 - c. SIMPSON STRONG-TIE "STRONG-BOLT 2" (ICC-ES ESR-3037)
 - d. HILTI "KWIK HUS-EZ" and "KWIK HUS-EZ I" SCREW ANCHOR (ICC-ES ESR-3027)
 - e. HILTI "KWIK BOLT-TZ" EXPANSION ANCHOR (ICC-ES ESR 1917)
 - f. HILTI "HDA UNDERCUT" (ICC-ES ESR-1546)
 - g. HILTI "HSL-3" EXPANSION ANCHOR (ICC-ES ESR-1545)
 - h. DEWALT "POWER-STUD+ SD1" (ICC-ES ESR-2818)
 - i. DEWALT "POWER-STUD+ SD2, SD4 or SD6" (ICC-ES ESR-2502)
 - j. DEWALT "SCREW-BOLT+" (ICC-ES ESR-3989)
 - k. DEWALT CCU+ (ICC-ES ESR 4810)
 - l. DEWALT SNAKE+ (ICC-ES ESR 2272)
 - m. DEWALT MINI UNDERCUT+ (ICC-ES ESR 3912)
 - n. DEWALT HANGER-MATE+(ICC-ES ESR 3889)
 2. Adhesive Anchors: Tested and qualified for use in accordance with ACI 355.4 and ICC-ES AC308 for cracked and uncracked concrete recognition. Acceptable products include:
 - a. SIMPSON STRONG-TIE "SET-3G" (ICC-ES ESR-4057)
 - b. SIMPSON STRONG-TIE "AT-3G" (ICC-ES ESR-5026)
 - c. HILTI "HIT-HY 200 SAFESET FAST CURE" (ICC-ES ESR-3187)
 - d. HILTI "HIT-RE 500-SD SLOW CURE" (ICC-ES ESR-2322)
 - e. DEWALT "AC200+" (ICC-ES ESR-4027)
 - f. DEWALT "PURE 110+" (ICC-ES ESR-3928)
 - g. Steel anchor element shall be Hilti HAS-E, ASTM F1554 Grade 36, or ASTM A193, Grade B6, B8, or B8M continuously threaded rod.
 3. Substitution requests for products other than those specified shall be submitted by the Contractor to the Architect Engineer along with calculations that are prepared and sealed by a registered professional engineer licensed in the State in which the project is located. The calculations shall demonstrate that the substituted product is capable of achieving the pertinent equivalent performance values (minimum) of the specified product using the appropriate design procedures and/or standard(s) as required by the building code.
- G. Steel-Reinforced Plastic Trowel Blades for use at Decorative Exposed Surfaces.
 1. Manufacturers:
 - a. Wagman Metal Products; Poly Pro reinforced trowel blades; www.wagmanmetal.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.06 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
- B. Epoxy Bonding System:
 - 1. Complying with ASTM C881/C881M and of Type required for specific application.
- C. PVC Waterstops: Complying with COE CRD-C 572.
 - 1. Configuration: For applications where exterior final grade is less than 4'-0" above the base of the wall, provide a minimum 4 inch wide waterstop. Where final grade is greater than 4'-0" above the base of the wall, provided a minimum 6 inch wide waterstop.
 - 2. Products:
 - a. BoMetals, Inc; RCB-4316 / RCB-6316: www.bometals.com/#sle.
 - b. Sika; Greenstreak 701 / 703.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- D. Hydrophilic Waterstops: Rectangular or trapezoidal strips manufactured from butyl rubber with sodium bentonite or other hydrophilic polymers, complying with NSF 61 and NSF 372.
 - 1. Configuration: For concrete elements less than 8 inches in width, provide 3/4 inch by 3/8 inch continuous strips. For concrete elements 8 inches and greater in width, provide a minimum 3/4 inch by 3/4 inch continuous strip.
 - 2. Products:
 - a. TREMCO Superstop
 - b. W. R. Meadows Waterstop EC
 - c. CETCO Waterstop-RX
 - d. Sika Swellstop
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- E. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
 - 1. Size: As indicated on drawings.
- F. Slab Isolation Joint Filler: 1/2-inch thick, height equal to slab thickness, with removable top section forming 1/2-inch deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber.
- G. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.
 - 1. Products:
 - a. W. R. Meadows, Inc; Speed-E-Joint: www.wrmeadows.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- H. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.
 - 1. Provide removable or non-removable plastic cap based on slab exposure, floor finish and manufacturer's recommendations. Removable plastic caps shall form a minimum 3/8" wide by 1/2" deep void for sealant.
 - 2. Height: To suit slab thickness.
- I. Sealant and Primer: As specified in Section 07 9200 - Joint Sealants.
- J. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95, according to ASTM D 2240.

2.07 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
 - 1. Products:

- a. Dayton Superior Corporation; AquaFilm: www.daytonsuperior.com/#sle.
 - b. Euclid Chemical Company ; EUCOBAR: www.euclidchemical.com/#sle.
 - c. SpecChem, LLC; SpecFilm Concentrate or SpecFilm: www.specchemllc.com/#sle.
 - d. W. R. Meadows, Inc; Evapre or Evapre-RTU: www.wrmeadows.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
- 1. Application: Use only at slabs scheduled to receive stain.
 - 2. Product dissipates within 4 to 6 weeks.
 - 3. Verify compatibility with final finish.
- C. Curing and Sealing Compound, High Gloss: Liquid, membrane-forming, clear, nonyellowing acrylic; complying with ASTM C1315 Type 1 Class A.
- 1. Application: Use at concrete slabs exposed in final construction but not scheduled to receive polishing or stain.
 - 2. A minimum of 2 coats are required. The first coat for curing and the second coat for sealing after all construction debris is removed.
 - 3. Vehicle: Solvent-based.
 - 4. Solids by Mass: 25 percent, minimum.
 - 5. VOC Content: Ozone Transport Commission (OTC) compliant.
- D. Moisture-Retaining Sheet: ASTM C171.
- 1. Regular curing paper, white curing paper, clear polyethylene, white polyethylene, or white burlap-polyethylene sheet.
- E. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
- 1. For trial mixtures method, employ independent testing agency acceptable to Architect Engineer for preparing and reporting proposed mix designs.
 - 2. Test reports verifying the concrete strength must be submitted with mix designs for approval.
- C. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.
- D. For floor slabs, verify components of mix design are compatible with the flooring materials and adhesives.
- E. Normal Weight Concrete:
- 1. Water-Cement Ratio: As indicated in Concrete Mixture Schedule.
 - 2. Air Content, when determined in accordance with ASTM C231: As indicated in Concrete Mixture Schedule for mixes where Air-entrainment is required.
 - 3. Maximum Slump: As indicated in Concrete Mixture Schedule before the addition of any water reducing admixture, but no more than 8 inches after the addition of any water reducing admixture. Higher slumps may be acceptable in self consolidating concrete or flowing concrete applications with the approval of the Architect Engineer.
 - 4. Maximum Aggregate Size: As indicated in Concrete Mixture Schedule.
 - 5. Fly Ash Content: Fly Ash shall not be used in concrete for slabs. Maximum 25 percent of cementitious materials by weight for other concrete.
 - 6. Water-Cement Ratio: As indicated in Concrete Mixture Schedule.
 - 7. Maximum Aggregate Size: [As indicated in Concrete Mixture Schedule.]

2.09 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.

- B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.
- C. Mixing Time: Mix and place concrete within 1 1/2 hours of initial batching of the concrete. When the air temperature is between 85 and 90 degrees F reduce the maximum time between batching and placing the concrete to 75 minutes. When the air temperature is above 90 degrees F reduce the batching and placing time to 60 minutes. Longer mix times may be possible with the use of appropriate admixtures but only with written approval of admixture manufacturer(s) and Architect/Engineer.
- D. Addition of Water at Job Site: Unless the delivery ticket states the amount of water that can be added without exceeding the design water cement ratio and the slump of the mix, water cannot be added at the job site. Addition of water above the design water/cement ratio shall be cause for rejection of the concrete.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.
- B. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete. Chamfer exterior corners and edges of permanently exposed concrete. Comply with Division 1 requirements for certified wood used for formwork and disposal of construction waste.
- C. Verify that forms are clean and free of rust before applying release agent.
 - 1. Where as-cast finishes are required do not use materials on the face of the form that will impart a stain to the concrete. Where the finished surface is required to be coated, the material applied to the form surfaces shall be compatible with the type of coating to be used.
- D. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
 - 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
 - 2. Use latex bonding agent only for non-load-bearing applications.
- F. Interior Slabs: Install vapor retarder under interior slabs per ASTM E 1643 and the manufacturer's written instructions. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Use manufacturer's recommended pipe boot and tape to seal vapor retarder to all pipes, conduits, and other elements that penetrate slabs-on-grade. Repair damaged vapor retarder before covering per manufacturer's instructions. Where slab is poured over void forms, mechanically bond the vapor retarder to the underside of the slab with textured tape per manufacturer's instructions.
 - 1. Extend vapor retarder over footings and seal to foundation wall, grade beam, or slab at an elevation consistent with the top of the slab or terminate at impediments such as water stops or dowels. Seal around penetrations such as utilities and columns in order to create a monolithic membrane between the surface of the slab and moisture sources below the slab as well as at the slab perimeter.
 - 2. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 PLACING CONCRETE

- A. Do not add water to concrete during delivery at Project site unless amount that can be added without exceeding the water/cement ratio is stated on the delivery ticket. If water is allowed to be added it must be introduced and mixed inside the transit mixer drum for 5 minutes or 70 revolutions before the concrete leaves the truck.
- B. Place concrete in accordance with ACI PRC-304.
 - 1. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301. Do not use vibrators to transport concrete inside of forms.
- C. Place concrete for floor slabs in accordance with ACI PRC-302.1.
 - 1. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel of section is complete. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- D. Notify Architect Engineer not less than 24 hours prior to commencement of placement operations.
- E. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- F. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- G. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- H. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.
- I. Cold Weather: When the temperature is below 40 degrees F maintain concrete temperature between 50 and 70 degrees F for the required curing period. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Do not use calcium chloride, salt, or other materials containing antifreeze agents. Do not use chemical accelerators unless approved by the Architect/Engineer and included in the mix designs. Follow recommendations of ACI 306R.
- J. Hot Weather: When the temperature is over 85 degrees F, maintain the concrete below 90 degrees F at the time of placement. Make arrangements for installation of windbreaks, shading, fog spraying, sprinkling, ponding, or other protective measures to protect the concrete. Fog spray forms, steel reinforcement, and subgrade just before placing concrete. Keep the subgrade uniformly moist without standing water, soft spots, or dry areas. Follow recommendations of ACI 305R.

3.04 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
 - 1. Install wherever necessary to separate slab from other building members, including walls, equipment foundations, footings, stairs, sumps, and drains.
- D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.

1. Form weakened-plane contraction joints in layout indicated. Provide keyed joints at construction joints and where indicated. Other joints may be keyed joints or sawn joints.
- E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
 1. Saw joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints in concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- F. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant. Install per manufacturer's recommendations.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. An independent testing agency, as specified in Section 01 4000 - Quality Requirements, will inspect finished slabs for conformance to specified tolerances.
- B. Maximum Variation of Surface Flatness:
 1. Exposed Concrete Floors: 1/4 inch in 10 feet.
 2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
 3. Under Carpeting: 1/4 inch in 10 feet.
- C. Correct the slab surface if tolerances are less than specified.
- D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 JOINTS - OTHER THAN SLABS

- A. General: Construction joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect/Engineer.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated or at 20 foot maximum on center if not indicated.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.07 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints where indicated to form a continuous diaphragm. Install in longest lengths practical. Support and protect waterstops during progress of the work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practical.

3.08 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
 1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

- D. Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
 - 1. Surfaces to Receive Thin Floor Coverings: "Light steel-troweled" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, thin set quarry tile, and thin set ceramic tile.
 - 2. Decorative Exposed Surfaces: "Normal steel-troweled" as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to be polished, and all other slab surfaces.
 - 3. Other Surfaces to Be Left Exposed: Trowel as described in ACI PRC-302.1, minimizing burnish marks and other appearance defects.
- E. In areas with floor drains, unless noted otherwise, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.

3.09 CURING AND PROTECTION

- A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 - 1. Normal concrete: Not less than seven days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Slabs scheduled to receive Adhesive-Applied Flooring or other moisture sensitive flooring: Slab shall be cured by being covered with moisture retaining sheets (curing paper, polyethylene, or a combination of the two) for 3 to 7 days. Slabs shall not be cured by adding water. Curing compounds are not allowed.
 - 1. Floor slabs shall meet the requirements of Section 090561 prior to installation of floor coverings.
- E. Slabs scheduled to receive stain: Curing shall be accomplished by damp curing, sheet curing, or a dissipating curing compound compatible with the stain system.
- F. Slabs on grade exposed in final construction, not subject to wheel traffic (such as forklifts or pallet jacks) and not scheduled to receive stain: Curing shall be by a curing and sealing compound.
 - 1. Curing and sealing compound: Apply uniformly to floors and slabs in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during the curing period. Clean the top of the slab and provide a final coat to seal the slab before the final acceptance by the owner.
- G. Protection of work: Protect all work from damage from concreting operations. Protect completed concrete as follows:
 - 1. Finished Surfaces: Protect from damage from rain. Keep surfaces clean and free from oil, grease, dirt, or other foreign matter and protect from damage by construction equipment, materials, etc. Do not permit heavy traffic on finished floor for a minimum of 7 days after it is placed. Install barriers and if necessary maintain a watchman to enforce this requirement. Do not cut pipe on slabs to be exposed in final construction. Diaper all equipment working over slabs to receive stain to prevent oil leakage.
 - 2. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

3.10 REMOVAL AND REUSING FORMS

- A. Removal of forms:
 - 1. Formwork not supporting the weight of the concrete, such as sides of beams, walls, column, and other similar part of the work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete provided the concrete is

sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

2. Formwork supporting the weight of the concrete, such as beam, soffits, and slabs, may not be removed in less than 14 days after the concrete is placed and until concrete has attained 80 percent of its minimum compressive strength at 28 days.
- B. Reusing forms:
1. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form release agent.
 2. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by the Architect/Engineer.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as here-in specified, to blend with in-place construction.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.
- C. Equipment Bases And Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnished machines and equipment.
- D. Steel Column Base Plates: Grout base plates and foundations as indicated on drawings using specified non-metallic non-shrink grout. Use flowable grout for column base plates.
- E. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces with light broom finish.
- F. Post-installed anchors:
1. Shall only be used where specified on the construction documents. The contractor shall obtain approval from the Architect/Engineer prior to installing post-installed anchors in place of missing or misplaced cast-in-place anchors.
 2. Care shall be taken in placing post-installed anchors to avoid conflicts with existing rebar.
 3. Hole shall be drilled and cleaned in accordance with the manufacturer's written instructions.
 4. Provide continuous or periodic inspection for all adhesive and mechanical anchors per the product's applicable ICC-ES Evaluation Report (ICC-ES ESR) OR IAPMO UES EVALUATION REPORT (IAPMO UES ER).
 5. Contact manufacturer's representative for the initial training for installation of and for product related questions and availability. Call SIMPSON STRONG-TIE at (800) 999-5099. Call HILTI at (800) 423-6587. Call DEWALT at (800) 524-3244.
 6. The contractor shall arrange an anchor manufacturer's representative to provide on-site installation training for all of their anchoring products specified. The Architect Engineer must receive documented confirmation that all of the contractor's personnel who install anchors are trained prior to the commencement of installing anchors.

3.12 JOINT FILLER

- A. Slab on Grade Control Joint Filler: At keyed construction joints, sawn joints, and tooled joints fill the control joint as follows:
1. Slabs exposed to view in final construction: Remove the cap at keyed control joints, clean the joint and fill the void with semi-rigid joint filler. Install in accordance with manufacturer's written instructions.

2. Slabs to be covered with tile: Remove the cap at keyed control joints, clean the joint, and fill the joint and any spalls or other slab imperfections with non-shrink grout or a concrete patching material a minimum of 56 days after the slab has been poured.
3. Slabs to be covered with carpet: Leave the cap at keyed control joints. Do not fill the joint except where the joint is greater than 1/8" in width and as required to fill spalls and other imperfections in the slab that may damage or show through the carpet. Clean the spall and joint in those areas and fill with non-shrink grout or a concrete patching material.

3.13 FIELD QUALITY CONTROL

- A. An independent testing agency shall perform field quality control tests, as specified in Section 01 4533 - Special Inspections.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. The testing agency shall verify the correct concrete mix design is being provided at the ready mix plant prior to going to the job site.
- E. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- F. Concrete Test Samples: Samples for acceptance tests on concrete shall be obtained in accordance with ASTM C172C172M.
- G. Compressive Strength Tests: ASTM C39/C39M.
 1. Make and cure test specimen in accordance with ASTM C31/C31M.
 2. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cu yd of concrete, nor less than once for each 5000 sq ft of surface area for slabs or walls
 3. A strength test shall be the average of the strengths of at least two 6 by 12 in. cylinders or at least three 4 by 8 in. cylinders made from the same sample of concrete and tested at 7 and 28 days. Test additional cylinders at 56 days if the average 28 day strength is less than the specified design strength.
 4. Take one additional test cylinder set during cold weather concreting, cured on job site under same conditions as concrete it represents.
- H. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
- I. Perform one air content test in accordance with ASTM C231C231M for each strength test of concrete.
- J. Determine temperature of concrete sample for each strength test in accordance with ASTM C1064/C1064M.
- K. Determine density (unit weight) and yield of concrete sample for each strength test in accordance with ASTM C138/C138M.

3.14 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect Engineer and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect Engineer for each individual area.
- E. Repair of Formed Surfaces: Surface defects include color and texture irregularities, crack, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Cut out honeycombs, rock

pockets, and voids more than 1/2 inch in any dimension in solid concrete. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush coat holes and voids with bonding agent. Fill and compact with patching mortar before the bonding agent has dried. Remove and replace concrete defective surfaces if defects cannot be repaired to satisfaction of Architect/Engineer.

- F. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surfaced plan to tolerances specified for each surface and finish. Correct high areas by grinding after concrete has cured at least 14 days. Correct low areas immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete.

3.15 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

3.16 CONCRETE MIXTURE SCHEDULE

- A. Use: Footings
 1. Compressive Strength (fc) Minimum at 28 Days, PSI: 3500
 2. Aggregate Size Maximum, inches (Note: 1): 1-1/2
 3. Slump Limit, inches: 4
 4. Water to Cement (w/c) Ratio Maximum: 0.48
 5. Air Content, percent: None
- B. Use: Reinforced Walls and Grade Beams
 1. Compressive Strength (fc) Minimum at 28 Days, PSI: 4500
 2. Aggregate Size Maximum, inches (Note: 1): 1-1/2
 3. Slump Limit, inches: 4
 4. Water to Cement (w/c) Ratio Maximum: 0.45
 5. Air Content, percent: 5.5
- C. Use: Interior Slab-on-Grade
 1. Compressive Strength (fc) Minimum at 28 Days, PSI: 3500
 2. Aggregate Size Maximum, inches (Note: 1): 1
 3. Slump Limit, inches: 4
 4. Water to Cement (w/c) Ratio Maximum: 0.45 (0.40 at slabs with floor coverings)
 5. Air Content, percent: None
- D. Use: Floor Slab on Steel Deck
 1. Compressive Strength (fc) Minimum at 28 Days, PSI: 3500
 2. Aggregate Size Maximum, inches (Note: 1): 1/2
 3. Slump Limit, inches: 4
 4. Water to Cement (w/c) Ratio Maximum: 0.45 (0.40 at slabs with floor coverings)
 5. Air Content, percent: None
- E. Use: Exterior Slabs and Pads
 1. Compressive Strength (fc) Minimum at 28 Days, PSI: 4500
 2. Aggregate Size Maximum, inches (Note: 1): 1
 3. Slump Limit, inches: 4
 4. Water to Cement (w/c) Ratio Maximum: 0.45
 5. Air Content, percent: 6
 6. Floor/Slab Finish: Broom finish
- F. Notes:
 1. Maximum size of coarse aggregates: Comply with ACI 301 for minimum clearance between reinforcing bars, sides of forms, and slab or topping thickness (except in unbonded topping maximum aggregate size shall not exceed one-quarter topping thickness).
 2. Air Content, when determined in accordance with ASTM C231: As indicated in Concrete Mixture Schedule for mixes where Air-entrainment is required.

3. Maximum Slump: As indicated in Concrete Mixture Schedule before the addition of any water reducing admixture, but no more than 8 inches after the addition of any water reducing admixture. Higher slumps may be acceptable in self consolidating concrete or flowing concrete applications with the approval of the Architect Engineer.

END OF SECTION

**SECTION 03 3511
CONCRETE FLOOR FINISHES**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.04 MOCK-UP

- A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- B. Mock-Up Size: 10 feet square.
- C. Locate where directed and may remain as part of final work.

1.05 DELIVERY, STORAGE, AND HANDLING

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

1.06 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.
- B. Maintain ambient temperature of 50 degrees F minimum.

PART 2 PRODUCTS

END OF SECTION

**SECTION 04 0100
MASONRY CLEANING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water and Chemical cleaning of masonry (brick & sandstone) surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 04 0500 - Masonry Restoration

1.03 PRICE AND PAYMENT PROCEDURES

- A. Chemical Cleaning: By the square foot.

1.04 REFERENCE STANDARDS

- A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; American Concrete Institute International; 2008.
- C. IMIAWC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.
- D. IMIAWC (HW) - Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
 - 1. Require attendance of parties directly affecting work of this section.
 - 2. Review conditions of installation, installation procedures, and coordination with related work.
- B. Scheduling:
 - 1. Perform cleaning and washing of masonry between the hours of 7 am to 11 pm only. Schedule work with Owner to facilitate use of site by visitors and staff, minimize disruption of access to Cane Hill Church and adjacent buildings.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on cleaning compounds.
- C. Manufacturer's Instructions: For cleaning materials, indicate special procedures, conditions requiring special attention.

1.07 QUALITY ASSURANCE

- A. Cleaning: Company specializing in masonry cleaning with minimum three years of documented experience.

1.08 MOCK-UP

- A. Clean a 10 ft by 10 ft panel of masonry areas to determine extent of cleaning and chemical agents required.
 - 1. Repeat, using different cleaning methods for up to three different panels.
- B. Locate where directed.
- C. Acceptable panels and procedures employed will become the standard for work of this section.
- D. Mock-up may remain as part of the Work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry cleaning materials neatly stacked and tied on pallets. Store clear of ground with adequate waterproof covering.

1.10 FIELD CONDITIONS

- A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Restoration and Cleaning Chemicals:
 - 1. PROSOCO; Product Restoration Cleaner (masonry): www.prosoco.com/#sle.
 - 2. PROSOCO ; Product Sure Klean 600 Detergent (tuckpointed masonry cleaning).
 - 3. PROSOCO ; Product Sure Klean Ferrous Stain Remover (chemical cleaning for specific areas of metallic/iron stains).
 - 4. PROSOCO; Product Sure Klean Limestone / Masonry Prewash 766 (heavily soiled areas on limestone, cast stone, concrete). Use with Limestone / Masonry Afterwash, Restoration Cleaner, or Limestone Restorer.
 - 5. PROSOCO; Product Limestone Cleaner 942
 - 6. PROSOCO; Product Sure Klean Limestone Restorer
 - 7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CLEANING MATERIALS

- A. Prosoco Enviro Klean EK Restoration Cleaner.
- B. Prosoco Sure Klean Limestone Restorer.
- C. Cleaning Agents: carbon solubizer (restoration - power wash) type. ProSoCo Sure Klean Restoration Cleaner, Limestone Restorer.
- D. Masonry / Pointed Joints: ProSoCo Sure Klean 600 Detergent. Use at newly tuckpointed areas.
- E. Ferrous Stains; ProSoCo Sure Klean Ferrous Stain Remover.

END OF SECTION

**SECTION 04 0500
MASONRY RESTORATION**

PART 1: GENERAL

1.01 SCOPE:

- A. Perform all masonry (brick and stone), repair and tuck-pointing as indicated on the drawings and as specified herein.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS:

- A. Sealants Section 07 9200
- B. Mockups, Submittals and Substitutions Section 01 3000

1.03 QUALITY ASSURANCE:

- A. Qualifications of Manufacturer: Use products for the work of this section produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.
- B. Qualifications of Workmen: 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.
- C. Provide one skilled journeyman mason who shall be present at all times during tuck-pointing operations.
- D. Field Constructed Mock-up: Prior to restoration of masonry, restore a sample wall to verify selections of mortar texture, mortar color, correct removal of existing mortar joints, to represent completed masonry restoration work for qualities of appearance, materials and construction; build mock-up to comply with the following requirements.
 - 1. Restore sample wall using materials and methods intended to match existing adjacent brickwork.
 - 2. Obtain Architect's acceptance of visual qualities of mock-up before start of masonry work. Retain mock-up and use as quality standard until work is completed.

1.04 SUBMITTALS:

- A. General: Comply with the pertinent provisions of Section 01 3000.
- B. Product Data: Submit the following to the Architect for approval:
 - 1. Manufacturer's specifications and other data required to demonstrate compliance with the specified requirements.
 - 2. Samples of proposed tuck-pointing mortar for approval of color and texture.
- C. Mortar Analysis Report: Several samples of existing masonry mortar (selected by architect) have been sent to the following company for a chemical and material analysis: Wollenberg Building Conservation, LLC. 314-645-4949. Analysis includes identification of materials used, and quantities of materials of the original mortar. A copy of the report follows this specification.

1.05 PRODUCT HANDLING:

- A. Delivery and Storage:
 - 1. Handle and store in such manner as to prevent damage or disfigurement. Store items and components subject to environmental damage above ground on pallets, platforms, or other supports and protect from elements and physical damage by adequate cover.
 - 2. Deliver mortar material in original unopened containers bearing label identifying manufacturer's name and brand.
 - 3. Protection: The installer shall protect any existing work subject to damage during installation of specified work and shall adequately protect specified work during installation. Finished work that is readily subject to damage by subsequent work or environmental conditions shall be protected by the installer immediately following the installation thereof.

4. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.01 MORTAR MATERIALS: COMPLY WITH THE FOLLOWING:

- A. Masonry Cement: ASTM C-91, Type II.
- B. Portland Cement: ASTM C-150.
- C. Hydrated Lime: ASTM C-207, Type S.
- D. Aggregate for Grout: ASTM C-404.
- E. Fine Aggregate: ASTM C-404.
- F. Water: Clean and free of deleterious amounts of acids, alkalies, or organic materials.
- G. Mortar Mix: Match chemical analysis of existing mortar.
- H. Mortar Tint: Shall be Sonobrite as manufactured by Sonneborn Division of Contech, Inc.

2.02 SEALANTS:

- A. Refer to Section 07 9200.

PART 3: EXECUTION

3.01 INSPECTION:

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

3.02 PROTECTION:

- A. Take all necessary precautions, erect all required shields, protective coverings, etc. to prevent adjacent materials and surfaces from being damaged during the execution of this portion of the work.

3.03 REPOINTING / RELAYING EXISTING BRICK:

- A. Have sample of existing mortar chemically tested and analyzed for composition.
- B. Match the existing mortar as closely as possible for composition, color, and texture. Furnish sample for architects approval before starting work.
- C. Carefully examine the joints of all exterior masonry. Repoint all joints having cracked, loose, or disintegrated mortar as called for on the plans.
- D. Remove all damaged or cracked mortar to a depth of at least 1-1/2 times the width of the joint.
- E. Repoint to match existing original mortar color, texture, and tooling. Add a small amount of pigment to achieve the weathered color. Use only pigments which are pure mineral oxides (because they will not fade or leach out of the mortar). In no event shall the pigment exceed two percent (2%) of the mortar mix by weight.
- F. All repointed joints shall be brushed clean and pointed with mortar in two (2) stages to a flat cut joint. When "thumbprint" hard, the joints and beds shall be tooled to match original work. Point in two (2) stages to seal the shrinkage cracks.
- G. Power tools for removing existing mortar are expressly prohibited. Hand tools must be used and in a method that does not chip, sear, or deface the stone in any way.
- H. Percentage of tuckpointing and relaying: As indicated on drawings.

3.04 REPOINTING / RELAYING EXISTING STONE:

- A. Refer to mortar analysis report that follows this spec for required mix ratio.
- B. Match the existing mortar as closely as possible for composition, color, and texture. Furnish sample for architects approval before starting work.

- C. Carefully examine the joints of all exterior stone / brick. Repoint all joints having cracked, loose, or disintegrated mortar as called for on the plans.
- D. Remove all damaged or cracked mortar to a depth of at least 1-1/2 times the width of the joint.
- E. Repoint to match existing original mortar color, texture, and tooling. Add a small amount of pigment to achieve the weathered color. Use only pigments which are pure mineral oxides (because they will not fade or leach out of the mortar). In no event shall the pigment exceed two percent (2%) of the mortar mix by weight.
- F. All repointed joints shall be brushed clean and pointed with mortar in two (2) stages to a flat cut joint. When "thumbprint" hard, the joints and beds shall be tooled to match original work. Point in two (2) stages to seal the shrinkage cracks.
- G. Power tools for removing existing mortar are expressly prohibited. Hand tools must be used and in a method that does not chip, sear, or deface the stone (or brick) in any way.
- H. Percentage of tuckpointing and relaying: As indicated on drawings.

END OF SECTION

**SECTION 04 0511
MASONRY MORTARING AND GROUTING**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

1.02 REFERENCE STANDARDS

- A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- B. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2010.
- C. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- F. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- I. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2011b.
- J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- K. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- L. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.
- M. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.
- N. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2013.
- O. ASTM C1072 - Standard Test Method for Measurement of Masonry Flexural Bond Strength; 2013.
- P. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2008).
- Q. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2014.
- R. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2014.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Submit packaged dry mortar manufacturer's installation instructions.

1.04 PRECONSTRUCTION TESTING

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

- B. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.
- C. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.

1.05 DELIVERY, STORAGE, AND HANDLING

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

1.06 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

- A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.

2.02 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - 1. Type: Types as scheduled in this section.
 - 2. Color: Mineral pigments added as required to produce approved color sample.
 - 3. Manufacturers:
 - a. Substitutions: See Section 01 6000 - Product Requirements.
- B. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
- C. Portland Cement: ASTM C150/C150M.
 - 1. Type: Type I - Normal; ASTM C150/C150M.
 - 2. Color: Standard gray.
- D. Masonry Cement: ASTM C91/C91M.
 - 1. Type: Type N; ASTM C91/C91M.
- E. Blended Masonry and Portland Cement Grout: ASTM C476.
- F. Packaged Dry Mortar: ASTM C387/C387M, Type N or S, using gray or white color cement as required to achieve desired mortar color.
- G. Hydrated Lime: ASTM C207, Type S.
- H. Quicklime: ASTM C5, non-hydraulic type.
- I. Mortar Aggregate: ASTM C144.
- J. Grout Aggregate: ASTM C404.
- K. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 - 1. Color(s): To match Architect's sample(s) when incorporated into specified mix design(s).
 - 2. Manufacturers:
 - a. Davis Colors: www.daviscolors.com/#sle.
 - b. Lambert Corporation: www.lambertusa.com/#sle.
 - c. Solomon Colors: www.solomoncolors.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- L. Water: Clean and potable.
- M. Bonding Agent: Latex type.

- N. Integral Water Repellent Admixture: Polymeric liquid admixture added to mortar at the time of manufacture.
1. Performance of Mortar with Integral Water Repellent:
 - a. Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours:
 - 1) No water visible on back of wall above flashing at the end of 24 hours.
 - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
 - 3) No more than 25 percent of wall area above flashing visibly damp at end of test.
 - b. Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
 - c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
 - d. Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
 2. Use only in combination with masonry units produced with integral water repellent admixture.

2.03 MORTAR MIXES

- A. Ready Mixed Mortar: ASTM C1142, Type RN.
- B. Mortar for Unit Masonry: ASTM C270, Property Specification.

2.04 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, re-temper only within two hours of mixing.

2.05 GROUT MIXES

- A. Bond Beams, Lintels, and Reinforced Cells: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
 1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.

2.06 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.
- C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- D. Do not use anti-freeze compounds to lower the freezing point of grout.

END OF SECTION

SECTION 04 2000 UNIT MASONRY

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Concrete building brick.
- C. Concrete facing brick.
- D. Clay facing brick.
- E. Reinforcement and anchorage.
- F. Flashings.
- G. Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2011.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- F. ASTM C55 - Standard Specification for Concrete Building Brick; 2011.
- G. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2018.
- H. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- I. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2011.
- J. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.
- K. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
- L. ASTM C1634 - Standard Specification for Concrete Facing Brick; 2011.
- M. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2005.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers. Mock-up to be complete and approved prior to scheduling meeting.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.

1.05 MOCK-UP

- A. Construct a masonry wall as a mock-up panel sized 6 feet long by 6 feet high; with full masonry system to include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), wall insulation, and final cleaning in mock-up.
- B. Locate where directed.
- C. Mock-up may not remain as part of the Work, unless approved by Architect.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Handle and store ceramic glazed masonry units and pre-faced concrete block units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
 - 2. Special Shapes: Provide non-standard blocks configured for corners.
 - a. Provide bullnose units for outside corners.
 - 3. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block, as indicated.
 - 4. Non-Loadbearing Units: ASTM C129.
- B. Concrete Brick:
 - 1. Size: As indicated on drawings.
 - 2. Concrete Building Brick: ASTM C55; lightweight, solid, for interior or concealed use.
 - 3. Concrete Facing Brick: ASTM C1634; solid, lightweight; for architectural, paver, and below grade use.

2.02 BRICK UNITS

- A. Manufacturers:
 - 1. Acme Brick Company; : www.brick.com
 - 2. Belden Brick; _____: www.beldenbrick.com/#sle.
 - 3. Meridian Brick LLC; Athens Architectural Series: www.meridianbrick.com/#sle.
 - 4. Substitutions: See section 01 6000 - Product Requirements.
- B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
 - 1. Color and texture: **THIS NEEDS TO BE MANUALLY ENTERED.**
 - 2. Nominal size: As indicated on drawings.
 - 3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

2.03 MORTAR AND GROUT MATERIALS

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

2.04 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
 - 1. Blok-Lok Limited: www.blok-lok.com.
 - 2. Hohmann & Barnard, Inc; www.h-b.com/#sle.
 - 3. WIRE-BOND www.wirebond.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi), deformed billet bars; galvanized.

- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss or ladder.
 - 2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
 - 3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
- E. Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss.
 - 2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
 - 3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
- F. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss, with adjustable ties or tabs spaced at 16 in on center.
 - 2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
 - 3. Size: 0.1875 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire, width of components as required to provide not less than 5/8 inch of mortar coverage from each masonry face.
- G. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Concrete or CMU backing: Dovetail anchors of bent steel strap, nominal 1 inch width x 0.024 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dipped galvanized to ASTM A 153/A 153M, Class B, installed in recessed dovetail slot or surface mounted to face of wall.
 - 2. Steel or Wood Stud backing: 2 piece anchor designed for use with continuous insulation and contains gasketing for sealing at weather barrier penetration.
 - a. Manufacturers:
 - 1) Hohmann and Barnard: 2-seal or approved equal. www.h-b.com.
 - 2) Rodenhouse: Pos-i-tie Veneer Anchoring System. Thermal Grip Brick Tie Washer. www.rodenhouse-inc.com
 - 3) Heckmann Building Products: Pos-i-tie Veneer Anchoring System. www.heckmannbuildingprods.com
 - b. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 - c. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
 - d. Vertical adjustment: Not less than 2 inches.
 - e. Seismic Feature: Provide lip, hook, or clip on end of wire ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter. Provide when project is located in Seismic Zone D or per Structural Plans indicate.

2.05 FLASHINGS

- A. Copper/Polymer Film or Fabric Flashing: 5 oz/sq ft copper sheet laminated between two sheets of polymer or fiberglass fiber-reinforced film.
 - 1. Manufacturers:
 - a. Hohmann & Barnard, Inc; Copper-Fabric NA: www.h-b.com/#sle.
 - b. York Manufacturing, Inc; Multi-Flash 500 Series: www.yorkmfg.com/#sle.
 - c. WireBond Copper Seal Flash. www.wirebond.com
 - d. Substitutions: See Section 01 6000 - Product Requirements.

- B. Termination Bars: Stainless steel or aluminum; compatible with membrane and adhesives.
- C. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.06 ACCESSORIES

- A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Manufacturers:
 - 1) Mortar Net Solutions; MortarNet: www.mortarnet.com/#sle.
 - 2) CavClear/Archovations, Inc: www.cavclear.com.
 - 3) Substitutions: See Section 01 6000 - Product Requirements.
- B. Weeps:
 - 1. Type: Polyester mesh.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.
- D. Steel Loose Lintels: Steel, hot dipped galvanized. See Division 05.
- E. Sand; white or tan for use on masonry joint sealants.

END OF SECTION

**SECTION 04 4313
STONE MASONRY VENEER**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cut stone veneer at exterior and interior walls.
- B. Cut Stone at Site Walls.
- C. Setting mortar and pointing mortar.

1.02 RELATED REQUIREMENTS

- A. Section 04 0511 - Masonry Mortaring and Grouting: Setting and pointing mortar.
- B. Section 07 6200 - Sheet Metal Flashing and Trim: Flashings.

1.03 REFERENCE STANDARDS

- A. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- B. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2016.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect stone from discoloration during storage on site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Stone Quarriers:
 - 1. JACOB STONE PRODUCTS, Inc.or equal.
 - a. <https://www.jacobstone.com>
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Stone Masonry Reinforcement and Accessories
 - 1. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STONE

- A. Limestone: Arkansas Natural Limestone.
 - 1. Color: Austin Cream.

2.03 MORTAR APPLICATIONS

- A. At Contractor's option, mortar may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.

2.04 MORTAR MIXES

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - 1. Type: Type S.
 - 2. Color: Mineral pigments added as required to produce approved color sample.

2.05 MORTAR

- A. Setting Mortar: ASTM C270, Type S, using the Proportion Method as specified in Section 04 0511.

2.06 ACCESSORIES

- A. Horizontal Joint Reinforcement: Truss type; stainless steel wire conforming to ASTM A580/A580M Type 304, 3/16 inch diameter side rods with 0.1483 inch diameter cross ties.

- B. Wall Ties: Formed steel wire, at least ____ inch diameter, stainless steel conforming to ASTM A580/A580M, eye and pintle type, with provision for vertical adjustment after attachment.
- C. Other Anchors in Direct Contact with Stone: ASTM A666 Type 304, stainless steel, of sizes and configurations required for support of stone and applicable superimposed loads.
- D. Weep/Cavity Vents: Polyethylene tubing.

2.07 STONE FABRICATION

- A. Nominal Thickness: 4 & 5 inch at Building, 12" at Site Walls.
- B. Nominal Face Size: 6 by 30 inch.
- C. Pattern and Coursing: per architectural drawings.
- D. Fabricate for 3/8 inch beds and joints.
- E. Face:
 - 1. Sawn
- F. Bed and Joint Surfaces:
 - 1. Cut or sawn full square for full thickness of unit.
- G. Backs: Sawn.

END OF SECTION

SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Structural steel framing members.
- B. Base plates, shear stud connectors.
- C. Grouting under base plates.

1.03 RELATED REQUIREMENTS

- A. Section 01 4533 - Special Inspections: Code required special tests and inspections.
- B. Section 03 30 00 - Grout for Baseplates
- C. Section 05 3100 - Steel Decking: Support framing for small openings in deck.
- D. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.04 REFERENCE STANDARDS

- A. ANSI/AISC 360 - Specification for Structural Steel Buildings; American Institute of Steel Construction, Inc.; 2010
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2010
- C. AISC Detailing for Steel Construction, Third Edition; 2009
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
- G. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
- H. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.
- I. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2020.
- J. ASTM A1085 - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS); 2013.
- K. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
- L. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry; 2018.
- M. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
- N. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
- O. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- P. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- Q. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014 (Amended 2015).

- R. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- S. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2014, with Errata (2015).
- T. US Government Department of Labor; Occupational Safety and Health Administration; 29 CFR Part 1926, Safety Standards for Steel Erection.
- U. SSPC-SP 3 - Power Tool Cleaning; 2018.
- V. Specification for Structural Joints Using High Strength Bolts, Research Council on Structural Connections; 2009.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - 2. Connections.
 - 3. Connections not detailed. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 4. Indicate cambers.
 - 5. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
 - 6. Plans shall be at 1/8" = 1'-0" or larger scale.
 - 7. Contractor shall require the detailer to thoroughly check and back-check all shop drawings before sending for approval, as described in ASIC Detailing for Steel Construction, Chapter 8. Incomplete and/or unchecked shop drawings will be returned without review by the Architect/Engineer.
 - 8. All shop drawings shall be reviewed and stamped by the general contractor prior to submittal. Shop drawings that have not been reviewed by the Contractor will be returned without review by the Architect/Engineer.
 - 9. When there are more than 100 sheets of structural steel shop drawings contractor shall submit the shop drawings in sequences so that each of the submittals do not exceed 100 sheets. Divide the sequences to match the erection sequence of the building. Submit the applicable columns, erection plans, and details with each sequence.
 - 10. Typical details are indicated on the drawings. Details for some special conditions will need to be developed by the detailer during the detailing process. The details will be reviewed during the review process. Final approval of the details will be at the discretion of the engineer of record. No additional charges for making corrections or changes to the shop drawings (redetailing costs) or for miscellaneous fabricated material will be allowed. Steel contractor shall make provisions for detailing corrections and miscellaneous material in the bid price. Adjustments to the contract will only be made for change orders approved prior to the commencement of any action on the changes.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
- E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- F. Testing and Inspection Laboratory qualifications.
- G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under AISC-Certified Plant Category: BU.

1.06 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."

- B. Fabricator: Fabricator shall be experienced in fabrication of steel similar to the steel required for this project with a minimum of 3 years of documented experience with a record of successful in-service performance as well as sufficient production capacity to fabricate structural steel for this project without delaying the work.
 - 1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant Category: BU (formerly STD); Certified Building Fabricators.
- C. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- E. Testing and Inspection Agency Qualifications: an independent testing and inspection lab, acceptable to Architect/Engineer, shall perform specified tests and inspections. The testing lab shall be qualified according to ASTM C 1077 and ASTM E 329 for testing indicated as documented according to ASTM E 548. See Section 014533.
- F. Fabricator shall design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located. All connections shall be shown in the shop drawings and are subject to the approval of the Architect/Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel W Shapes, C Shapes, and WT Shapes: ASTM A992/A992M.
- B. Steel Angles, Plates, and Bars: ASTM A572/A572M Grade 50.
- C. Rectangular and Square Hollow Structural Sections: ASTM A500, Grade C or ASTM A1085
- D. Shear Stud Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- E. Deformed Bar Anchors: A496 or A1064, minimum yield strength 75 KSI
- F. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A.
- G. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M , Grade A325 (A325M), Type 1, medium carbon, plain. Where load indicator bolts are indicated provide twist-off type assemblies conforming to ASTM F3125, Grade F1852.
- H. Tension Control Bolts: Twist-off style; ASTM F3125/F3125M, Grade F1852.
- I. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563/A563M nuts and ASTM F436/F436M Type 1 washers.
- J. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- K. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- L. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible. Shop fabrication shall be in accordance with OSHA Safety Standards for Steel Erection.
- B. Fabricate connections for bolt, nut, and washer connectors.
- C. Develop required camber for members.

2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, or faying surfaces of a slip critical connection.

- C. Galvanize structural steel members, where indicated, to comply with ASTM A123/A123M. Provide minimum 1.7 oz/sq ft galvanized coating.

2.04 SOURCE QUALITY CONTROL

- A. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts.
- B. Welded Connections: Visually inspect all shop-welded connections and test 100 percent of welds greater than 5/16" in thickness and all complete penetration welds using one of the following:
 - 1. Radiographic testing performed in accordance with ASTM E94/E94M.
 - 2. Ultrasonic testing performed in accordance with ASTM E164.
 - 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
 - 4. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" and in compliance with OSHA Safety Standards for Steel Erection.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components and shear studs indicated on drawings.
- D. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs[where indicated], back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.
 - 4. Where welds are exposed in the final construction, make fillet welds oversized and grind to uniform profile with smooth face and transition. Appearance of exposed welds shall be subject to the approval of the Architect.
- E. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts".
- F. Do not field cut or alter structural members without approval of Architect Engineer.
- G. After erection, prime welds, abrasions, and surfaces not shop primed.
- H. Galvanized Surfaces: After erection of galvanized steel clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780. Use a primer that matches the finish of the galvanizing where the galvanized surface will be exposed in the final construction.
- I. Grout solidly between column base plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Use only flowable grout products. See Section 03 30 00. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.
- J. Shear Stud Connectors: Fusion weld studs to plates or beams with a stud welding gun in accordance with Chapter 7 of AWS D1.1. Do not fillet weld studs.

- K. Deformed Bar Anchors: Fusion weld anchors to plates with a stud welding gun in accordance with Chapter 7 of AWS D1.1. Do not fillet weld deformed bar anchors.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency acceptable to the Architect/Engineer shall perform field quality control tests, as specified in Section 01 45 33 - Special Inspections.
- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts".
- C. Welded Connections: Visually inspect all field-welded connections and test field-welded connections as indicated in the Schedule of Special Inspections by Ultrasonic testing (UT) performed in accordance with ASTM E164.
- D. Welds that fail testing shall be repaired and retested at contractor's expense. If a weld fails testing all previous untested similar welds by the same welder shall be tested.
- E. High Strength Blind Bolted Connections: Visually inspect all high strength blind bolted connections.

END OF SECTION

SECTION 05 3100
STEEL DECKING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Roof deck.
- B. Composite floor deck.
- C. Metal form deck.
- D. Supplementary framing for openings up to and including 18 inches.
- E. Stud shear connectors.

1.03 RELATED REQUIREMENTS

- A. Section 01 4533 - Special Inspections: Code required special tests and inspections.
- B. Section 03 2000 - Concrete Reinforcing.
- C. Section 03 3000 - Cast-in-Place Concrete: Concrete topping over metal deck.
- D. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
- E. Section 05 5000 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.04 REFERENCE STANDARDS

- A. ANSI/ASSE A10.3 - Safety Requirements for Powder-Actuated Fastening System; 2013
- B. ANSI/SDI C - Standard for Composite Steel Deck-Slabs, Steel Deck Institute; 2017
- C. ANSI/SDI NC - Standard for Non-Composite Steel Deck, Steel Deck Institute; 2017
- D. ANSI/SDI RD - Standard for Steel Roof Deck, Steel Deck Institute; 2017
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- F. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014 (Amended 2015).
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- H. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.
- I. FM DS 1-28 - Wind Design; 2016.
- J. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; 2016, with Editorial Revision (2020).
- K. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems; 2016.
- L. ICC-ES AC70 - Acceptance Criteria for Fasteners Power Driven into Concrete, Steel and Masonry Elements; 2016.
- M. SDI DDM04 - Diaphragm Design Manual Fourth Edition, including latest errata and addendum; Steel Deck Institute; 2015
- N. SDI COSP - Code of Standard Practice; Steel Deck Institute; 2017
- O. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- P. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.

- B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- C. Shop Drawings: Submit detailed shop drawings showing layout and types of deck panels, weld or mechanical fastener types and sizes, weld or mechanical fastener patterns, conditions requiring closure panels, supplementary framing, sump pans, cant strips, cut openings, special jointing or other accessories. Where variances in substrate thickness require the use of multiple mechanical fastener types, the layout locations of each fastener type must be clearly indicated in plan on the shop drawings. Include calculations and required information if not completely covered by load tables and products data.
- D. Mechanical fasteners shall be permitted to fasten deck to support framing where specifically indicated on the Drawings or in lieu of welding where approved by the Architect Engineer. Where mechanical fasteners are proposed in lieu of welds, include calculations in accordance with SDI Diaphragm Design Manual indicating equivalent diaphragm strength to specified attachment pattern.
- E. Certificates: Certify that products furnished meet or exceed specified requirements.
- F. Submit manufacturer's installation instructions.
- G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.06 QUALITY ASSURANCE

- A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.
- B. An independent special inspector shall:
 - 1. Verify placement of deck for alignment and proper lap.
 - 2. Verify deck gage.
 - 3. The inspector shall verify welding procedures and welder qualifications prior to the start of work.
 - 4. Welds: Visually inspect 100% of welded connections for proper size, quality, and pattern. Measure all weld sizes where adequacy is inconclusive based on a visual inspection. All welds with inadequate size or other deficiencies must be repaired.
 - 5. Mechanical fasteners: Visually inspect 100% of connections for proper type, embedment, and spacing. Examine washer condition and ensure deck is clamped to the supporting steel framing. Measure all fastener embedments where adequacy is inconclusive based on a visual inspection. All deficient mechanical connectors must be corrected by replacing the deficient connector.
 - 6. Verify sidelap connections.
 - 7. Verify shear stud installation spacing and welds.
- C. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of documented experience.
 - 1. All personnel installing steel deck mechanical fasteners shall be trained and licensed on the project site by a manufacturer's representative.
- D. Operators of Powder-actuated tools shall be certified in accordance with ANSI/ASSE A10.3.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Deck:
 - 1. Canam Steel Corporation; ____: www.canam-steeljoists.ws.
 - 2. Cordeck, Inc; ____: www.cordeck.com/#sle.

3. Nucor-Vulcraft Group; ____: www.vulcraft.com/#sle.
4. ASC Steel Deck: www.ascsd.com.
5. New Millennium : www.newmill.com
6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STEEL DECK

- A. Roof Deck: Non-composite type, fluted steel sheet:
 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230 minimum, with G90/Z275 galvanized coating.
 2. Structural Properties:
 - a. Provide deck type and minimum properties as indicated on the drawings.
 - b. Provide vented deck where required by the lightweight insulating concrete supplier.
- B. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 40/275 minimum, with G90/Z275 galvanized coating.
 2. Structural Properties:
 - a. Provide deck type and minimum properties as indicated on the drawings.
- C. Metal Form Deck: _____ sheet steel:
 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230 minimum, with G90/Z275 galvanized coating.
 2. Structural Properties: provide deck type and minimum properties as indicated on the drawings.

2.03 ACCESSORY MATERIALS

- A. Stud Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- B. Welding Materials: AWS D1.1/D1.1M.
- C. Fasteners: Galvanized hardened steel, self tapping.
- D. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.
 1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications, ICC-ES AC 43, FM wind uplift resistance, and specified UL fire-rated roof assembly.
 2. Where fasteners are exposed to the elements in their final condition, an AISI 304 stainless steel sealing cap with bonded neoprene washer shall be installed over each fastener. Alternately, fasteners with coatings that have met the requirements of ASTM G85 Annex E for 140 cycles are permitted.
- E. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
 1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of 1SDI design method for roof deck and floor deck applications, 1, and 1/2 wind uplift resistance.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
- H. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.04 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, cover plates, and ridge and valley plates, 20 gauge, 0.0359 inch thick sheet steel; of profile and size as indicated; finished same as deck.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

- A. Erect metal deck in accordance with manufacturer's instructions and SDI Code of Standard Practice and ANSI/SDI Standards for each deck type . Align and level.
- B. On masonry surfaces provide minimum 4 inch bearing.
- C. On steel supports provide minimum 1-1/2 inch bearing.
- D. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods indicated on drawings.
- E. At mechanically fastened male/female side laps fasten at 24 inches on center maximum, unless indicated otherwise on drawings.
- F. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.
- G. Weld floor deck in accordance with AWS D1.3/D1.3M. Do not weld roof deck.
- H. At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically anchor or puddle weld to deck at each flute.
- I. Where deck (other than cellular deck electrical raceway) changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Puddle weld 12 inches on center maximum.
- J. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.
- K. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- L. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.
- M. Weld shear shear connectors through steel deck to structural members below using automatic mechanized welding gun. Do not fillet weld.
- N. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.
- O. Suspended ceilings, light fixtures, equipment, ducts or other utilities shall not be supported by the steel roof deck.

3.03 WELDING

- A. All welding of floor deck shall be in accordance with ANSI/AWS D1.3, Structural Welding Code – Sheet Steel. Each welder shall demonstrate an ability to produce satisfactory welds using a procedure such as shown in the ANSI/SDI Standards and as described in ANSI/AWS D1.3.
- B. Provide weld washers for deck thinner than 22 gage.
- C. Weld metal shall penetrate all layers of deck material at end laps and shall have good fusion to the supporting members.
- D. Where two panels butt, fasten each deck unit with separate welds.

3.04 MECHANICAL FASTENING

- A. Gauge powder-actuated tool systems to the base material steel type, steel deck type and thickness prior to final installation. Confirm appropriate power regulation and powder-actuated cartridge type prior to final installation.
- B. Verify axis of fastener is within +/- 10 degrees of perpendicular to the deck prior to driving.

- C. Where two panels butt, fasten each deck unit with separate fasteners.

3.05 NONCONFORMING WORK AND REPAIRS

- A. Work not conforming with the contract documents shall be repaired or replaced at the Contractor's expense.
- B. Additional testing and inspection required to determine compliance of corrected work shall be at the Contractor's expense.
- C. Repair damaged galvanized coatings on both surfaces of the deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- D. Repair damaged paint coatings on painted sides of the deck with repair paint.
 - 1. Wire brush and clean rust spots, welds, and abraded areas.
 - 2. Repair paint shall be of same color as shop-primed deck where exposed to view.
- E. Replace or supplement under-driven and over-driven mechanical fasteners with adjacent, properly installed fasteners.

3.06 QUALITY CONTROL

- A. A qualified representative from the manufacturer of mechanical fasteners used to anchor deck to supporting structure shall conduct a pre-installation conference with all contractors involved in installing the metal deck. The manufacturer's representative shall visit the project site and inspect the start up of deck anchorage to insure that the correct fastener type, location and installation procedures are followed. A written report of the meeting and inspection by the manufacturer's representative shall be forwarded to the Architect Engineer.
- B. All deck fastening to supports and sidelap fastener installation will be visually inspected for quantity and quality by a independent special inspector. See Section 014533 (01410).
 - 1. Connections and welds that are found unsatisfactory by the inspecting laboratory shall be corrected to the satisfaction of the inspector at the Contractor's expense. A copy of the final report shall be submitted to the Architect Engineer for review.
 - 2. Connections, welds, and shear studs shall not be covered or made inaccessible until the final approval is obtained.

END OF SECTION

SECTION 05 4000
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Formed steel stud exterior wall framing.

1.03 RELATED REQUIREMENTS

- A. Section 01 4533 - Special Inspections: Code required special tests and inspections.
- B. Section 05 12 00: Structural building framing.
- C. Section 09 2116 - Gypsum Board Assemblies: Cold-formed steel nonstructural framing.
- D. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.04 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2018).
- B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.
- C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015 (Amended 2017).
- D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- H. ASTM A1003/A1003 - Standard Specification for Steel Sheet, Carbon, Metallic and Nonmetallic-Coated for Cold-Formed Framing Members; 2013.
- I. ASTM C 1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2004.
- J. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014 (Amended 2015).
- K. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.
- L. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. ICC (IBC)-2021 - International Building Code; 2021.
- N. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to metal framing systems, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
- C. Product Data: For lateral-force resisting systems, provide product data sheets on hold-down, showing compliance with requirements.
- D. Shop Drawings: Indicate component details, framed openings, anchorage, loading, and type and location of fasteners, and accessories or items required of related work.
 - 1. Indicate stud layout.
 - 2. Describe method for securing studs to tracks and for _____ framing connections.
- E. Research/Evaluation Reports: For cold-formed steel framing.
 - 1. Metal stud manufacturer to have a third party evaluation report for its products that are reviewed to the local building code or its model code (IBC 2012 and AISI S100).

1.07 QUALITY ASSURANCE

- A. Designer Qualifications: Design framing system under direct supervision of a professional structural engineer experienced in designing this work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
 - 1. Manufacturer must participate in a third party code compliance certification program.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

1.08 PROJECT CONDITIONS

- A. Verify that field measurements are as indicated on the drawings.

1.09 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's "Code of Standard Practice".

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Structural Framing:
 - 1. ClarkDietrich; _____: www.clarkdietrich.com/#sle.
 - 2. MarinoWARE; _____: www.marinoware.com/#sle.
 - 3. The Steel Network, Inc; _____: www.SteelNetwork.com/#sle.
 - 4. Telling Industries: www.buildstrong.com
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Connectors:
 - 1. Same manufacturer as metal framing.
 - 2. Simpson Strong Tie: www.strongtie.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Design Requirements: Design cold-formed framing systems, components and connectors to withstand specified design loads in compliance with ICC (IBC), ASCE 7, AISI S100, and AISI S240.

2.03 MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.

2.04 STRUCTURAL FRAMING COMPONENTS

- A. Wall Studs and Track Sections: AISI S240; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.

1. Thickness and Depth: Depth as indicated on the drawings; thickness and structural grade as required to meet design criteria.
- B. Steel Sheet for studs and tracks: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 1. Grade: ST33H, unless indicated otherwise.
 2. Coating: G60 min.
- C. Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as indicated on drawings.
- D. Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as indicated on drawings.
- E. Framing Accessories:
 1. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
 2. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.05 MISCELLANEOUS CONNECTIONS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized per ASTM A153/A153M.
 1. Products:
 - a. ITW Commercial Construction North America; ITW CCNA-Buildex Tek's Select Series; _____: www.ITWBuildex.com/#sle.
 - b. Simpson Strong-Tie; Self-Drilling X-Series Metal Screws; www.strongtie.com.
- B. Anchorage Devices: As required..

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Coordinate work of this section with the placement of components within the metal framing system.
- C. Verify field measurements and adjust installation as required.

3.02 INSTALLATION - GENERAL

- A. Install structural members and connections in compliance with ASTM C1007.

3.03 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions, ASTM C1007 requirements, and AISI S200.
- B. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- C. Install studs full length in one piece. Splicing of studs is not permitted.
- D. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- E. Install intermediate studs above and below openings to align with wall stud spacing.
- F. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.
- G. Attach cross studs to studs for attachment of fixtures anchored to walls.
- H. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- I. Touch-up field welds and damaged corrosion protected surfaces with primer.

3.04 FIELD QUALITY CONTROL

- A. The independent Special Inspectors shall verify that cold-formed metal framing is installed in accordance with the construction documents and approved shop drawings. See Section 014533.
- B. Remove and replace work where test results indicate that it does not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 TOLERANCES

- A. Maximum Variation from True Position: 1/2 inch.
- B. Maximum Variation of any Member from Plane: 1/2 inch.

END OF SECTION

SECTION 05 5100
METAL STAIRS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Stairs with concrete treads.
- B. Structural steel stair framing and supports.

1.03 RELATED REQUIREMENTS

- A. Section 01 4533 - Special Inspections: Code required special tests and inspections.
- B. Section 03 3000 - Cast-in-Place Concrete: Concrete fill in stair pans and landings; mesh reinforcement for landings.
- C. Section 03 3000 - Cast-in-Place Concrete: Placement of metal anchors in concrete.
- D. Section 051200 - Structural Steel Framing: Quality Assurance; Support framing; Field Quality Control.
- E. Section 05 5213 - Pipe and Tube Railings: Metal handrails for the stairs specified in this section.

1.04 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- C. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2015.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
- E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- F. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019, with Editorial Revision (2020).
- G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- I. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Submit 2 copies of each shop drawing for approval. One checked copy will be returned to the Contractor who will then run and distribute all copies required.
 - 3. Contractor shall require the detailer to thoroughly check all shop drawings before sending for approval. All shop drawings shall be reviewed and stamped by the general contractor

prior to submittal. Incomplete shop drawings, unchecked drawings and shop drawings that have not been reviewed by the Contractor will be returned without review by the Architect/Engineer.

4. Provide calculations for all contractor delegated design components. Include the design engineer's seal and signature on each sheet of shop drawings.
- C. Design Data: As required by authorities having jurisdiction.
- D. Designer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. See Section 051200 - Structural Steel Framing.
- B. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
 2. Structural Design: Provide complete stair and railing assemblies that comply with the applicable local code.
 3. Dimensions: As indicated on drawings.
 4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 6. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels:
 1. Architectural at monumental stair: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
 2. Commercial at interior stair: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit IS considered exposed to view.
 - a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
 - b. Welds Exposed to View: Ground smooth and flush.
 - c. Mechanical Joints: Butted tight, flush, and hairline.
 - d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
 - e. Exposed Edges and Corners: Eased to small uniform radius.
 - f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

- A. Jointing and Finish Quality Level: Commercial as defined above.

- B. Risers: Closed.
- C. Treads: Metal pan with field-installed concrete fill.
 - 1. Concrete Depth: 1-1/2 inches, minimum.
 - 2. Tread Pan Material: Steel sheet.
 - 3. Tread Pan Thickness: As required by design; 14 gauge, 0.075 inch minimum.
 - 4. Concrete Reinforcement: Welded wire mesh.
 - 5. Concrete Finish: For resilient floor covering.
- D. Risers: Same material and thickness as tread pans.
 - 1. Nosing Depth: Not more than 1-1/4 inch overhang.
 - 2. Nosing Return: Flush with top of concrete fill, not more than 1 inch wide.
- E. Stringers: HSS Rectangular Tubes.
 - 1. Stringer Depth: As indicated on drawings.
 - 2. End Closure: Sheet steel of same thickness as risers welded across ends.
- F. Landings: As indicated on drawings.
- G. Finish: Shop- or factory-prime painted.

2.03 HANDRAILS AND GUARDS

- A. Wall-Mounted Rails: See Section 05 5213.
- B. Guards: Pipe railings, see Section 05 5213.

2.04 MATERIALS

- A. Steel Sections: ASTM A572/A572M Grade 50.
- B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- C. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
 - 1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation SS (structural steel), Grade 33.
 - 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation SS (structural steel), Grade 33, Type 1.
- E. Concrete Reinforcement: Mesh type as detailed, galvanized.

2.05 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces where field welding is required.
- C. Prime Painting: Use specified shop- and touch-up primer.
 - 1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
 - 2. Number of Coats: One.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.
- B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.03 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.

- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- D. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- E. Obtain approval prior to site cutting or creating adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized.

3.04 FIELD QUALITY CONTROL

- A. See Section 051200 - Structural Steel Framing. An independent testing agency acceptable to the Architect/Engineer shall perform field quality control inspections and tests, as specified in Section 014533 Special Inspections.

3.05 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION

SECTION 05 5213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.

1.03 RELATED REQUIREMENTS

- A. Section 01 4533 - Special Inspections: Code required special tests and inspections.
- B. Section 03 3000 - Cast-in-Place Concrete: Placement of anchors in concrete.
- C. Section 051200 - Structural Steel Framing: Quality Assurance; Field Quality Control
- D. Section 05 5100 - Metal Stairs: Attachment plates for handrails specified in this section.
- E. Section 09 2116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.04 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2015.
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- G. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Include the design engineer's seal and signature on each sheet of shop drawings.
- C. Submit 2 copies of each shop drawing for approval. One checked copy will be returned to the Contractor who will then run and distribute all copies required.
- D. Contractor shall require the detailer to thoroughly check all shop drawings before sending for approval. All shop drawings shall be reviewed and stamped by the general contractor prior to submittal. Incomplete shop drawings, unchecked shop drawings and shop drawings that have not been reviewed by the Contractor will be returned without review by the Architect/Engineer.

1.06 QUALITY ASSURANCE

- A. See Section 051200 - Structural Steel Framing.

- B. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- B. Allow for expansion and contraction of members and building movement without damage to connections or members.
- C. Dimensions: See drawings for configurations and heights.
- D. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
 - 2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.
 - 3. For anchorage to stud walls, provide backing plates, for bolting anchors.
 - 4. Posts: Provide adjustable flanged brackets.
- E. Provide mechanical and welding fittings where indicated to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M, Grade C cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M, Grade B Schedule 80, black finish.
- C. Steel Plates, Shapes and Bars: _____ ASTM A572/A572M Grade 50.
- D. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
- E. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- F. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
- G. Galvanizing: In accordance with requirements of ASTM A123/A123M.
 - 1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
 - 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
 - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete with setting templates, for installation as work of other sections.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
- D. Anchor railings securely to structure.
- E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.
- F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

3.05 FIELD QUALITY CONTROL

- A. See Section 051200 - Structural Steel Framing. An independent testing agency acceptable to the Architect/Engineer shall perform field quality control inspections and tests, as specified in Section 014533 Special Inspections.

END OF SECTION

**SECTION 05 7311
DECORATIVE METAL AND GLAZED METAL RAILINGS - HDI**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Railing systems.
- B. Metal railings.
- C. Structural glass railings.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
 - 1. Contractor.
 - 2. Manufacturer's representative.
 - 3. Architect.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor locations, transitions, and terminations.
- C. Samples: Submit one of each item below for each type and condition shown:

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with no less than 20 years of documented experience.
- B. Installer Qualifications: Installation by manufacturer.
- C. Installer Qualifications: Factory authorized subcontract installer.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Substitutions: Not permitted.

2.02 MATERIALS AND FINISHES

END OF SECTION

**SECTION 05 7311
DECORATIVE METAL AND GLAZED METAL RAILINGS - LIVERS BRONZE LLC**

PART 2 PRODUCTS

1.01 MANUFACTURER

- A. Livers Bronze, LLC: www.liversbronze.com/#sle.
- B. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

1.02 RAILING SYSTEMS, GENERAL

- A. Factory- or shop-fabricate to suit project conditions, for connection to building structure, and in largest practical sizes for delivery to site.
- B. Joints: Tightly fitted and secured, machined smooth with hairline seams.
- C. Field Connections: Provide sleeves, anchors, and other devices required for site assembly and installation.
- D. Welded Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
- E. Fasteners:

1.03 MATERIALS AND FINISHES

**SECTION 05 7311
DECORATIVE METAL AND GLAZED METAL RAILINGS - VIVA**

PART 2 PRODUCTS

1.01 MANUFACTURER

- A. Viva Railings, LLC: 151 W. Vista Ridge Mall Drive, Lewisville, TX 75067. 972-353-8482.
www.vivarailings.com/#sle.
- B. Substitutions: Not permitted.

1.02 MATERIALS AND FINISHES

END OF SECTION

**SECTION 06 1000
ROUGH CARPENTRY**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Roof-mounted curbs.
- B. Roofing nailers.
- C. Preservative treated wood materials.
- D. Fire retardant treated wood materials.
- E. Communications and electrical room mounting boards.
- F. Concealed wood blocking, nailers, and supports.
- G. Wall sheathing with factory applied water-resistive and air barrier sheet.

1.02 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- C. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies; 2011.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.
- F. PS 1 - Structural Plywood; 2009.
- G. PS 20 - American Softwood Lumber Standard; 2010.
- H. SPIB (GR) - Grading Rules; 2014.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on structural lumber, sheathing, fire treated and wood preservative materials and application instructions.
- C. Installation fastener requirements and spacing.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Southern Pine, unless otherwise indicated.
 - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.

3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Stud Framing (2 by 2 through 2 by 6):
 1. Species: Douglas Fir-Larch.
 2. Grade: No. 2.
- E. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
 1. Grade: [CHOICE TEXT].
- F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 1. Lumber: S4S, No. 2 or Standard Grade.
 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

- A. Wall Sheathing at backside of parapets : Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant.
 1. To be used ast backside of parapets at locations where single-ply roofing membranes are installed. Coordinate with roofing manufacturer requirements.
 2. Manufacturers:
 - a. Georgia-Pacific Gypsum; DensDeck Prime: www.gpgypsum.com/#sle.
- B. Wall Sheathing (with factory applied Weather Barrier) : Glass mat faced gypsum with integral water-resistive and air barrier, ASTM C1177/C1177M, 5/8 inch thick.
 1. Edges: Square.
 2. Water Vapor Permeance: 1 perm, minimum, when tested in accordance with ASTM E96/E96M.
 3. Air Permeance, Assembly: 0.04 cfm per square foot, maximum, when tested in accordance with ASTM E2357.
 4. Fluid-Applied Flashing: Approved by sheathing manufacturer.
 5. Warranty:
 - a. Exposure: Manufacturer's standard; 12 months, against exposure damage, and dated from installation of product.
 - b. Defect: Manufacturer's standard; 5 years, against manufacturing defects, and dated from purchase of product.
 6. Manufacturers:
 - a. Georgia-Pacific LLC; DensElement Barrier System: www.DensElement.com/#sle.
 - b. Tremco Commercial Sealants & Waterproofing; Securock ExoAir 430 Panel: www.tremcosealants.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- D. Other Applications:
 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
 2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
 3. Other Locations: PS 1, C-D Plugged or better.

2.04 ACCESSORIES

- A. Fasteners and Anchors: Use fasteners suitable for proper attachment to substrates and contain weatherized coating approved for use where exposed. Fasteners in treated lumber are required to have high corrosion resistance, compatible with chemical treatment and be approved for use by wood manufacturer.
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
- B. Sill Flashing: As specified in Section 07 6200.
- C. Water-Resistive Barrier: For other locations, as specified in Section 07 2500.
- D. Fluid Applied Weather Barrier Joint Treatment: Dens Defy Liquid Flashing.
- E. Joint Transition Membrane: Dens Defy Transition Membrane.

2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood (FRTW) : Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood (PTW): Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
 - 1. Interior Type A: AWWA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat rough carpentry items as indicated .
 - c. Do not use fire treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Treatment:
 - 1. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber in contact with roofing, flashing, or waterproofing.
 - c. Treat lumber in contact with masonry or concrete.

END OF SECTION

**SECTION 06 2000
FINISH CARPENTRY**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Finish carpentry items.
- B. Wood casings and moldings.
- C. Hardware and attachment accessories.

1.02 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
- D. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009.
- E. PS 1 - Structural Plywood; 2009.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide instructions for attachment hardware and finish hardware.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Samples: Submit two samples of finish plywood, 8x8 inch in size illustrating wood grain and specified finish.
- E. Samples: Submit two samples of wood trim 12 inch long.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.
 - 2. Single Source Responsibility: Provide and install this work from single fabricator.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Interior Woodwork Items:
 - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish.

2.02 WOOD-BASED COMPONENTS

- A. Provide sustainably harvested wood, certified or labeled as specified in Section 01 6000 - Product Requirements.

2.03 LUMBER MATERIALS

- A. Hardwood Lumber: White Oak species, plain sawn, maximum moisture content of 6 percent ; with vertical grain , of quality suitable for transparent finish.

2.04 SHEET MATERIALS

- A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
- B. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; HPVA HP-1 Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

2.05 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Concealed Joint Fasteners: Threaded steel.

2.06 ACCESSORIES

- A. Lumber for Shimming, Blocking, and other concealed spaces: Softwood lumber of Southern Pine species.
- B. Primer: Alkyd primer sealer.
- C. Wood Filler: Solvent base, tinted to match surface finish color.

2.07 HARDWARE

- A. Hardware: Comply with BHMA A156.9.

2.08 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Fit exposed sheet material edges with 3/8 inch matching hardwood edging. Use one piece for full length only.
- C. Cap exposed plastic laminate finish edges with aluminum trim.
- D. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- E. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
- F. Apply laminate backing sheet to reverse face of plastic laminate finished surfaces.

2.09 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
- D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 12 Polyurethane Water-based.
 - b. Stain: As selected by Architect.
 - c. Sheen: Satin.

END OF SECTION

SECTION 06 4100
ARCHITECTURAL WOOD MILLWORK

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Custom made specially fabricated cabinet units and assemblies.
- B. Countertops.
- C. Hardware.
- D. Factory finishing.

1.02 REFERENCE STANDARDS

- A. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- B. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
- C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 3. Include certification program label.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs. Provide documentation that millwork meets or exceeds quality standard specified.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
- B. Quality Certification:
 - 1. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.07 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Single Source Responsibility: Provide and install this work from single fabricator.

2.02 CABINETS

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Wood Veneer Faced Cabinet:
 - 1. Exposed Surfaces: Wood Grade AA, White Oak, plain sliced, slip-matched, veneer stained / varnished.
 - 2. Semi-Exposed Surfaces: Wood Grade A, White Oak, rotary cut, random-matched, veneer stained / varnished.
 - 3. Concealed Surfaces: Manufacturer's option.
- C. Plastic Laminate Faced Cabinets: Custom grade.
 - 1. Finish - Exposed Exterior Surfaces: HPL veneer.
 - 2. Finish - Exposed Interior Surfaces: HPL veneer.
 - 3. Finish - Semi-Exposed Interior Surfaces: TFL veneer, unless noted otherwise.
 - 4. Finish - Concealed Surfaces: Manufacturer's Standard.
- D. Cabinets:
 - 1. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
 - 2. Casework Construction Type: Type A - Frameless.
 - 3. Cabinet Design: As indicated on drawings.
 - 4. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - 5. Cabinet Style: Flush overlay.
 - 6. Cabinet Doors and Drawer Fronts: Flush style.
 - 7. Drawer Construction Technique: Dovetail joints.

2.03 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.04 PLASTIC LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation: www.formica.com/#sle.
 - 2. Panolam Industries International, Inc; Nevamar Standard HPL: www.panolam.com/#sle.
 - 3. Wilsonart; www.wilsonart.com
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.
 - 1. Manufacturers:
 - a. Wilsonart LLC: www.wilsonart.com/#sle.
 - b. Color: Black.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- C. High Pressure Laminate (HPL): NEMA LD 3, types as recommended for specific applications.
- D. Provide specific types as indicated.
 - 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, black color, finish as indicated.
 - 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, black color, finish as indicated.
 - 3. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, black color, finish as indicated.
 - 4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure laminate.

2.05 COUNTERTOPS & SILL SURFACES

- A. Quartz Surfacing (QTZ): Quartz slabs bonded to substrate; use as large pieces as possible with inconspicuous adhesive joints.
 - 1. Product: Cambria. Uniform surface without cracks, void or pin holes.
 - 2. Color: Portrush.

3. Stone Thickness: 3/4 inch (2cm) minimum.
 4. Surface Finish: Satin.
 5. Exposed Edge Treatment: Square profile stone, 1 inch thick with 1/8 inch radius corner.
 6. Back and End Splashes: Same material; 3/4 inch (2cm) thickness; for field attachment.
 7. Fabricate in accordance with AWI/AWMAC/WI (AWS) Standards, Section 11- Premium Grade.
- B. Bioglass Surfacing (BGL): Bio-Glass® is a circular material with C2C Gold certification and can help achieve up to 15 LEED points on USGBC-registered projects.
1. Product: Coverings ETC Bio-Glass.
 2. Color: Bio-Glass® Urban Fossil Aquamarine w/Topaz Bottles.
 3. Thickness: 3/4".
 4. Surface Finish: Standard.
- C. High Pressure Laminate Surfacing (HPL): Medium density fiberboard substrate covered with HPL, conventionally fabricated and self-edge banded.

2.06 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.07 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Shelf standards and Rests: Injection molded transparent polycarbonate friction fit into cabinet end panels and vertical dividers, adjustable on 32mm centers. Each shelf support has 2 integral support pins, 5mm diameter, to interface pre-drilled holes and to prevent accidental rotation of support. The support automatically adapts to 19mm (3/4") or 25mm (1") thick shelving and provides a non-tip feature for shelving. Supports may be field fixed if desired. Structural load to 1200 pounds (300 pound per support) without failure.
- C. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome or satin chrome finish, for nominal 1 inch spacing adjustments.
- D. Drawer and Door Pulls: Amerock Edge Pull, Matte Black.
- E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- F. Drawer Slides: Soft-Closing.
 1. Type: Full extension.
 2. Static Load Capacity: Commercial grade.
 3. Mounting: Side mounted.
 4. Stops: Integral type.
 5. Features: Provide self closing/stay closed and soft close type.
 6. Manufacturers:
 - a. Knappe & Vogt Manufacturing Company; KV Brand Medium Duty with Soft-Close: www.knappeandvogt.com/#sle.
- G. Hinges: European style concealed self-closing type, matte black finish, soft-closing..
 1. Manufacturers:

- a. Knappe & Vogt Manufacturing Company; KV Hinge with Soft-Close:
www.knappeandvogt.com/#sle.

2.08 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
- E. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
 - 1. Provide center matched panels at each elevation.
 - 2. Provide sequence matching across each elevation.
 - 3. Carry figure of cabinet fronts to toe kicks.
- F. Mechanically fasten back splash to countertops with steel brackets at 16 inches on center.

2.09 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 11, Polyurethane, Catalyzed.
 - b. Stain: As selected by Architect.
 - c. Sheen: Satin.

END OF SECTION

SECTION 06 4200 WOOD PANELING

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Custom wood veneer paneling and trim.
- B. Solid wood panel trim.
- C. Shop finishing.

1.02 REFERENCE STANDARDS

- A. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- D. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fire retardant treatment materials and application instructions.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories. Indicate joints of panels for approval.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide plan of panel number sequencing and veneer matching.
 - 3. Indicate elevations, profiles, sections, quality, and views of panelwork.
 - 4. Show sizes, thicknesses, quantities, markings, materials, wood species, finishes, accessories, hardware, and locations of each item.
 - 5. Include assembly and installation drawings to show methods of wood blocking, fastening, bracing, jointing, and connecting to work of other trades.
 - 6. Indicate dimensions necessary for fitting panelwork and appliances to fixed walls. Be responsible for details and dimensions not controlled by Project conditions. \
 - 7. Indicate cut-out locations, plumbing fixtures, mechanical and electrical devices, and other items occurring in panelwork.
 - 8. Indicate grain direction for solid lumber and veneer. Show flitch layout for veneers.
- D. Samples: Submit two samples of finished plywood, 6 x 6 inch in size, illustrating wood grain and specified finish.
- E. Samples: Submit two samples of wood trim, 6 inch long.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company certified by Woodwork Institute.
 - 2. Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 3. Capacity to lay up veneers.
- B. Single Source Responsibility:
 - 1. Obtain architectural panelwork from single source to ensure uniformity in quality, appearance, and construction.
 - 2. Fabricator is responsible for finishing and installation of panelwork.
 - 3. Provide panel core, fire retardant treatment, adhesives, veneers, finishes, fabrication processes, storage, handling, building conditioning, and similar items that are compatible with one another to prevent product failures such as veneer delamination, checking,

cracking, blisters, glue bleedthrough, or discoloration of veneers

- C. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
 - 3. Certification by treating plant indicating type of chemicals used and fire performance characteristics achieved. Certify treatment will not have adverse affect on finish.
- D. Quality Certification:
 - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 2. Provide designated labels on shop drawings as required by certification program.
 - 3. Provide designated labels on installed products as required by certification program.
 - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - 5. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - 6. All fees charged by the Woodwork Institute for their Certified Compliance program are responsibility of millwork manufacturer and/or installer and shall be included in their bid.

1.05 MOCK-UP

- A. Construct mock-up, 4 feet long by 4 feet wide, illustrating full panel sheet, edge trim, joint trim, applied finish and other details.
- B. Locate where directed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.
- B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with recommendations of AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- C. Field Measurements:
 - 1. Field measure conditions where panelwork is indicated to be fitted to other construction prior to fabricating work of this Section.
 - 2. Show final field measurements on shop drawings.
 - 3. Where field measurements cannot be made without delaying Project, coordinate dimensions among trades to ensure proper fit of panelwork.

PART 2 PRODUCTS

2.01 PANELING

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless otherwise indicated.
- B. Flat Paneling: Basis of Design;
 - 1. Species: White Oak.
 - 2. Cut: Plain Slice, grain run vertically.
 - 3. Panels: Veneer of full width and balanced sequence matched.
 - a. Panels More Than One Leaf High: Architectural end matching.
 - 4. Visible Edges and Reveals: Edgebanded with matching trim.
 - 5. Outside Corners: As indicated on the Drawings.

2.02 WOOD-BASED MATERIALS - GENERAL

- A. Wood fabricated from old growth timber is not permitted.

- B. Hardwood Plywood: HPVA HP-1 Grade A; veneer core, type of glue recommended for application; of grain quality suitable for transparent finish.
- C. Particleboard: Complying with ANSI A208.1; composed of wood chips, medium density, made with waterproof resin binders; of grade to suit application; sanded faces, **Fire Retardant Pressure Treated**.
 - 1. Fire Retardant Pressure Treated Description:
 - a. Ensure not required to have brush treatment of cuts made in the field.
 - b. Ensure not capable of bleed through or adversely affecting type of finish indicated.
 - c. Ensure not capable of corroding metals when tested in accordance with MIL-L-19140E.
 - d. Acceptable Products and manufacturers: D-Blaze, Chemical Specialties Inc.; Dricon, Hickson Corporation; Pyroguard, Hoover Treated wood products.
- D. Lumber: Maximum moisture content of 6 percent; with vertical grain , of quality suitable for transparent finish.

2.03 ADHESIVES AND FASTENERS

- A. Adhesives: Type suitable for intended purpose, complying with applicable air quality regulations.
- B. Panel Clips Fasteners: Monarch Metal Fabrication: www.monarchmetal.com
 - 1. MF375 2" Clip attached to panels & Continous Lengths attached to wall.. Minimum 3 Rows of Clips per Panel. Minimum 4 Clips per Row. Space Per Manufacturer's recommendation.
- C. Fasteners in contact with aluminum trim to be aluminum or metal that will not cause galvanic action.
- D. Where multiple layers occur, use glue and fasten to substrate.

2.04 ACCESSORIES

- A. Edgebanding: Pre-glued and non pre-glued .6 mm to all exposed sides of panels.
- B. Solid stock wood trim: Premium Grade Douglas Fir, Quarter Sawn, Vertical grain.
- C. Aluminum Trim: Solid bar stock extruded aluminum, ATSM B221 (ASTM B221M).
 - 1. Sizes: As indicated on drawings.
- D. Lumber for Shimming, Blocking : Softwood lumber of Southern Yellow Pine species.
- E. Primer: Alkyd primer sealer type.
- F. Wood Filler: Tinted to match surface finish color.
- G. Correction pens and lacquer pen: In colors to match selected surface.

2.05 FABRICATION

- A. Shop prepare and identify panels for grain matching during site erection.
- B. Prime concealed and semi-concealed surfaces with sealer. Brush apply only.
- C. Route or groove back of flat trim members, kerf backs of other wide flat members except plywood or veneered members.
- D. Prepare panels for delivery to site, permitting passage through building openings.
- E. Finish exposed edges of panels as specified by grade requirements.

2.06 SHOP FINISHING

- A. Shop finish work in accordance with AWI Section 1500. No field finishing permitted except for minor retouching.
- B. Sand work smooth and set exposed nails and screws.
- C. Apply wood filler in exposed nail and screw indentations.

- D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
1. Transparent:
 - a. Satin - Polyurethane.
 - b. Sheen: Satin.
 - c. Stain: As selected by Architect
 2. Sealer:
 - a. Benjamin Moore: Sanding Sealer Clear No. 253.
 - b. Fuller O'Brien: Super Nap Seal and Finish No 255-04.
 - c. PPG: Speedhide Alkyd Sanding Sealer, 6-10.
- E. Apply 2 coats of sealer of concealed surfaces.

END OF SECTION

**SECTION 07 0150.19
PREPARATION FOR RE-ROOFING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Partial removal of existing roofing system in preparation for a new roof membrane system.
- B. Removal of existing roofing system in preparation for a new roof membrane system.
- C. Temporary roofing protection.

1.02 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 2200 - Unit Prices, for additional unit price requirements.
 - 1. New Insulation:
 - a. Basis of Measurement: By the square foot.
 - b. Basis of Payment: Includes complete removal of existing wet or water damaged insulation, replace with new insulation of same thickness.

1.03 REFERENCE STANDARDS

- A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012.
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with affected mechanical and electrical work associated with roof penetrations.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
- C. Schedule work to coincide with commencement of installation of new roofing system.

1.05 QUALITY ASSURANCE

- A. Materials Removal Company Qualifications: Company specializing in performing work of type specified with at least five years of documented experience.

1.06 FIELD CONDITIONS

- A. Do not remove existing roofing membrane when weather conditions threaten the integrity of the building contents or intended continued occupancy.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Temporary Roofing Protection Materials:
 - 1. Plastic Sheeting: Provide polyethylene sheets; use weights to retain sheeting in position.
- B. Protection Board: ASTM C208 cellulose fiber board, one face finished with mineral fiber, asphalt, and kraft paper.
 - 1. Provide protection board with the following characteristics:
 - 2. Board Size: 48 X 96 inch.
 - 3. Board Thickness: 3/4 inch.
 - 4. Board edges: Square.
- C. Recover Board: Glass mat faced gypsum panels, ASTM C1177, moisture- and fire-resistant board with factory applied acrylic primer coating.
 - 1. Board size: 4 feet X 8 feet
 - 2. Board Thickness: 1/4 inch.
 - 3. Thermal Insulance (R Value): 0.28
 - 4. Board edges: Square.
 - 5. Products: Temple-Inland Building Products by Georgia-Pacific, LLC; GreenGlass Roof Board or GreenGlass Primed Roof Board: www.temple.com.

END OF SECTION

**SECTION 07 1400
FLUID-APPLIED WATERPROOFING**

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 ABBREVIATIONS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 PRODUCTS

2.01 WATERPROOFING APPLICATIONS

2.02 FLUID APPLIED WATERPROOFING MATERIALS

END OF SECTION

SECTION 07 2100 THERMAL INSULATION

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, underside of floor slabs, and exterior wall behind masonry or siding wall finish.
- B. Batt insulation in exterior and interior wall, ceiling, and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2009a.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- H. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
- I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- J. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Installation schedule: Provide description of locations where each proposed product will be installed. Include description of compliance with fire rated, acoustical and NFPA 285 details.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.04 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATION SCHEDULE

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundations, below grade: Extruded polystyrene (XPS) board.

- C. Insulation at Perimeter of Foundations, above grade: Mineral Wool Board.
- D. Insulation as Protection Board at Foundations, below grade only: Extruded polystyrene (XPS) board.
- E. Insulation Inside Cavity of Masonry Veneer Walls, below grade only: Extruded polystyrene (XPS) board.
- F. Insulation on Inside Cavity of Masonry Veneer Walls, above grade: _____ board.
- G. Insulation on exterior face of sheathing: Mineral Wool board.
- H. Insulation behind exterior Metal Wall Panels: Mineral Wool board.
- I. Insulation inside STC and Fire Rated partitions: SAFB Mineral Wool Insulation, no vapor retarder.
- J. Insulation inside exterior metal framing walls: Batt insulation with no vapor retarder
- K. Insulation inside metal framed partitions: Batt insulation with no vapor retarder.
- L. Insulation inside Wood Framed Walls: Batt insulation with no vapor retarder.
- M. Insulation in Framed Ceiling Structure: Batt insulation with separate vapor retarder.
- N. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

2.02 BOARD INSULATION MATERIALS

- A. Extruded Polystyrene Board Insulation (**XPS**): ASTM C578, Type IV; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Size: 48 x 96 inch.
 - 4. Board Thickness: 1-1/2 inches, or unless indicated otherwise.
 - 5. Board Edges: Shiplap.
 - 6. Thermal Conductivity (k factor) at 25 degrees F: 0.18 (R= 5 minimum per inch).
 - 7. Compressive Resistance: 25 psi.
 - 8. Manufacturers:
 - a. Dow Chemical Company: www.dow.com/#sle.
 - b. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi: www.kingspan.com/#sle.
 - c. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Mineral Wool Board Insulation: Rigid or semi-rigid stone wool insulation, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Combustibility: Behavior of material at 750 degrees as non-combustible per ASTM E136.
 - 2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 - 3. Board Size: 16 by 48 inches standard, size varies by manufacturer.
 - 4. Board Thickness: 2 inches and/or as indicated on drawings.
 - 5. Thermal Resistance: R-value of 4.3 per inch at 75 degrees F, minimum, when tested according to ASTM C518.
 - 6. Minimum Density: 4.3 pound per cubic foot, nominal.
 - 7. Manufacturers:
 - a. Johns Manville; CladStone 45 _____: www.jm.com/#sle.
 - b. ROCKWOOL (ROXUL, Inc); CAVITYROCK: www.rockwool.com/#sle.
 - c. Thermafiber, Inc; RainBarrier ic HC 80 _____: www.thermafiber.com/#sle.
 - 8. Substitutions: See Section 01 6000 - Product Requirements.

2.03 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or SAFB mineral wool insulation may be used, at Contractor's option, unless specifically noted or required otherwise.
 - 1. Use Sound Attenuation Fire Blanket (SAFB) Mineral Wool at all fire rated assemblies and STC rated wall per drawings and partition schedule and as required by code/UL test.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
 - 4. Formaldehyde Content: Zero.
 - 5. Thermal Resistance: R-value of 3.5 per inch minimum.
 - 6. Thickness: Match cavity thickness or as indicated on drawings or insulation schedule.
 - 7. Facing: Unfaced.
 - 8. Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com/#sle.
 - b. Johns Manville: www.jm.com/#sle.
 - c. Knauf Insulation GmbH: www.knaufinsulation.us.
 - d. Owens Corning Corp: www.owenscorning.com.
 - 9. Substitutions: See Section 01 6000 - Product Requirements.
- C. Sound Attenuation Fire Blanket (SAFB) Mineral Wool: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 - 3. Thermal Resistance: R-value of 3.5 per inch, minimum.
 - 4. Thickness: Match cavity thickness, indicated on drawings or per insulation schedule.
 - 5. Manufacturers:
 - a. Knauf Insulation; EcoBatt Insulation: www.knaufinsulation.com/#sle.
 - b. Thermafiber, Inc; SAFB: www.thermafiber.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

- A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
- B. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- C. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- D. Protection Board for Below Grade Insulation: XPS, 2 inch thick.
- E. Adhesive: Type recommended by insulation manufacturer for application.
- F. Spray-foam Insulation: See also Section 07 2119.
 - 1. Polyurethane expanding foam.
 - 2. Products: DuPont Great Stuff; www.greatstuff.dupont.com
 - 3. Dupont Great Stuff

END OF SECTION

**SECTION 07 2119
FOAMED-IN-PLACE INSULATION**

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Foamed-in-place insulation installed as part of the exterior building thermal envelope.
- B. At junctions of dissimilar wall and roof materials.
- C. Protective intumescent coating.

1.02 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- B. ASTM D1622/D1622M - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2014.
- C. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- F. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements and shop drawings identifying locations being applied.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.
- D. Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- B. Field Density testing: Take field samples daily and provide report on density of samples.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame and smoke limitations.

1.07 MOCK-UP

- A. Locate where directed.
- B. Mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 degrees F of dew point.

PART 2 PRODUCTS

MANUFACTURERS

1.01 FOAMED-IN-PLACE INSULATION:

63337

CAW JTH Administration Building

07 2119-238

FOAMED-IN-PLACE
INSULATION
03/28/2025

- A. BASF Corporation; WALLTITE US Series Closed Cell: www.spf.basf.com/#sle.
- B. Icynene-Lapolla; Icynene ProSeal (MD-C-200 v3): www.icynene.com/#sle.
- C. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com/#sle.
- D. Substitutions: See Section 01 6000 - Product Requirements.

1.02 MATERIALS

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
 - 1. Thermal Resistance: R-value of 5.0, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.
 - 2. Water Vapor Permeance: Vapor retarder; 2 perms, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
 - 3. Water Absorption: Less than 1 percent by volume, maximum, when tested in accordance with ASTM D2842.
 - 4. Air Permeance: 0.04 cfm per square foot, maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf.
 - 5. Closed Cell Content: At least 90 percent.
 - 6. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
 - 7. Density: 2.0 lbs/cuft, nominal, in accordance with ASTM D1622/D1622M.

1.03 ACCESSORIES

- A. Primer: As required by insulation manufacturer.
- B. Overcoat: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes.

END OF SECTION

SECTION 07 2500 WEATHER BARRIERS

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Weather Barrier Assemblies: Under exterior wall cladding, integral with sheathing or applied to substrate; that resists the transmission of air and is moisture permeable.
- B. Transition Membrane: Membrane products that span joints between different types of substrates to provide continuity
- C. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.
- D. Flashing: Materials that form a system to move liquid water to the outside of the exterior walls typically occurring at wall transitions and openings.

1.02 REFERENCE STANDARDS

- A. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; 2014.
- B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).
- C. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- F. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.
- G. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; ICC Evaluation Service, Inc.; 2015.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: Provide drawings of special joint conditions.

1.04 MOCK-UP

- A. Install weather barrier materials in mock-up.

1.05 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

- A. Air Barrier:
 - 1. At concrete walls: On the outside surface of the concrete use air barrier coating.
 - 2. At Masonry wall construction: On outside surface of inside wythe of exterior masonry cavity walls use air barrier coating.
 - 3. At framed walls with Masonry Veneer: Use wall sheathing with integral weather barrier as specified in section 06 1000 Rough Carpentry. Joint and perimeter treatments per 07 2500 Weather Barriers.
 - 4. At mechanically attached siding: Use wall sheathing with integral weather barrier as specified in section 06 1000 Rough Carpentry. Joint and perimeter treatment per 07 2500 Weather Barriers.

5. At E.I.F.S.: On outside surface of sheathing of exterior walls use air barrier/water barrier as part of E.I.F.S. system. Refer to Exterior Insulation and Finish Systems Section 07 2400.
 6. At framed walls with Metal Wall Panels: Use wall sheathing with integral weather barrier as specified in section 06 1000 Rough Carpentry. Joint and perimeter treatment per 07 2500 Weather Barriers.
- B. Vapor Retarder:
1. At underside of slab on grade concrete floors use vapor retarder sheet. Reference specification 03 3000.

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier (Weather Barrier) Coating:
1. Material: Water-based acrylic or polymer-modified bitumen.
 2. Dry Film Thickness: 20 mils (0.020 inch), minimum. Verify with manufacturer.
 3. Air Permeance: 0.004 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
 4. Water Vapor Permeance: 12 perms, minimum, when tested in accordance with ASTM E96/E96M, Procedure B.
 5. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for up to 4 months of weather exposure after application.
 6. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
 7. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 8. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
 9. VOC Content: 25 g per L or less.
 10. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
 11. Manufacturers:
 - a. BASF Corporation; ENERSHIELD-HP: www.master-builders-solutions.basf.us/#sle.
 - b. Carlisle Coatings and Waterproofing, Inc.; Barritech-VP: www.carlisle-ccw.com.
 - c. DuPont Building Innovations; Tyvek Fluid Applied WB, Fluid Applied Flashing - Brush Formulation, Fluid Applied Flashing & Joint Compound, and Sealant for Fluid Applied System: www.dupont.com.
 - d. Parex USA, Inc; Parex USA WeatherSeal Spray & Roll-on: www.parexusa.com/#sle.
 - e. PROSOCO, Inc; R-GUARD Spray Wrap MVP: www.prosoco.com/r-guard/#sle.
 - f. W.R. Meadows, Inc.; Air-Shield LMP: www.wrmeadows.com.
 - g. Tremco; ExoAir 230: www.tremcosealants.com.
 - h. Substitutions: See Section 01 6000 - Product Requirements.

2.03 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

- A. Vapor Retarder Sheet : See specification section 03 3000.

2.04 SEALANTS

- A. Butyl Sealant: as specified in Section 07 9200.
- B. Sealants: as specified in Section 07 9200.
- C. Polyurethane Sealant: as specified in Section 07 9200.
- D. Sealant Backers: As specified in Section 07 9200.
- E. Primers, Cleaners, and Other Sealant Materials: As recommended by sealant manufacturer, appropriate to application, and compatible with adjacent materials.

2.05 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
 - 1. Thickness: 40 mil, 0.040 inch, nominal.
 - 2. Manufacturers:
 - a. Carlisle Coatings and Waterproofing, Inc.; CCW-705 TFW: www.carlisle-ccw.com.
 - b. Intertape Polymer Group, Inc; NovaFlash SA Universal Self-Adhered Flashing (25 mil): www.itape.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- C. Liquid Flashing for sheathing with integral weather barrier: One part, fast curing, non-sag, gun grade, trowelable liquid flashing.
 - 1. Georgia Pacific LLC; DensDefy Liquid Flashing: www.gpgypsum.com.
- D. Transition Membrane for sheathing with integral weather barrier: Self-adhering flexible membrane:
 - 1. Georgia Pacific LLC; DensDefy Transition Membrane: www.gpgypsum.com.
- E. Thinners and Cleaners: As recommended by material manufacturer.
- F. Dust resistant cap screws, length as necessary to penetrate sheathing with plastic screw caps that seal penetration air tight.
 - 1. Tyvek Wrap cap screws, by DuPont, with 2 inch diameter caps.
 - 2. Approved equal.
- G. Seam Tape: Dupont Tyvek Tape as distributed by DuPont.

END OF SECTION

**SECTION 07 4213
METAL WALL PANELS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Manufactured metal panels for exterior wall panels, interior liner panels, soffit panels, and subgirt framing assembly, with insulation, related flashings, and accessory components.

1.02 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate dimensions, layout, joints, construction details, _____, and methods of anchorage.
- C. Samples: Submit two samples of wall panel and soffit panel, 12 inch by 12 inch in size illustrating finish color, sheen, and texture.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.
- F. Test Reports showing compliance for reference standards.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- B. Installer Qualifications: Company specializing in installing products of the type specified in this section with minimum five years of documented experience.

1.05 MOCK-UP

- A. Construct mock-up, 3 feet long by 3 feet wide; include panel and soffit system, glazing, attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, related insulation in mock-up.
- B. Locate where directed by Architect.
- C. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

1.07 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Manufacturer Warranty:

1. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of no less than 20 year period from date of Substantial Completion.
- C. Installer's warranty: Provide warranty in which installer agrees to repair and replace components of the wall panel system that fail in material or workmanship within 2 years from the date of substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Wall Panels - Concealed Fasteners:
 1. Morin Corporation: www.morincorp.com/#sle.
 2. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
 3. Centria, www.centria.com.
 4. IMETCO, www.imetco.com.
 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MANUFACTURED METAL PANELS

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
 1. Provide exterior wall panels, interior liner panels, soffit panels, and subgirt framing assembly.
 2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
 3. Design Pressure: In accordance with ASCE 7, wind loads as indicated on structural plans and applicable codes.
 4. Maximum Allowable Deflection of Panel: $L/180$ for length(L) of span.
 5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
 6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
 7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
 8. Corners: Factory-fabricated in one continuous piece with minimum 2 inch returns or in profiles as indicated on plans.
- B. Exterior Wall Panels:
 1. Profile: Vertical and horizontal, as indicated; style as indicated.
 - a. Metal Wall Panel (MWP-1):
 - 1) Panel width: 16 inches.
 - 2) Material: Precoated galvanized sheet steel, 24 gauge, 0.0276 inch minimum thickness.
 - 3) Basis of Design - Morin Integrity X-16
 - b. Metal Wall Panel (MWP-2):
 - 1) Panel width: 12 inches.
 - 2) Material: Precoated galvanized sheet steel, 24 gauge, 0.0276 inch minimum thickness.
 - 3) Basis of Design - Morin Integrity mix of 50% XD-12 and 50% XF-12
 - (a) See Drawings for Pattern
 2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
- C. Soffit Panels:
 1. Profile: Basis of Design - Morin Primo PS 12-2.

- 2. Material: Precoated steel sheet, 24 gage, 0.0276 inch minimum thickness.
- D. Subgirt Framing Assembly:
 - 1. 14 gage, 0.0785 inch thick formed non-precoated steel sheet spaced to comply with ASCE 7 wind loads.
- E. Internal and External Corners: Standard Mitered Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- F. Internal and External Corners: Micro-Seam Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles; factory soldered together.
- G. Expansion Joints: Same material, thickness and finish as exterior sheets; ____ gage, ____ inch thick; manufacturer's standard brake formed type, of profile to suit system.
- H. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- I. Anchors: Galvanized steel.

2.03 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
- B. Precoated Aluminum Sheet: ASTM B209 (ASTM B209M), 3105 alloy, O temper, smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 FINISHES

- A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer. Full color options to include Metallics and Micas.
- B. Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.
- C. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as selected by Architect from manufacturer's standard line.
 - 1. Manufacturers:
 - a. PPG Metal Coatings; Duranar: www.ppgmetalcoatings.com/#sle.
 - b. Valspar; Fluoropon: www.valsparcoilextrusion.com/#sle.

2.05 ACCESSORIES

- A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- B. Concealed Sealants: Non-curing butyl sealant or tape sealant.
- C. Sealants: As specified in Section 07 9005.
- D. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.
- E. Field Touch-up Paint: As recommended by panel manufacturer.
- F. Bituminous Paint: Asphalt base.

END OF SECTION

**SECTION 07 5400
THERMOPLASTIC MEMBRANE ROOFING**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Single ply thermoplastic roofing membrane fully adhered system.
- B. Insulation, flat and tapered.
- C. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.02 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- D. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- E. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing; 2013.
- F. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011.
- G. FM (AG) - FM Approval Guide; current edition.
- H. FM DS 1-28 - Wind Design; 2007.
- I. NRCA (RM) - The NRCA Roofing Manual; 2017.
- J. NRCA (WM) - The NRCA Waterproofing Manual; 2005.
- K. UL (FRD) - Fire Resistance Directory; current edition.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for membrane materials including flashing materials, insulation, fasteners, and adhesives.
 - 1. LEED Submittals: Include testing documentation for solar reflectance index.
- C. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, mechanical fastener layout, and paver layout.
 - 1. Include UL Assembly and FM Assembly Compliance.
- D. Wind resistance documentation including uplift wind pressures, calculations, assembly installation methods and manufacturer's certification on uplift pressures.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Installer's Qualification Statement.
- G. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions.
- H. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.

I. Manufacturer's Qualification Statement.

- J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer. Provide letter from manufacturer indicating intent to warrant the roofing system.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- B. Store materials in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

1.07 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Manufacturer's Warranty:
1. Material Warranty: Provide single-source manufacturer's No Dollar Limit (NDL) warranty for weathertightness of roofing system, include agreement to repair and/or replace roofing that fails to keep out water within specified warranty period of 20 years from date of Substantial Completion.
 2. Warranty coverage to include roofing membrane, base flashings, liquid applied flashing, roofing membrane accessories, roof insulation, fasteners, cover board, walkway products, manufacturer's expansion joints, edge metal products, parapet caps, and other single-source components of roofing system marketed by the manufacturer.
- C. Installer's Warranty: Provide warranty in which installer agrees to repair and replace components of the roofing system that fail in materials or workmanship within 2 years from the date of Substantial Completion.
1. Warranty coverage to include work of the Section, including all components of roofing system such as membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders and walkway products.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thermoplastic Polyolefin (TPO) Membrane Materials:
1. Carlisle Roofing Systems, Inc; Sure-Weld TPO: www.carlisesyntec.com.
 2. Firestone Building Products, LLC: www.firestonebpco.com/#sle.
 3. Johns Manville Corporation JM TPO: www.jm.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation:
1. Atlas Roofing Corporation: www.atlasroofing.com.
 2. Carlisle SynTec; SecurShield Insulation: www.carlisle-syntec.com/#sle.
 3. GAF: www.gaf.com/#sle.
 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING SYSTEM DESCRIPTION

- A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.
- B. Roofing System Requirements:
 - 1. Warranty: Full system warranty covering membrane, roof insulation, and membrane accessories.
 - 2. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E1980.
 - a. Field applied coating may not be used to achieve specified SRI.
 - 3. Roof Covering External Fire Resistance Classification: UL (FRD) Class A.
 - 4. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.
 - 5. Wind resistance: Roofing system must be successfully tested by a qualified testing agency following ANSI/FM 4474 to resist the design uplift pressures calculated by the American Society of Civil Engineers (ASCE) 7 and after multiplying the results with a safety factor (determined by design professional), but assembly uplift pressures shall be not less than 60 lbs. / sq. ft.
 - 6. Insulation Thermal Resistance (R-Value): 3 per inch, minimum; provide insulation of thickness required to achieve minimum LTTR of 26 at any location.
- C. Roofing System Components: Listed in order from the top of the roof down:
 - 1. Membrane: Thicknesses as specified, fully adhered.
 - 2. Coverboard Over Insulation: Mechanically attached.
 - 3. Insulation: Mechanically attached.
 - 4. Structural base.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

- A. Membrane Roofing Materials:
 - 1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
 - a. Thickness: 60 mil, 0.060 inch, minimum.
- B. Flexible Flashing Material: Same material as membrane.
- C. Water Pervious Fabric: Woven polyethylene, UV stabilized, open to moisture movement, black.

2.04 DECK SHEATHING & COVERBOARD

- A. Deck Sheathing & Coverboard : Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
 - 1. Thickness: 5/8 inch, Type X, fire resistant.
 - 2. Manufacturers:
 - a. Georgia-Pacific; DensDeck Prime with EONIC Technology:
www.densdeck.com/#sle.

2.05 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type II:
 - 1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
 - 3) Thermal Resistance, R-value: At 1-1/2 inch thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F.
 - 2. Board Size: 48 by 96 inch.
 - 3. Board Thickness: 2.0 inch. minimum. Provide insulation in layers as necessary to achieve specified LTTR, minimum 2 layers of insulation.
 - 4. Tapered Board: Slope as indicated; minimum thickness 0.5 inch; fabricate of fewest layers possible.

2.06 ACCESSORIES

- A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- B. Sheet Metal Flashings: See Section 07 6200.
- C. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
 - 1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
- D. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- E. Insulation Adhesive: As recommended by insulation manufacturer.
- F. Sealants: As recommended by membrane manufacturer.
- G. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
 - 1. Composition: Roofing membrane manufacturer's standard.
 - 2. Size: 18 by 18 inch.
 - 3. Surface Color: White or yellow.

END OF SECTION

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.
- B. Sealants for joints within sheet metal fabrications.
- C. Sheet metal splash pans.

1.02 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- E. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2009.
- F. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007 (Reapproved 2012).
- G. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- H. CDA A4050 - Copper in Architecture - Handbook; current edition.
- I. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, material thickness, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit one sample, 12 x 12 inch minimum in size illustrating material and fabrication details of typical standing seam profiles.
- D. Samples: Submit two samples 2 x 3 inch in size illustrating metal finish color.
 - 1. Color chart can be submitted preliminary as long as a physical sample is submitted for final approval

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.
- C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 3 years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

- B. Reference roofing specifications for warranty limits and terms that apply. Products or fabrications installed with the roofing system to contain manufacturer's warranty as specified in roofing specification section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sheet Metal Flashing and Trim Manufacturers:
 - 1. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
 - 2. Metal Era Inc. www.metalera.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SHEET MATERIALS

- A. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 0.032 inch thick minimum; plain finish shop pre-coated with fluoropolymer coating.
 - 1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: As selected by Architect from manufacturer's standard colors.

2.03 FABRICATION

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Form sections true to shape, accurate in size, square, and free from distortion or defects. Fabricate metal flashing and trim without excessive oil canning, buckling and tool marks, true to line and levels indicated with exposed edges folded back to form hems.
- D. Form pieces in longest possible lengths to a maximum of 15 feet unless specifically approved otherwise by Architect. Treat seams between two different pieces with flat-lock seams at non-moving joints, unless otherwise indicated. At moving seams, use seated, lapped, bayonet type or interlocking hooked seams.
- E. All exposed edges to be folded back with hem of 1/2 inch; miter and seam corners.
- F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- G. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- H. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joint of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints. Provide for expansion no more than in 40 feet long sections.
- I. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- J. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than the thickness of the metal being secured.

2.04 GUTTER AND DOWNSPOUT FABRICATION

- A. Gutters: SMACNA Architectural Sheet Metal Manual, Square profile - 6".
 - 1. Lengths to be continuous no longer than 40 foot sections.
 - 2. Joints to be flat-lock seam with sealant.

3. Corners to be factory mitered and welded.
 4. Expansion joints to have end of each gutter capped, allow for 1" of expansion between gutters and covered with coverplate.
- B. Downspouts: Rectangular profile 4" wide x 3" deep or unless indicated otherwise.
1. Same as Gutters except: Vertical seams to be Double Corner Seam with sealant.
- C. Accessories: Profiled to suit gutters and downspouts.
1. Anchorage Devices: In accordance with SMACNA requirements with Stainless Steel or Aluminum fasteners.
 2. Gutter Supports: Straps of size per SMACNA requirements, but not less than twice the thickness of the gutter material.
 3. Downspout Supports: Straps.
 4. Valley Diverters: 12-inch x 12-inch minimum at valley, 0.040 inch thick minimum. Extend a minimum of 4" above eave edge.
- D. Splash Pans: Same metal type as downspouts, formed to 8 by 12 inch size; rolled sides of 3 inch high for inverted pan placement.
- E. Seal metal joints, see Joint Sealants.

2.05 ACCESSORIES

- A. Fasteners: Aluminum or Stainless Steel, with soft neoprene washers.
- B. Underlayment: ASTM D226/D226M, organic roofing felt, Type I (No. 15).
- C. Protective Backing Paint: Zinc molybdate alkyd.
- D. Concealed Sealants: Non-curing butyl sealant.
- E. Flexible Flashing: Self-adhered flashing as specified in Section 07 2500.
- F. Sealants: Type as specified in Section 07 9200.
- G. Plastic Cement: ASTM D4586/D4586M, Type I.

2.06 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Manufactured Straight and Radius Copings: See Section 07 7100.
- B. Manufactured Roof Edge / Gravel Stop Edge: See Section 07 7100.
- C. Accessories:
1. Splice Plates: Same thickness as coping, minimum.
 2. Cleats: Same thickness as coping, minimum.

2.07 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Constructions: Fabricate head, sill and similar flashing to extend beyond openings as indicated. Unless otherwise indicated, form head and sill flashing with 2-inch high end dams.

2.08 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Beam and Column Surrounds: Fabricate as detailed, reinforced as required for a smooth, even appearance without oil-canning or distortions, with tight seams and all exposed edges hemmed.

END OF SECTION

SECTION 07 7100 ROOF SPECIALTIES

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Factory manufactured roof specialties, including straight and radius copings, fascias, gravel stops, vents, and roof edges.
- B. Roof expansion joints and covers.

1.02 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.
- C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- D. NRCA (RM) - The NRCA Roofing Manual; 2017.
- E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
- D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

1.04 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty:
 - 1. Material Warranty: Provide warranty to repair and/or replace components that fails to keep out water within specified warranty period of 20 years from date of Substantial Completion. Warranty must be compatible with overall roofing system manufacturer.
 - 2. Performance Warranty: Provide warranty to repair and/or replace components that fails to withstand 120 mph wind speeds for specified warranty period of 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Straight Copings and Roof Edges:
 - 1. Architectural Products Co: www.archprod.com/#sle.
 - 2. Metal-Era Inc: www.metalera.com/#sle.
 - 3. Peterson Aluminum Corp; www.pac-clad.com
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Radius Copings:
 - 1. Metal Era Inc: www.metalera.com.
 - 2. Peterson Aluminum Corp; www.pac-clad.com
 - 3. Substitutions: See Section 01 6000- Product Requirements.
- C. Pipe and Penetration Flashings:
 - 1. Portals Plus: www.portalsplus.com/#sle.

2.02 COMPONENTS

- A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
 - 1. Configuration: Fascia, cant, and edge securement for roof membrane.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
 - 3. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
 - 4. Finish: 70 percent polyvinylidene fluoride.
 - 5. Color: To be selected by Architect from manufacturer's standard ranges, including metallics.
 - 6. Manufacturers:
 - a. Basis of Design: Peterson Aluminum Corp; Pac-Loc Fascia 2000: www.pac-clad.com
- B. Straight Copings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners, .
 - 1. Configuration: Concealed 20 ga. hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners. Cleat to be nominal 1'-0" in width and located at approximately 4'-0" o.c.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
PICK THICKNESS OF ALUMINUM, REFER TO SMACNA FOR GUIDELINES.
 - 3. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
 - 4. Finish: 70 percent polyvinylidene fluoride.
 - 5. Color: To be selected by Architect from manufacturer's standard range.
 - 6. Manufacturers:
 - a. Basis of Design: Peterson Aluminum Corp; Pac-Tite: www.pac-clad.com
- C. Radius Copings: Fabricate to sizes required; welded corners; concealed fasteners.
 - 1. Configuration: Concealed 20ga hold down cleat at both legs; internal splice piece at joints of same material thickness as cap; concealed stainless steel fasteners. Cleat to be 1'-0" in width and located at approximately 4'-0" o.c.
 - 2. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
 - 3. Finish: 70 percent polyvinylidene fluoride.
 - 4. Color: To be selected by Architect from manufacturers standard range.
 - 5. Factory fabricate radiused copings to provide seamless, non-segmented curve, with welded or non-penetrating fastened seams.
 - 6. Fabricate in sections no smaller than 4-foot and no larger than 10-foot.
- D. Control and Expansion Joint Covers: Composite construction of 4 inch wide flexible EPDM flashing of black color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 2 inch. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.

2.03 FINISHES

- A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as selected from manufacturer's standard colors.

2.04 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer. Type as specified in Section 07 9200.
- B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

- C. Roof Cement: ASTM D4586/D4586M, Type II.
- D. Flexible Flashing: See Section 07 2500.
- E. Fasteners: Stainless steel screw type with a minimum pull-out resistance of 240 # (109 kg) as supplied by the manufacturer per substrate application. No exposed fasteners shall be permitted.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Conform to SMACNA Architectural Sheet Metal Manual (ASMM) drawing details.
- C. Roof Edge, Specialty Coping and Radius Copings: Anchor to resist uplift and outlet forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Comply with installation requirements of roofing manufacturer regarding spacing of anchors below membrane flashing in field of roof.
 - 1. Install flexible flashing covering entire substrate beneath coping; not required where roofing membrane extends beneath coping. Seal perimeters against weather barrier and/or roofing.
 - 2. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at minimum 8 inch centers.
- D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION

SECTION 07 7200 ROOF ACCESSORIES

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Roof hatches.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
 - 1. Non-penetrating Rooftop Supports: Submit design calculations for loadings and spacings.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 ROOF HATCHES

- A. Roof Hatch Manufacturers:
 - 1. Acudor Products Inc; Galvanized Steel Roof Hatch: www.acudor.com/#sle.
 - 2. Bilco Company; Type TB (various types and special size): www.bilco.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
 - 1. Style: Provide flat metal covers unless otherwise indicated.
 - 2. Mounting Substrate: Provide frames and curbs suitable for mounting on standing seam metal roof panel system.
 - 3. For Ladder Access: Single leaf; 30 by 36 inches.
 - 4. For Ships Ladder Access: Single leaf; 30 by 54 inches.
- C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
 - 1. Material: Stainless steel, Type 304, 14 gage, 0.0747 inch thick.
 - 2. Finish: Factory prime paint.
 - 3. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
 - 4. Curb Height: 12 inches from finished surface of roof, minimum.
- D. Metal Covers: Flush, insulated, hollow metal construction.
 - 1. Capable of supporting 40 psf live load.
 - 2. Material: Galvanized steel; outer cover 14 gage, 0.0747 inch thick, liner 22 gage, 0.03 inch thick.
 - 3. Finish: Factory prime paint.
 - 4. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
 - 5. Gasket: Neoprene, continuous around cover perimeter.
- E. Safety Railing System: Manufacturer's standard accessory safety rail system mounted directly to curb.
 - 1. Comply with 29 CFR 1910.23, with a safety factor of two.

2. Posts and Rails: Aluminum tube.
 3. Gate: Same material as railing; automatic closing with latch.
 4. Finish: Manufacturer's standard, factory applied finish.
 5. Mounting Brackets: Hot dipped galvanized steel, 1/4 inch thick, minimum.
 6. Fasteners: Stainless steel, Type 316.
 7. Manufacturers:
 - a. BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- F. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
 2. Hinges: Heavy duty pintle type.
 3. Hold open arm with vinyl-coated handle for manual release.
 4. Latch: Upon closing, engage latch automatically and reset manual release.
 5. Manual Release: Pull handle on interior.
 6. Locking: Padlock hasp on interior.
- G. Ladder Safety Post: Manufacturer's standard accessory ladder safety post extension to extend 42 inches above a landing platform with spring assisted telescoping design.
1. Post: Powder coated steel, safety yellow color.
 2. Accessories: As required for a complete installation.
 3. Provide at all roof hatches with vertical fixed ladder below.
 4. Manufacturers:
 - a. Babcock-Davis Inc.; Model BSP: www.babcockdavis.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements

END OF SECTION

SECTION 07 8400 FIRESTOPPING

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not.

1.02 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; current edition.
- B. FM (AG) - FM Approval Guide; current edition.
- C. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.
- D. UL (FRD) - Fire Resistance Directory; current edition.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, locations of all rated walls with type of fire stopping system proposed, fire rating of the penetrated assembly, locations of all rated walls with type of fire stopping system proposed, firestopping test or design number, and locations of all rated walls with type of fire stopping system proposed.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Certificate from authority having jurisdiction indicating approval of materials used.
- F. Installer Qualification: Submit qualification statements for installing mechanics.

1.04 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Verification of minimum three years documented experience installing work of this type.

1.05 MOCK-UP

- A. Install one firestopping assembly representative of each fire rating design required on project.
- B. If accepted, mock-up may remain and represent minimum standard of the Work. Remove and replace mock-ups not accepted.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Prohibited Materials: Do not use any product that contains asbestos..

- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.02 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
- B. Firestopping at Uninsulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches or less: Caulk or putty.
- C. Firestopping at Combustible Pipe and Conduit Penetrations, of diameter 4 inches or less: Any material meeting requirements.
- D. Firestopping at Cable Tray Penetrations: Any material meeting requirements.
- E. Firestopping at Cable Penetrations, not in Conduit or Cable Tray: Any material meeting requirements.
- F. Firestopping at Control Joints (without Penetrations): Any material meeting requirements.
- G. Firestopping Between Edge of Floor Slab and Curtain Wall: Fiber firestopping with smoke seal coating.
- H. Firestopping Between Top of Partition Wall and Roof Slab: Fiber firestopping with smoke seal coating.
- I. Temporary Firestopping: Reusable intumescent shapes.

2.03 MATERIALS

- A. Firestopping Sealants: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- B. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 1. Color: Dark Grey or Red
 - 2. Manufacturers:
 - a. A/DFire Protection Systems Inc: www.adfire.com.
 - b. 3M Fire Protection Products: www.3m.com/firestop.
 - c. Hilti, Inc: www.us.hilti.com.
 - d. Specified Technologies, Inc: www.stifirestop.com.
- C. Foam Firestopping: Single component silicone foam compound.
 - 1. Color: Dark Grey or Red.
 - 2. Manufacturers:
 - a. 3M Fire Protection Products: www.3m.com/firestop.
 - b. Hilti, Inc: www.us.hilti.com.
 - c. Specified Technologies, Inc: www.stifirestop.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- D. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers.
 - 1. Color: Dark Grey.
 - 2. Manufacturers:
 - a. A/DFire Protection Systems Inc: www.adfire.com.
 - b. USG: www.usg.com.
- E. Fiber Firestopping: Mineral fiber insulation used in conjunction with elastomeric surface sealer forming airtight bond to opening.
 - 1. Manufacturers:
 - a. A/DFire Protection Systems Inc: www.adfire.com.
 - b. Pecora Corporation: www.pecora.com.
 - c. Thermafiber, Inc: www.thermafiber.com.

- F. Firestop Devices - Wrap Type: Mechanical device with incombustible filler and sheet stainless steel jacket, intended to be installed after penetrating item has been installed; conforming to the following:
1. Manufacturers:
 - a. RectorSeal: www.rectorseal.com.
 - b. 3M Fire Protection Products: www.3m.com/firestop.
 - c. Hilti, Inc: www.us.hilti.com.
 - d. Specified Technologies, Inc: www.stifirestop.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- G. Firestop Devices - Cast-In Type: Sleeve and sealing material, intended to be cast in concrete floor forms or in concrete on metal deck, not requiring any additional materials to achieve penetration seal.
1. Manufacturers:
 - a. 3M Fire Protection Products: www.3m.com/firestop.
 - b. Hilti, Inc: www.us.hilti.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- H. Intumescent Putty: Compound that expands on exposure to surface heat gain; conforming to the following:
1. Potential Expansion: Minimum 1000 percent.
 2. Color: Red.
 3. Manufacturers:
 - a. RectorSeal: www.rectorseal.com.
 - b. 3M Fire Protection Products: www.3m.com/firestop.
 - c. Hilti, Inc: www.us.hilti.com.
 - d. Specified Technologies, Inc: www.stifirestop.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- I. Reusable Firestopping: Removable intumescent compressible shapes, pillows, or blocks specifically tested in removable configuration.
1. Manufacturers:
 - a. RectorSeal: www.rectorseal.com.
 - b. Hilti, Inc: www.us.hilti.com.
 - c. Nelson FireStop Products: www.nelsonfirestop.com.
 - d. Specified Technologies, Inc: www.stifirestop.com.
- J. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

END OF SECTION

SECTION 07 9200 JOINT SEALANTS

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2006 (Reapproved 2011).
- B. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).
- F. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.
- G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).
- H. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.
- I. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2005 (Reapproved 2010).
- J. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Sample product warranty.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- F. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.04 MOCK UP

- A. Provide mock-up of sealant joints in conjunction with wall and air barrier system.

- B. Construct mock-up with specified sealant types and with other components noted.
- C. Locate where directed. Mockup may remain as part of the Work.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Field Quality Control Plan:
 - 1. Visual inspection of entire length of sealant joints.
 - 2. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
 - a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
 - b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
 - 3. Field testing agency's qualifications.
- E. Field Adhesion Test Procedures:
 - 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 - 2. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 3. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 - 4. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
 - 5. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- F. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
 - 1. Sample: At least 18 inches long.
 - 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
 - 3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

1.06 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 - 1. Dow Corning Corporation: www.dowcorning.com/construction/#sle.
 - 2. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.

3. Pecora Corporation: www.pecora.com.
 4. Sherwin-Williams Company: www.sherwin-williams.com.
 5. Sika Corporation: www.usa-sika.com.
 6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
- B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
1. Dow Corning Corporation: www.dowcorning.com/construction/#sle.
 2. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
 3. Pecora Corporation: www.pecora.com.
 4. Sherwin-Williams Company: www.sherwin-williams.com.
 5. Sika Corporation: www.usa-sika.com.
 6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Other joints indicated below.
 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing; Type H.
 2. Lap Joints between Manufactured Metal Panels: Butyl rubber, non-curing; Type H.
 3. Butt Joints in Exterior Metal Work and Siding: Acrylic Emulsion; Type G.
 4. Joints between concrete panels and between panels of adjacent work:
 5. Joints between masonry and cast stone: Type U with sand.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
 2. Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
 3. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 4. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
- D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.03 NONSAG JOINT SEALANTS

- A. Type U-1 - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 4. Color: Match adjacent finished surfaces.
 5. Cure Type: Single-component, neutral moisture curing.
 6. Service Temperature Range: Minus 20 to 180 degrees F.
 7. Manufacturers:
 - a. Dow Chemical Company; DOWSIL 795 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - b. Pecora Corporation: www.pecora.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- B. Type U-2 - Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: Match adjacent finished surfaces.
 4. Cure Type: Single-component, neutral moisture curing.
 5. Service Temperature Range: Minus 65 to 180 degrees F.
 6. Manufacturers:
 - a. Dow Chemical Company; DOWSIL 999-A Building and Glazing Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - b. Pecora Corporation: www.pecora.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- C. Type E - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 1. Color: White.
 2. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
- D. Type A - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's standard range.
 4. Service Temperature Range: Minus 40 to 180 degrees F.
 5. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
 - b. Sherwin-Williams Company; Stampede-1/-TX Polyurethane Sealant: www.sherwin-williams.com/#sle.
 - c. BASF Corporation; MasterSeal NP1, One component polyurethane sealant. www.master-builders-solutions.basf.us
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- E. Type J - Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface .
 1. Movement Capability: Plus and minus 35 percent, minimum.
 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's standard range.
 4. Service Temperature Range: Minus 40 to 180 degrees F.
 5. Manufacturers:

- a. Sika Corporation; Sikaflex-1a: www.usa-sika.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- F. Type B - Non-Sag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's standard range.
- G. Type G - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
 - 1. Color: Standard colors matching finished surfaces, Type OP (opaque).
 - 2. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
 - b. Sherwin-Williams Company; 850A Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - c. Sherwin-Williams Company; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
- H. Type C - Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag; not expected to withstand continuous water immersion or traffic.
 - 1. Hardness Range: 10 to 30, Shore A, when tested in accordance with ASTM C661.
 - 2. Color: To be selected by Architect from manufacturer's standard range.
 - 3. Service Temperature Range: Minus 13 to 180 degrees F.
 - 4. Manufacturers:
 - a. Sherwin-Williams Company; Storm Blaster All Season Sealant: www.sherwin-williams.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- I. Type H - Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.
 - 1. Manufacturers:
 - a. Pecora Corporation; Pecora BA-98 Non-Skinning Butyl Sealant: www.pecora.com/#sle.

2.04 SELF-LEVELING SEALANTS

- A. Type F - Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: Grey.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Manufacturers:
 - a. Sherwin-Williams Company; Stampede 1SL Polyurethane Sealant: www.sherwin-williams.com/#sle.
 - b. Sika Corporation; Sikaflex-1c SL: www.usa-sika.com/#sle.
- B. Type P - Semi-Rigid Self-Leveling Polyurea Joint Filler: Two-component, 100 percent solids; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic. Joint filler for areas to receive polished concrete finish. Confirm material with system manufacturer / installer.
 - 1. Durometer Hardness, Type A: 75, minimum, after seven days when tested in accordance with ASTM D2240.
 - 2. Color: To be selected by Architect from manufacturer's standard colors.

3. Joint Width, Maximum: 3/4 inch.
4. Manufacturers:
 - a. ARDEX Engineered Cements; ARDEX ARDISEAL RAPID PLUS: www.ardexamericas.com/#sle.
 - b. Euclid Chemical Company; EUCO QWIKjoint UVR: www.euclidchemical.com/#sle.
 - c. Nox-Crete Inc; DynaFlex JF-85: www.nox-crete.com/#sle.

2.05 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
 2. Open Cell: 40 to 50 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.
- F. Sand: White or tan sand, selection based on field mockup.

END OF SECTION

**SECTION 07 9513
EXPANSION JOINT COVER ASSEMBLIES**

PART 2 PRODUCTS

1.01 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 4. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

END OF SECTION

**SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Sound-rated hollow metal doors and frames.
- F. Hollow metal borrowed lites glazing frames.
- G. Accessories, including glazing, louvers, and matching panels.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- J. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- K. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- L. ITS (DIR) - Directory of Listed Products; current edition.
- M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- O. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- R. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- S. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

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HOLLOW METAL DOORS
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- B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- E. Manufacturer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Maintain at project site copies of reference standards relating to installation of products specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Assa Abloy Ceko, Curries or Flemming; www.assaabloydss.com
 - 2. Steelcraft, an Allegion brand; ____: www.allegion.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Beveled, both sides.
 - 5. Typical Door Face Sheets: Flush.
 - 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
 - 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 - 8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Type ____, Exterior Doors: Thermally insulated.

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum, not less than level specified.
 2. Core Material: Polystyrene, 1 lbs/cu ft minimum density.
 3. Door Thermal Resistance: R-Value of 9.9, minimum, for installed thickness of polyisocyanurate. U-Value of 0.50 minimum.
 4. Door Thickness: 1-3/4 inch, nominal.
 5. Weatherstripping: Refer to Section 08 7100.
- B. Type ____, Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum, not less than level specified.
 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 3. Door Thickness: 1-3/4 inch, nominal.
- C. Type ____, Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum, not less than level specified.
 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - b. Attach fire rating label to each fire rated unit.
 3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
 4. Door Thickness: 1-3/4 inch, nominal.
- D. Type ____, Sound-Rated Interior Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum, not less than level specified.
 2. Sound Transmission Class (STC) Rating of Door and Frame Assembly: STC of 39, minimum, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.
 3. Door Core Material: Manufacturer's standard construction as required to meet acoustic requirements indicated.
 4. Door Thickness: As required to meet acoustic requirements indicated.
 5. Sound Seals: Refer to Section 08 7100.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Fully welded.
 - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 - 2. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
 - 3. Weatherstripping: Separate, see Section 08 7100.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 - 1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
- E. Door Frames, Fire-Rated: Fully welded type.
 - 1. Fire Rating: Same as door, labeled.
- F. Sound-Rated Door Frames: Fully welded type.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- I. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inch high to fill opening without cutting masonry units.
- J. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
- K. Frame width to extend past face of wall or partition on either sides, unless noted or detailed otherwise.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 8000.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Astragals for Double Doors: Specified in Section 08 7100.
 - 1. Exterior Doors: Steel, Z-shaped.
 - 2. Fire-Rated Doors: Steel, shape as required for fire rating.
- D. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
- E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

END OF SECTION

**SECTION 08 1416
FLUSH WOOD DOORS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire rated, non-rated, acoustical, and special function.

1.02 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- C. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- D. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.
- E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- H. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- I. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- J. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Samples: Submit two samples of door construction, 8 x 8 inch in size cut from top corner of door.
- E. Samples: Submit two samples of door veneer, 8 x 8 inch in size illustrating wood grain, stain color, and sheen. Submit stain color selection kit for available factory finishes.
- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- G. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- H. Manufacturer's Installation Instructions: Indicate special installation instructions.
- I. Specimen warranty.
- J. Warranty, executed in Owner's name.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:

1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
3. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.06 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 1. Graham Wood Doors: www.grahamdoors.com.
 2. Marshfield DoorSystems, Inc: www.marshfielddoors.com/#sle.
 3. VT Industries, Inc: www.vtindustries.com/#sle.
 4. Masonite Architectural Doors; <http://architectural.masonite.com>.
 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS AND PANELS

- A. Doors: Refer to drawings for locations and additional requirements.
 1. Quality Standard: Custom Grade, Standard Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 1. Provide solid core doors at each location.
 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with 16 CFR 1201 - Negative (Neutral) Pressure; Underwriters Laboratories Inc. (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 3. Sound Retardant Doors: Minimum STC of 41, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
 4. Wood veneer facing with factory transparent finish.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
- C. Sound Retardant Doors: Equivalent to Type particleboard core (PC) construction with core as required to achieve STC rating specified; plies and faces as indicated.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White oak, HPVA Grade A, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face; unless otherwise indicated.
- B. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
 - 1. Exception: Doors to be field finished.
- E. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent, Premium Quality:
 - a. System - 5, Varnish, Conversion.
 - b. Stain: As selected by Architect.
 - c. Sheen: to be selected.
- B. Factory finish doors in accordance with approved sample.
- C. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

- A. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- B. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.

END OF SECTION

**SECTION 08 3100
ACCESS DOORS AND PANELS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Wall mounted access units.
- B. Ceiling mounted access units.

1.02 RELATED REQUIREMENTS

- A. See Fire Protection, Plumbing, Mechanical, Electrical, and other associated trades for components located above hard lid ceilings and within walls that may require access panels to reach them. Locations may not be visually shown on drawings but where device is installed and concealed an access panels must be provided. It is encouraged to locate device, valve, etc. in location accessible to avoid installation of access panel. GC responsible to coordinate panel locations among trades to reduce quantity and verify acceptability with Architect.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; current edition.
- B. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units:
 - 1. Panel Material: Steel.
 - 2. Size: 12 inch by 12 inch, minimum or as required to permit access. Coordinate size with other trades access panel is used for.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 4. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
- B. Fire-Rated Wall-Mounted Units:
 - 1. Wall Fire-Rating: As indicated on drawings.
 - 2. Panel Material: Steel.
 - 3. Size: 12 inch by 12 inch., minimum or as required to permit access. Coordinate size with other trades access panel is used for.
- C. Fire-Rated Ceiling-Mounted Units:
 - 1. Ceiling Fire-Rating: As indicated on drawings.
 - 2. Panel Material: Steel.
 - 3. Size: 12 inch by 12 inch., minimum, or as required to permit access. Coordinate size with other trades access panel is used for.

2.02 WALL AND CEILING MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. ACUDOR Products Inc: www.acudor.com/#sle.
 - 2. Cendrex, Inc: www.cendrex.com/#sle.
 - 3. J.L. Industries Inc: www.activarcpg.com/jl-industries
 - 4. Milcor, Inc: www.milcorinc.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

- B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Door Style: Single thickness with rolled or turned in edges.
 2. Frames: 16 gage, 0.0598 inch, minimum thickness.
 3. Single Steel Sheet Door Panels: 1/16 inch, minimum thickness.
 4. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 - b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
 5. Steel Finish: Primed.
 6. Primed and Factory Finish: Polyester powder coat; color manufacturer's standard.
 7. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.

END OF SECTION

**SECTION 08 3323
OVERHEAD COILING DOORS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Overhead coiling doors and shutters, operating hardware, fire-rated, non-fire-rated, exterior, and FEMA Rated; electrically operated, and manual where specifically noted on door schedule.
- B. Wiring from electric circuit disconnect to operator to control station.

1.02 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ITS (DIR) - Directory of Listed Products; current edition.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- G. NEMA MG 1 - Motors and Generators; 2014.
- H. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- I. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.
- J. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general construction, electrical equipment, component connections and details, and manufacturer color charts.
- C. Certifications: FEMA rated safe room installations:
 - 1. Provide certification from an accredited testing laboratory of product compliance with FEMA 361 Safe Room for Tornadoes and Hurricanes.
 - 2. Provide certifications from an accredited testing laboratory of product compliance with ICC 500 ICC/NSSA Standard for the Design and Construction of Storm Shelters.
 - 3. Provide certifications from an accredited testing laboratory of product compliance to sustain a 240 psf wind pressure (1.2 times the design wind pressure of 200 psf) in accordance with ASTM E330.
 - 4. Provide certification from accredited testing laboratory of product compliance in accordance with the requirements of ASTM E1886 Large Missile impact for FEMA 361 assemblies.
- D. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- E. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.04 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

1.05 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Provide lifetime manufacturer limited warranty for counterweights and tension springs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Overhead Coiling Doors:
 - 1. Clopay Building Products; Model CERD20: www.clopaydoor.com/#sle.
 - 2. Cornell Iron Works, Inc: www.cornelliron.com/#sle.
 - 3. The Cookson Company: www.cooksondoor.com/#sle.
 - 4. McKeon.: www.mckeonDoor.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COILING DOORS

- A. Coiling Doors: Steel slat curtain.
 - 1. Capable of withstanding positive and negative wind loads of 26 psf, or no less than wind speed indicated on structural drawings, without undue deflection or damage to components.
 - 2. Sandwich slat construction with insulated core (at exterior wall locations) of foamed-in-place polyurethane insulation; minimum R-value of 8.1.
 - 3. Nominal Slat Size: 2 inches wide by required length.
 - 4. Finish: Factory painted, color as selected from manufacturer's full range.
 - 5. Guides: Assembly shall be fabricated of minimum 4" x 4" steel support angle or tube (4x4 tube not required at CMU wall construction), a 2" x 3" inner guide angle and a 3"x3" outer guide angle. Support tubes shall be constructed with a slip joint at the top and guides provided with slotted holes for thermal expansion.
 - a. Guide system and support tube to be capable of fully self supporting of door assembly. Provide all components necessary for installation.
 - b. Provide internal, fully concealed UL Classified Smoke Seals located within each guide assembly. Externally mounted smoke seal shall not be acceptable.
 - 6. Guide, Angles: Primed steel. Galvanized steel at exterior wall locations.
 - 7. Hood Enclosure: Manufacturer's standard; primed steel.
 - 8. Electric operation.
 - 9. Mounting: Within framed opening.
- B. FEMA Fire-Rated Coiling Doors: Steel slat curtain. (Hardened Doors / Openings at storm shelter only.
 - 1. Manufacturer: McKeon - SafeSpace 500-G.
 - 2. Nominal Slat Size: 2 inches wide by required length.
 - 3. Finish: Factory painted, gray color.
 - 4. Guides, Angles: Galvanized steel. Field painted.
 - 5. Hood Enclosure: Manufacturer's standard; primed steel.
 - 6. Electric operation.
 - 7. Emergency Release Mechanism: Electric-motor operated from master control station and/or from MASS notification and/or fire alarm system.
 - a. Provide fail-secure (fail closed) locking device upon power loss.
 - b. Provide 10 second time delay for activation upon loss of power.
 - c. Provide resettable device without replacement of parts, except when release triggered from exposure to local heat.
 - 8. Mounting: Within framed opening.
 - 9. Where more than one FEMA door occurs, provide master control station to operate all doors.
- C. Fire-Rated Coiling Doors: Steel slat curtain; comply with NFPA 80.
 - 1. 2 hour fire rating.

2. Provide products listed and labeled by ITS (DIR) or UL (DIR) as suitable for purpose specified and indicated on drawings.
3. Oversized Openings: Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated units and operating hardware assembly.
4. Single thickness slats.
5. Nominal Slat Size: 3 inches wide by required length.
6. Finish: Factory painted, color as selected.
7. Guides, Angles: Primed steel.
8. Hood Enclosure: Manufacturer's standard; primed steel.
9. Fire Alarm Release Mechanism: Electric-motor operated from fire alarm system and local heat/smoke detectors.
 - a. Provide fail-secure (fail-closed) locking device upon power loss.
 - b. Provide 10 second time delay for activation upon loss of power.
 - c. Provide resettable device without replacement of parts, except when release triggered by exposure to local heat.
10. Electric operation.
11. Mounting: As indicated.

2.03 MATERIALS AND COMPONENTS

- A. Metal Curtain Construction: Interlocking slats.
 1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 2. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
 3. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
 4. Smoke Seals: Provide brush or gasket type weatherstripping seals to prevent passage of smoke and hot gases in compliance with UL 1784 testing requirements.
 5. Steel Slats: Minimum thickness, 20 gage, 0.0396 inch; ASTM A653/A653M galvanized steel sheet.
- B. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.
- C. Guides - Angle or support tubes: ASTM A36/A36M metal angles, size as required for wind loading, designed and provided by door manufacturer.
 1. Hot-dip galvanized in compliance with ASTM A123/A123M.
 2. Prime paint, unless noted otherwise.
- D. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.
 1. Minimum thickness; 22 gage, 0.0336 inch.
 2. Finish: Factory painted manufacturer standard color to be selected.
- E. Lock Hardware:
 1. For motor operated units: Motor should provide electronic locking and prevent intrusion from manually raising door.
 2. Manual units Latching Mechanism: Inside mounted, adjustable keeper, spring activated latch bar feature to keep in locked or retracted position.
- F. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

2.04 ELECTRIC OPERATION

- A. Electric Operators:
 1. Mounting: Side mounted.
 2. Motor Enclosure:

- a. Exterior Coiling Doors: NEMA MG 1, Type 4; open drip proof.
- 3. Motor Rating: 1/3 HP; continuous duty.
- 4. Motor Voltage: 120 volts, single phase, 60 Hz. Verify with Manufacturer.
- 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
- 6. Controller Enclosure: NEMA 250, Type 4.
- 7. Opening Speed: 12 inches per second.
- 8. Brake: Manufacturer's standard type, activated by motor controller.
- 9. Manual override in case of power failure.
- 10. Coordinate with Section 26 0583 for electrical connections. Coordinate all electrical requirements with Electrical Contractor.
- 11. At Fire Rated doors: Fail-Safe / Fail-secure design, automatic self-operating mechanism to open/close in event of power failure. Refer to door schedule for convention.
- B. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325. At locations where used in public access corridors, provide key operated device.
 - 1. 24 volt circuit.
 - 2. Surface mounted, at interior door jamb.
 - 3. Multiple Control Station: Provide MCS for control up to 10 operators.
 - 4. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide NEMA 1 photo eye sensors or NEMA 4X photo eye sensors as required with momentary-contact control device.
 - b. Secondary Device: Provide electric sensing edge with wireless edge kit as an option along with continuous-constant control device.

END OF SECTION

**SECTION 08 3613
SECTIONAL DOORS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Overhead sectional doors, manually operated.
- B. Operating hardware and supports.
- C. Electrical controls.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- C. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- D. DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors; 2011.
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- C. Product Data: Show component construction, anchorage method, and hardware.
- D. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.
- E. Operation Data: Include normal operation, troubleshooting, and adjusting.
- F. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS for warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for electric motor and transmission.
- D. Provide five year manufacturer warranty for electric operating equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sectional Doors:
 - 1. Clopay Building Products; Model 3720: www.clopaydoor.com/#sle.

2. Fimbel Architectural Door Specialties: www.fimbelads.com/#sle.
3. Raynor Garage Doors; ThermalSeal, Model ____: www.raynor.com/#sle.
4. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com/#sle.

2.02 STEEL DOORS

- A. Steel Doors: Flush steel, insulated; vertical lift operating style with track and hardware; complying with DASMA 102, Commercial application.
 1. Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
 2. Door Nominal Thickness: 2 inches thick. R Value of 9.1.
 3. Exterior Finish: Factory finished with polyester baked enamel; color as selected by Architect.
 4. Interior Finish: Factory finished with polyester baked enamel; color as selected from manufacturers standard line.
 5. Electric Operation: Electric control station.
- B. Door Panels: Steel construction; outer steel sheet of 20 gage, 0.0359 inch minimum thickness, flush profile; inner steel sheet of 20 gage, 0.0359 inch minimum thickness, flat profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.

2.03 COMPONENTS

- A. Track: Rolled galvanized steel, 0.090 inch minimum thickness; 2 inch wide, continuous one piece per side; galvanized steel mounting brackets 1/4 inch thick.
- B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
- C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.
- D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.
- E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
- F. Head Weatherstripping: EPDM rubber seal, one piece full length.
- G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.
- H. Lock: Inside center mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior and exterior handle.

2.04 MATERIALS

- A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G60/Z180 coating, plain surface.
- B. Float Glass: Provide float glass glazing, unless noted otherwise.
 1. Heat-Strengthened and Fully Tempered Types: ASTM C1048.
 2. Tinted Types: Color and performance characteristics as indicated.
- C. Insulation: Foamed-in-place polyurethane, bonded to facing.

2.05 ELECTRIC OPERATION

- A. Electric Operators:
 1. Mounting: Side mounted on cross head shaft.
 2. Motor Rating: 1/3 hp; continuous duty.
 3. Motor Voltage: 120 volts, single phase, 60 Hz.
 4. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.

5. Controller Enclosure: NEMA 250, Type 1.
 6. Opening Speed: 12 inches per second.
 7. Brake: Adjustable friction clutch type, activated by motor controller.
 8. Manual override in case of power failure.
 9. Refer to Section 26 0583 for electrical connections.
- B. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated; enclose terminal lugs in terminal box sized to comply with NFPA 70.
- C. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
1. 24 volt circuit.
 2. Surface mounted, at interior door jamb.
 3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide NEMA 1 photo eye sensors or NEMA 4X photo eye sensors as required with momentary-contact control device.
 - b. Secondary Device: Provide electric sensing edge with wireless edge kit as an option along with continuous-constant control device.

END OF SECTION

**SECTION 08 4229
AUTOMATIC ENTRANCES**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Operators for doors provided in other sections.
- B. Controllers, actuators and safety devices.
- C. Maintenance.

1.02 REFERENCE STANDARDS

- A. BHMA A156.10 - American National Standard for Power Operated Pedestrian Doors; 2011.
- B. ITS (DIR) - Directory of Listed Products; current edition.
- C. NFPA 101 - Life Safety Code; 2015.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- E. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
 - 2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.
- C. Product Data: Provide data on system components, sizes, features, and finishes.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience, and a member of AAADM.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience and approved by manufacturer.

1.05 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide two year manufacturer warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Door Operators for Swing Doors Specified in Other Sections:
 - 1. LCN, an Allegion brand: www.allegion.com/us/#sle.
 - 2. Horton Automatics: www.hortondoors.com/#sle.
 - 3. Stanley Access Technologies; Magic Access LE (Low Energy): www.stanleyaccess.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 POWER OPERATED DOORS

- A. Power Operated Doors: Provide products that comply with NFPA 101 and requirements of authorities having jurisdiction; provide equipment selected for actual door weight and for light pedestrian traffic, unless otherwise indicated.
 - 1. Swinging Door Operators: Fully adjustable for opening and closing speeds, checking speeds, and hold-open time; in the event of power failure, disengage operator allowing door to function as a door with a spring closer.
- B. Swinging Doors with Full Power Operators: Comply with BHMA A156.10; safeties required.
 - 1. Comply with UL 325; acceptable evidence of compliance includes UL (DIR) or ITS (DIR) listing or test report by testing agency acceptable to authorities having jurisdiction.
 - 2. Force Required to Set Door in Motion When Unpowered: 30 pound-force, maximum, measured at 1 inch from the latch edge of the door at any point in the closing cycle.

2.03 OPERATORS FOR SWINGING DOORS PROVIDED BY OTHERS

- A. Door Operator: Electric, surface mounted overhead.
 - 1. Operation: Full-power open, spring close operation.
 - 2. Variable speed control for opening and closing cycles.
 - 3. Push-Side Actuator: Push plate.
 - 4. Pull-Side Actuator: Push plate.
 - 5. Pull-Side Safety: Door-mounted.
 - 6. Hold Open: Toggle switch at inside head of doors; deactivate hold-open on activation of fire alarm system, refer to Section 28 4600.

2.04 CONTROLLERS, ACTUATORS, AND SAFETIES

- A. Controller: Provide microprocessor operated controller for each door.
- B. Comply with BHMA A156.10 for actuator and safety types and zones.
- C. Proximity Detector Actuator/Safety: Microwave; distance of control sensitivity adjustable.
- D. Push Plate Actuator: Standard wall mounted, surface mounted momentary contact type; satin stainless steel plate; 4 inches diameter; labeled PUSH.
- E. Swinging Door Safety Device: Door-mounted proximity detector device arranged to prevent operation of door when persons or obstructions are in the swing zone.

2.05 ACCESSORIES

- A. Steel Clips, Supports, and Steel Anchors: Galvanized to 1.25 oz/sq ft.

END OF SECTION

**SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with insulated glass units installed at exterior openings of building envelope.
- B. Aluminum-framed storefront, with single pane glass installed in interior partitions.
- C. Aluminum entrance doors and frames with insulated glass units installed at exterior openings in building envelope.
- D. Aluminum entrance doors and frames with single pane glass installed at interior storefront systems.
- E. Door hardware, weatherstripping and accessories for a storefront installation.

1.02 REFERENCE STANDARDS

- A. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- J. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding

required. Indicate method of installation for all components.

- D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- F. Samples: Submit two samples 4x3 inches in size illustrating finished aluminum surface, glass, glazing materials.
- G. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Arkansas.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.07 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Correct defective Work, including the watertightness of system, within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Kawneer North America; Kawneer Trifab 451 UT. www.kawneer.com
- B. Other Acceptable - Aluminum-Framed Storefronts Manufacturers:
 - 1. Manko Window Systems, Inc: www.mankowindows.com/#sle.
 - 2. Oldcastle BuildingEnvelope: www.oldcastlebe.com/#sle.
 - 3. Tubelite, Inc: www.tubeliteinc.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Center-Set Style, Thermally-Broken:
 - 1. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

2.03 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

- A. Center-Set Style:
 - 1. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep.

2.04 BASIS OF DESIGN -- SWINGING DOORS

- A. Medium Stile, Insulating Glazing, Thermally-Broken:
 - 1. Thickness: 1-3/4 inches.

2.05 ALUMINUM- FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Overall U-Value Including Glazing: _____, maximum.
 - 2. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 - 3. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 - 4. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 - 5. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 - 6. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and inner sheet of infill panel and heel bead of glazing compound.
- B. Performance Requirements:
 - 1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.
 - 2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
 - 3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

2.06 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Framing members for interior applications need not be thermally broken.
 - 2. Glazing Stops: Flush.
 - 3. Sill Flashing: High performance, thermally broken sill flashing equal to Kawneer 451T-HP-037, that utilizes clip system for bottom sill member attachment to sill flashing.
 - a. Install end dams to sill flashing at each end of opening.
 - 4. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 - 5. Internal reinforce for Hardware attachments as Required.
- B. Swing Doors: Glazed aluminum, thermally broke at exterior locations.
 - 1. Thickness: 1-3/4 inches.
 - 2. Top Rail: 4 inches wide.
 - 3. Vertical Stiles: 4-1/2 inches wide. GC to verify width with provided hardware mounting requirements.
 - 4. Bottom Rail: 10 inches wide.
 - 5. Glazing Stops: Square.
 - 6. Finish: Same as storefront.
 - 7. Internal reinforcement for Hardware as Required.

2.07 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).

- C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- D. Fasteners: Stainless steel.
- E. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.
- F. Concealed Flashings: 0.032 inch thick aluminum.
- G. Perimeter Sealant: Type A specified in Section 07 9005.
- H. Glass: As specified in Section 08 8000.

2.08 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.
- C. Color: As selected by Architect from manufacturer's standard range.
- D. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.09 HARDWARE

- A. Door Hardware: Storefront manufacturer's standard type to suit application.
 - 1. Finish on Hand-Contacted Items: per approved sample.
 - 2. For each door, include butt hinges, pivots, push handle, pull handle, exit device, narrow stile handle latch, closer, and other specified hardware, reference section 08 7100.. Where hardware is provided in other sections, coordinate installation requirements. Where other hardware is not specified, provide cylinder and keyway to match building system.
 - 3. Coordinate the installation of hardware with section 08 7100 and other applicable access control components.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- C. Rain Drip: Extruded aluminum to match framing system; located at all exterior doors were not covered above by awning or canopy.
- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.
- F. Pivots: Center type; top and bottom.
 - 1. Provide on all doors.
- G. Push/Pull Set:
 - 1. Provide on all doors.

2.10 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Reinforce framing members for imposed loads.

END OF SECTION

**SECTION 08 4413
GLAZED ALUMINUM CURTAIN WALLS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Aluminum-framed curtain wall system, with vision glazing, glass spandrel glazing panels and/or MCM panels installed at openings of the building exterior envelope.
- B. Column covers.
- C. Perimeter sealant.
- D. Firestopping between curtain wall and edge of floor slab.

1.02 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- J. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2015.
- K. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).
- N. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, hardware, structural reinforcing members, and infill.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, framing member types, structural reinforced members, anchorage locations, affected related

Work, expansion and contraction joint location and details, glazing type locations, and field welding required.

- D. Samples: Submit two samples 4 by 3 inches in size illustrating finished aluminum surface, glazing, infill panels, and glazing materials.
- E. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
- F. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure, anchorage method and fasteners. Calculations must be reviewed and be signed and sealed by a Structural Engineer licensed in the State the project is located in.
- G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Arkansas.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

1.06 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-ups.
- B. Locate on-site where directed by Architect; mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Correct defective Work, including watertightness of assembly, within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Kawneer North America; Product 1600 Wall - System 1..
- B. Other Acceptable - Glazed Aluminum Curtain Walls Manufacturers:
 - 1. EFCO, a Pella Company; 5500: www.egcocorp.com
 - 2. Manko Window Systems, Inc: www.mankowindows.com/#sle.
 - 3. Oldcastle Building Envelope: www.oldcastlebe.com/#sle.
 - 4. Tubelite, Inc: www.tubeliteinc.com/#sle.

5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CURTAIN WALL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Outside glazed, with pressure plate and mullion cover, where indicated on drawings.
 - 2. Vertical Mullion Face Width: 2-1/2 inches.
 - 3. Vertical Mullion Depth From Face of Glazing to Back of Frame: 6-1/4 inches, or otherwise indicated on plans or required to meet structural performance requirements.
- B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
 - 1. Design Wind Loads: Comply with the requirements of ASCE 7, Structural Building Design Wind Loads, design loads listed below; or current code. Use design load which is the greatest.
 - a. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
 - b. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
 - c. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
 - 2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Expansion and contraction caused by 180 degrees F surface temperature.
 - b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
- C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
 - 1. Test Pressure Differential: 15 lbf/sq ft.
 - 2. Test Method: ASTM E331.
- D. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: As specified in Section 08 8000.
- C. Doors and Hardware: As specified in Section 08 43 13.
- D. Column Covers: Aluminum, 20 gage, 0.032 inch minimum thickness, full contact pressure bonded to _____ for flat surface, finish to match curtain wall framing members.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

- D. Structural Supporting Anchors: See Section 05 1200.
- E. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
- F. Structural Supporting Anchors Attached to Reinforced Concrete Members: Design for welded attachment to weld plates embedded in concrete.
- G. Fasteners: Stainless steel ONLY. No exposed fasteners permitted.
- H. Firestopping: As specified in Section 07 8400.
- I. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.
- J. Perimeter Sealant: Type A specified in Section 07 9005.
- K. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- L. Glazing Accessories: As specified in Section 08 8000.
- M. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.05 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Color: To be selected by Architect from manufacturer's standard range.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

END OF SECTION

SECTION 08 7100 DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hardware for wood doors.
- B. Hardware for fire-rated doors.

1.02 REFERENCE STANDARDS

- A. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- B. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty years of documented experience.
- B. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.07 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Provide five year warranty for door closers.

PART 2 PRODUCTS

2.01 SUPPLIERS

2.02 DOOR HARDWARE - GENERAL

- A. Provide hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Provide items of a single type of the same model by the same manufacturer.
- C. Provide products that comply with the following:
 - 1. Applicable provisions of federal, state, and local codes.
 - 2. Fire-Rated Doors: NFPA 80.
 - 3. Hardware on Fire-Rated Doors, Except Hinges: Listed and classified by UL as suitable for the purpose specified and indicated.
 - 4. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide hardware that enables door assembly to comply with air leakage requirements of the applicable code.

2.03 LOCKS AND LATCHES

- A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
 - 1. If no hardware set is indicated for a swinging door provide an office lockset.
 - 2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.

- 3. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
- B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
 - 1. Provide cams and/or tailpieces as required for locking devices required.
- C. Keying: Keyed in like-groups.
- D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.04 HINGES

- A. Hinges: Provide hinges on every swinging door.
 - 1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
 - 2. Provide ball-bearing hinges at all doors having closers.
 - 3. Provide hinges in the quantities indicated.
 - 4. Provide non-removable pins on exterior outswinging doors.
 - 5. Where electrified hardware is mounted in door leaf, provide power transfer hinges.

2.05 LOCKS AND LATCHES

- A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
 - 1. Hardware Sets indicate locking functions required for each door.
 - 2. If no hardware set is indicated for a swinging door provide an office lockset.
 - 3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
 - 4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
- B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
 - 1. Provide cams and/or tailpieces as required for locking devices required.
- C. Keying: Grand master keyed.
- D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

END OF SECTION

SECTION 08 8000 GLAZING

PART 1 GENERAL V.22

1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units to be installed in window opening or door assemblies.
- C. Fire-resistant rated and Fire-Protection rated glazing.
- D. Glazing compounds and accessories.
- E. Unframed glass or mirrors applied directly to wall surfaces.

1.02 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
- C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2011).
- E. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.
- H. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.
- I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.
- J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- K. GANA (GM) - GANA Glazing Manual; 2009.
- L. GANA (SM) - GANA Sealant Manual; 2008.
- M. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.
- N. ICC (IBC) - International Building Code; 2015.
- O. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).
- P. ITS (DIR) - Directory of Listed Products; current edition.
- Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- R. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2012.
- S. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.
- T. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.
- U. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.
- V. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- W. UL 9 - Standard for Fire Tests of Window Assemblies; Current Edition, Including All Revisions.

- X. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- Y. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- Z. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit one sample 12 by 12 inch in size of glass units.
- E. Certificate: Certify that products of this section meet or exceed specified requirements.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

1.06 MOCK-UPS

- A. Provide mock-up of window assembly including glass and air barrier and vapor retarder seal.

1.07 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. AGC Glass North America, Inc: www.agcglass.com/#sle.
 - 2. Guardian Glass, LLC: www.guardianglass.com/#sle.
 - 3. Pilkington North America Inc: www.pilkington.com/na/#sle.
 - 4. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
 - 5. Substitutions: Refer to Section 01 6000 - Product Requirements.
- B. Fire-Resistance-Rated and Fire-Protection-Rated Glass: Provide products as required to achieve indicated fire-rating period.

1. Manufacturers:
 2. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL: www.safti.com/#sle.
 3. Technical Glass Products; Pilkington Pyrostop: www.fireglass.com/#sle.
 4. Vetrotech North America; Contraflam: www.vetrotechusa.com/#sle.
- C. Mirrored Glass Manufacturers:
1. Pilkington North America Inc; Pilkington Mirropane Transparent Mirror: www.pilkington.com/na/#sle.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
1. Design Pressure: Calculated in accordance with ASCE 7 or no less than as indicated on structural plans for building ultimate wind speed.
 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/200 of their lengths under specified design load.
 4. Glass thicknesses listed are minimum.
- B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
1. In conjunction with vapor retarder and joint sealer materials described in other sections.
 2. To utilize the inner pane of multiple pane insulating glass units for the continuity of the vapor retarder and air barrier seal.
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 5. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
 6. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.04 INSULATING GLASS UNITS

- A. Manufacturers:
1. Any of the manufacturers specified for float glass.
 2. Substitutions: Refer to Section 01 6000 - Product Requirements.
- B. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.

3. Metal Edge Spacers: Aluminum, bent and soldered corners.
4. Spacer Color: Black.
5. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
6. Color: Black.
7. Purge interpane space with dry air, hermetically sealed.
- C. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
 1. Applications: Typical all _____ Exterior glazing locations unless specifically noted otherwise.
 2. Space between lites filled with air.
 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: _____ Vitro SolarBan 60 Optiblu, on #2 surface.
 4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch.
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.29, nominal.
 7. Visible Light Transmittance (VLT): 51 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 0.35, nominal.
- D. Type IG-2 - Insulating Glass Units: Spandrel glazing.
 1. Applications: Exterior spandrel glazing unless otherwise indicated.
 2. Space between lites filled with air.
 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Same as on vision units, on #2 surface.
 4. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick.
 - a. Opacifier: Ceramic frit, on #4 surface.
 - b. Opacifier Color: to be selected by Architect.
 - c. Opacifier may be exposed on interior; apply sufficient coats of opacifier to achieve 100% even spaced coverage when viewed from interior.
 5. Total Thickness: 1 inch.
 6. Glazing Method: Dry glazing method, gasket glazing.
- E. Type IG-3 - Insulating Glass Units: Safety glazing.
 1. Applications: provide this type of glazing in the following locations:
 - a. Glazed lites in all exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on drawings.
 2. Space between lites filled with air.
 3. Glass Type: Same as other vision glazing except use fully tempered float glass for both outboard and inboard lites.

2.05 GLAZING UNITS

- A. Type G-2 - Monolithic Interior Vision Glazing:
 1. Applications: Typical Interior glazing unless otherwise indicated.
 2. Glass Type: Annealed float glass.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
 5. Glazing Method: Dry glazing method, gasket glazing.

- B. Type G-3 - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period exceeding 45 minutes.
1. Applications:
 - a. Glazing in fire-rated door and window assemblies.
 - b. Glazing in sidelites, borrowed lites, and other glazed openings in fire-rated wall assemblies.
 2. Glass Type: Multi-laminate annealed glass with intumescent fire retardant interlayers, or other pre-approved type that meets rating and testing requirements.
 3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
 4. Safety Glazing Certification: 16 CFR 1201 Category II.
 5. Glazing Method: As required for fire rating.
 6. Fire-Rating Period: 60 minutes or greater as required by drawings.
 7. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on fire-resistance-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
 - a. "W" - meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
 - b. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
 - d. "T" - meets temperature rise of not more than 450 degrees F above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
 - e. "XXX" - placeholder that represents fire-rating period, in minutes.
- C. Type G-4 - Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve fire-doors indicated fire-rating period of 45 minutes or less.
1. Applications:
 - a. Glazing in fire-rated door and window assemblies.
 - b. Other locations as indicated on drawings.
 2. Glass Type: Specialty tempered float glass with modifications such as surface applied films as necessary or required.
 3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
 4. Safety Glazing Certification: 16 CFR 1201 Category II.
 5. Glazing Method: As required for fire rating.
 6. Fire-Rating Period: 45 minutes or less as indicated on drawings.
 7. Markings for Fire-Protection-Rated Glazing Assemblies: Provide permanent markings on fire-protection-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
 - a. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - b. "OH" - meets fire window assembly criteria including hose stream test of NFPA 257, or UL 9 fire test standards.
 - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire tests standards.
 - d. "XXX" - placeholder that represents fire-rating period, in minutes.
- D. Type G-5 - Monolithic Safety Glazing: Non-fire-rated.
1. Applications: Provide this type of glazing in the following locations, non-fire rated:
 - a. Glazed lites in interior doors and sidelights.
 - b. Other locations required by applicable federal, state, and local codes and regulations.

- c. Other locations indicated on drawings.
- 2. Glass Type: Fully tempered safety glass as specified.
- 3. Tint: Clear or as indicated.
- 4. Thickness: 1/4 inch, nominal.
- E. Type M-1 - Clear, tempered safety glass; ASTM C1048, with copper and silver coatings, and protective overcoating.
 - 1. Applications: Locations as indicated on drawings.
 - 2. Thickness: 1/4 inch.
 - 3. Glass Tint: None..
 - 4. Glass Type: Fully tempered.

2.06 GLAZING COMPOUNDS

- A. Manufacturers:
 - 1. BASF Corporation: www.basf.com/#sle.
 - 2. Dow Corning Corporation: www.dowcorning.com/construction/#sle.
 - 3. Pecora Corporation: www.pecora.com/#sle.
 - 4. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.07 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- E. Glazing Clips: Manufacturer's standard type.
- F. Mirror Adhesive: Chemically compatible with mirror coating and wall substrate.

END OF SECTION

**SECTION 09 0561
COMMON WORK RESULTS FOR FLOORING PREPARATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Broadloom carpet.
 - 3. Carpet tile.
 - 4. Thin-set ceramic tile and stone tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.
- H. Remedial floor sheet membrane.

1.02 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.
- F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.04 SUBMITTALS

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- C. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.

2. Summary of conditions encountered.
 3. Moisture and alkalinity (pH) test reports.
 4. Copies of specified test methods.
 5. Recommendations for remediation of unsatisfactory surfaces.
 6. Product data for recommended remedial coating.
 7. Submit report to Architect.
 8. Submit report not more than two business days after conclusion of testing.
- D. Adhesive Bond and Compatibility Test Report.
- E. Copy of RFCI (RWP).

1.05 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by Owner.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 1. Provide access for and cooperate with testing agency.
 2. Confirm date of start of testing at least 10 days prior to actual start.
 3. Allow at least 4 business days on site for testing agency activities.
 4. Achieve and maintain specified ambient conditions.
 5. Notify Owner when specified ambient conditions have been achieved and when testing will start.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring

manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

1. Thickness: 1/8 inch, maximum.
2. Products:
 - a. ARDEX Engineered Cements; ARDEX MC RAPID: www.ardexamericas.com/#sle.
 - b. Floor Seal Technology, Inc; MES 100 with Floor Seal FloorCem SLU: www.floorseal.com/#sle.
 - c. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle.
 - d. Tnemec Company, Inc; Series 208 Epoxoprime MVT: www.tnemec.com/#sle.
- C. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 1. Thickness: 28 mil (0.028 inch).
 2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.
 3. Products:
 - a. GCP Applied Technologies; Kovara MBX: www.gcpat.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Perform following operations in the order indicated:
 1. Preliminary cleaning.
 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 5. Specified remediation, if required.
 6. Patching, smoothing, and leveling, as required.
 7. Other preparation specified.
 8. Adhesive bond and compatibility test.
 9. Protection.
- B. Remediations:
 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.05 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.06 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 - 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 - 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.07 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

3.08 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.09 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.10 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

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

END OF SECTION

**SECTION 09 2116
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal partition and soffit framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.
- H. Framing Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- F. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- H. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- I. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- J. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2013.
- K. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- L. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- M. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- N. GA-216 - Application and Finishing of Gypsum Board; 2013.
- O. GA-600 - Fire Resistance Design Manual; 2015.
- P. UL (FRD) - Fire Resistance Directory; current edition.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
 - 1. Indicate special details associated with fireproofing and acoustical seals.
 - 2. Indicate component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related

work.

3. Describe method for securing studs to track, splicing, and for blocking and reinforcing of framing connections.
 4. Provide partition legend indicating proposed assembly components at each partition type.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system. Include framing load charts and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of documented experience.

1.05 MOCK-UP

- A. Provide mock-up of stud wall, ceiling, and soffit framing including insulation, sheathing, window frame, and door frame and finish specified in other sections. Coordinate installation of associated work specified in other sections.
1. Mock-up may remain part of finish work.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
1. See PART 3 for finishing requirements.
- B. Interior Partitions, Indicated as Acoustic and/or STC on partition schedule: Provide completed assemblies with the following characteristics:
1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
 2. Treat all penetrations and perimeters of wall assembly with acoustical sealant, both sides of wall.
- C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- E. Fire Rated Assemblies: Provide completed assemblies as indicated on partition schedule and complying with applicable code.
1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
1. ClarkDietrich: www.clarkdietrich.com/#sle.
 2. Marino: www.marinoware.com/#sle.
 3. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.

4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf, with steel thickness not less than 20 gauge (30 mils). Adjust steel thickness to comply with deflection with stud heights. Walls with tile or masonry veneer, comply with deflection of wall framing of L/360 at 5psf.
 1. Studs: "C" shaped with knurled or embossed faces.
 2. Runners: U shaped, sized to match studs.
 3. Ceiling Channels: C-shaped.
 4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
- C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
- E. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs.
- F. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
- G. Metal Framing Fasteners: ASTM C1002 self-piercing tapping screws.
- H. Sheet Metal Backing: 0.036 inch thick, galvanized.
- I. Partial Height partitions: Use steel wall stiffeners bolted to floor surface and stud framing at 48" o.c., minimum of two per wall. Provide No-Flex Stud Stiffeners, or approved equal.
www.noflex.com.

2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 1. American Gypsum Company: www.americangypsum.com/#sle.
 2. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 3. National Gypsum Company: www.nationalgypsum.com/#sle.
 4. Temple-Inland Building Product by Georgia-Pacific, LLC: www.temple.com.
 5. USG Corporation: www.usg.com/#sle.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 1. Application: Use for standard vertical surfaces and ceilings, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
 - b. Mold resistant board is required at all toilet rooms, janitor closets, laundry rooms, kitchen and similar wet areas at all wet locations such as: Locker, shower, toilet rooms, kitchens, janitor closets, etc and behind plumbing fixtures locations. Also refer to partition schedule and locations otherwise noted.
 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch., sag resistant.
 5. Paper-Faced Products:
 - a. American Gypsum Company; LightRoc Gypsum Wallboard.
 - b. Georgia-Pacific Gypsum; ToughRock.
 - c. Georgia-Pacific Gypsum; ToughRock Fireguard X.

- d. Georgia-Pacific Gypsum; ToughRock Fireguard C.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- 6. Mold Resistant Paper Faced Products:
 - a. American Gypsum Company; M-Bloc.
 - b. Continental Building Products; Mold Defense Type X.
 - c. Georgia-Pacific Gypsum; ToughRock Mold-Guard.
 - d. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard.
 - e. National Gypsum Company; Gold Bond XP Gypsum Board.
 - f. Lafarge North America Inc; Mold Defense Drywall.
 - g. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
 - h. Temple-Inland Building Product by Georgia-Pacific, LLC; ComfortGuard Mold Resistant Gypsum Board.
 - i. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
- C. Tile Backer Board: As specified in section 09 3000.
- D. Exterior Sheathing Board: As specified in Section 06 1000.
- E. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
 - 1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

2.04 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: As specified in Section 07 2100.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
- D. Water-Resistive Barrier: As specified in Section 07 2500.
- E. Finishing Accessories: ASTM C1047, galvanized steel, pre-approved rigid plastic, rolled zinc, pre-approved rigid plastic, or pre-approved rigid plastic, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
 - 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
 - 3. Products:
 - a. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
 - b. Trim-tex, Inc: www.trim-tex.com/#sle.
 - c. Fry Reglet Corporation; www.fryreglet.com
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 3. Joint Compound: Drying type, vinyl-based, ready-mixed.
 - 4. Joint Compound: Setting type, field-mixed.
- G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

2.05 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

END OF SECTION

SECTION 09 3000 TILING

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Tile for floor and wall applications.
- B. Backer board as tile substrate.
- C. Ceramic accessories, ceramic and non-ceramic trim.

1.02 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium).; 2017.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
- C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
- E. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- F. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- G. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- H. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- I. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- J. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- K. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- L. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- M. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2017.
- N. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- O. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2013.1.
- P. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.
- Q. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2015.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers. Have all materials to be used in installation at jobsite for observation.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details, and TCNA installation method details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 x 18 inches in size illustrating pattern, color variations, and grout joint size variations. Provide sample boards of tile color ranges for selection.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 1 percent of each size, color, and surface finish combination but not less than 10 of each type.

1.05 MOCK-UP

- A. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 - 1. Minimum size of mock-up is indicated on drawings.
 - 2. Approved mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

- A. Ceramic Tile, Type CRT: ANSI A137.1, standard grade.
 - 1. Product: Concept Surfaces: Paloma 3"x9"
 - 2. Color(s): Azzurro Quilt Glossy, Niveo Quilt Glossy, and Indaco Quilt Glossy
- B. Terrazzo Wall Tile, Type TWT: ANSI A137.1, standard grade.
 - 1. Product: Livden, Popsicles Uneven, 12"x12"
 - 2. Color: Navy Blue
- C. Porcelain Tile, Type PCT: ANSI A137.1 standard grade.
 - 1. Product: Anatolia, Mjork, 24"x
 - 2. Color: To be selected from manufacturer's full range.

2.02 TRIM AND ACCESSORIES

- A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.

- B. Non- Ceramic Trim: Satin brass anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall tile.
 - b. Open edges of floor tile.
 - c. Transition between floor finishes of different heights.
 - d. Thresholds at door openings.
 - e. Borders and other trim as indicated on drawings.
 - 2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com. Schiene, Dilex and Reno.
 - b. Genesis APS International: www.genesis-aps.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SETTING MATERIALS

- A. Provide setting materials made by the same manufacturer as grout.
 - 1. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
 - a. Products:
 - 1) Custom Building Products; MegaLite Ultimate Crack Prevention Large Format Tile Mortar: www.custombuildingproducts.com/#sle.
 - 2) LATICRETE International, Inc; LATICRETE 254 Platinum: www.laticrete.com/#sle.
 - 3) Mapei Corporation.
 - 2. Glass Tile Adhesive: ANSI A136.1, thin-set polymer fortified adhesive type.
 - a. Use Type I in areas subject to prolonged moisture exposure.
 - b. Products: LATICRETE Glass Tile Adhesive
 - c. Color: White only.

2.04 GROUTS

- A. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Applications: All locations.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. Custom Building Products; CEG-Lite: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
 - c. MAPEI Corporation.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.05 ACCESSORY MATERIALS

- A. Waterproofing Membrane at Floors and Walls: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
 - 2. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber or Acrylic.
 - b. Thickness: 25 mils, minimum, dry film thickness.
 - c. Products:
 - 1) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com/#sle.
 - 2) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
 - 3) MAPEI Corporation; Mapelastic 400.
- B. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

- C. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
 - 1. Standard Type: Thickness 1/2 inch.
 - 2. Fire Resistant Type: Type X core, thickness 5/8 inch.
- D. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.
- E. Self Leveling underlayment System: Cement based underlayment and primer.
 - 1. Laticrete International; Level & Primer: www.laticrete.com.

END OF SECTION

**SECTION 09 5100
ACOUSTICAL CEILINGS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- C. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.
- F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- G. UL (FRD) - Fire Resistance Directory; current edition.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed. Provide at a minimum 1 box or carton of ceiling tile.

1.05 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:

1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
 2. CertainTeed Corporation: www.certainteed.com/#sle.
 3. USG Corporation: www.usg.com/ceilings/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Suspension Systems:
1. Same as for acoustical units.

2.02 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Panels, Type ACT-1: Painted mineral fiber, with the following characteristics:
1. Classification: ASTM E1264 Type XII.
 2. Size: 24 by 24 inches.
 3. Thickness: 5/8 inches.
 4. Composition: Wet felted.
 5. Light Reflectance: 83 percent minimum, determined in accordance with ASTM E1264.
 6. NRC Range: 0.85 minimum, determined in accordance with ASTM E1264.
 7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 8. Panel Edge: Angled Tegal.
 9. Surface Pattern: Fine Texture.
 10. Color: White.
 11. Suspension System: Exposed grid.
 12. Products:
 - a. Armstrong World Industries, Inc; Optima: www.armstrongceilings.com/#sle.
- C. Linear Wood Ceiling, Type WD-1: Metal panels with woodgrain face veneer and non-woven acoustic material adhered to back of panel.
1. Size and Configuration: 6 inches x 144 inches.
 2. Thickness: 3/4 inches.
 3. Panel Weight: 1.25 psf
 4. Panel Finish: Surface Veneer Species;; Factory finished color walnut from manufacturer's standard range.
 5. Accessories: Provide Trim, Backer Clip, Ledger & other accessories as necessary for a complete system.
 6. Backer: Black felt.
 7. Products:
 - a. Armstrong; Woodworks Linear: www.armstrongceilings.com/.

2.03 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid with aluminum cap; factory-applied closed-cell foam gaskets.
1. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
 2. Profile: Tee; 15/16 inch face width.
 3. Finish: Baked enamel.
 4. Products:
 - a. USG Corporation; Donn Brand DXLA/DXCE 15/16 inch Acoustical Suspension System: www.usg.com/ceilings/#sle.
 - b. Armstrong; Prelude XL 15/16" Exposed Tee.. www.armstrongceilings.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12-gage 0.08 inch galvanized steel wire.
- C. Perimeter Moldings: Same metal and finish as grid.
 - 1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
- D. Acoustical Insulation: Specified in Section 07 2100.
 - 1. Thickness: 2 inch.
 - 2. Size: To fit acoustical suspension system.
- E. Gypsum Board: Fire rated type; 5/8 inch thick, ends and edges square, paper faced.
- F. Acoustical Sealant For Perimeter Moldings: Specified in Section 07 9005.
- G. Touch-up Paint: Type and color to match acoustical ceiling tiles and grid units.

END OF SECTION

**SECTION 09 5813
ENSEMBLE ACOUSTICAL CEILING SYSTEM**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 2300 - Alternates, for product alternatives affecting this section.
 - 1. This section describes an alternative product. Refer to Section 09 2116 - Gypsum Board Assemblies for base bid product.

1.03 SUMMARY

- A. Section Includes:
 - 1. Suspension systems for perforated gypsum interior ceilings and soffits.
 - 2. Acoustical Insulation for perforated gypsum board ceilings.
 - 3. Extruded aluminum trim for ceiling height changes and material transitions.
- B. Related Requirements:
 - 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.04 LEED PERFORMANCE REQUIREMENTS

- A. Regional Materials:
 - 1. If applicable, provide the location of manufacturer and point of extraction, harvest, or recovery for each raw material. Must be within 100 miles of project site for credit.
- B. Recycled Content:
 - 1. Provide materials with recycled or reused content.
- C. VOC Emissions Evaluation:
 - 1. For acoustical and metal ceilings, products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1-2010 or CDPH Standard Method v1.2-2017, using the applicable exposure scenario. The manufacturers' or third-party certification must state the exposure scenario used to determine compliance. Claims of compliance for wet-applied products must state the amount applied in mass per surface area. The Claims of compliance must also state the range of total VOCs after 14 days, measured as specified in CDPH Standard Method v1.1 or CDPH Standard Method v1.2-2017.
- D. Environmental Product Declaration:
 - 1. Purchase product from manufacturer that has an EPD conforming to ISO 14025 and EN 15804, or ISO 21930 and having at least a cradle to gate scope . If applicable, use products that have a compliant embodied carbon optimization report or action plan.
- E. Health Product Declaration:
 - 1. Purchase product that has a Health Product Declaration (HPD), Cradle to Cradle certificate, Declare label, meets ANSI ANSI/BIFMA e3 Furniture Sustainability Standard, declared Manufacturer Inventory (MI), or Product Lens Certification.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.06

- A. Complete provided Product Data Reporting Form in spec section 01 8113 and provide the following:
 - 1. Regional Materials:

- a. For regional materials, indicate location of material manufacturer and point of extraction, harvest, or recovery for each material (this includes components of the mix design). Include distance to Project and cost for each regional material.
2. Recycled Content:
 - a. Provide recycled content information. Highlight post-consumer and pre-consumer quantities. Provide material costs excluding labor itemized .
3. VOC Emissions Evaluation:
 - a. Provide documentation that product complies with one of the following: SCS Indoor Advantage Gold, FloorScore, MAS Certified Green, UL Greenguard Gold or CRI Green Label Plus. The third-party certification must state the exposure scenario used to determine compliance. Claims of compliance for wet-applied products must state the amount applied in mass per surface area. The Claims of compliance must also state the range of total VOCs after 14 days, measured as specified in CDPH Standard Method v1.1 or CDPH Standard Method v1.2-2017.
4. Environmental Product Declaration:
 - a. Provide manufacturers EPD conforming to ISO 14025 and EN 15804, or ISO 21930 and having at least a cradle to gate scope. If applicable, provide a compliant embodied carbon optimization report or action plan.
5. Health Product Declaration:
 - a. Provide manufacturers Health Product Declaration (HPD), Cradle to Cradle certificate, Declare label, ANSI ANSI/BIFMA e3 Furniture Sustainability Standard documentation, Manufacturer Inventory (MI) documentation, or Product Lens Certification, as applicable.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Subcontractor is an experienced Installer, approved and trained by product manufacturer to properly install ceiling system.
 1. Subcontractor shall provide documentation that they are certified installers of the USG Ensemble™ Ceiling System.
 2. Subcontractor shall utilize approved equipment and procedures for proper installation.
- B. Source Limitations: The Ensemble Ceiling is to be purchased and installed by a certified single-source provider.

1.08 COORDINATION:

- A. Pre-installation conference: Conduct conference at project site (coordinate all luminaires, sprinklers, exit signs and MEP devices that are to be installed in the ceiling).
- B. Coordinated Shop Drawings: Contractor shall submit coordinated shop drawings that clearly indicate the following components for Architect Approval prior to installation. Shop drawings shall include device alignment, dimensions, center lines and indicate the following:
 1. Access panels.
 2. Ceiling devices.
 3. Ceiling framing.
 4. Changes in ceiling height elevation.
 5. Control joints
 6. Drywall edge profile for Compasso™ Elite and associated spice clips for vertical joints.
 7. Life safety devices.
 8. Light fixtures.
 9. MEP grilles.
 10. Miscellaneous items located on ceiling.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, unopened packaging and store in an enclosed shelter providing protection from damage and exposure to the elements.
 1. Store within temperature limits required by manufacturer.

2. Store Ensemble [™] panels flat.
 3. Comply with manufacturer's requirements for safety and handling.
- B. Discard joint compounds and sealants that cannot be applied within their stated shelf life.
- C. Store accessory materials in a location with constant ambient temperatures of 50 to 80 °F (15 to 27 °C). Avoid exposure to sustained temperatures exceeding 125 °F (52 °C).

1.10 FIELD CONDITIONS

- A. Install Ensemble system in an indoor environment that is climate controlled.
- B. Comply with ASTM C840 requirements for interior drywall installation: Maintain room temperatures at greater than 40 °F (4.4 °C) at least 48 hours before panel installation and greater than 50 °F (10 °C) at least 48 hours before joint treatment or spray-applied finish application, and continuously during and after application.
- C. Avoid exposure and protect from excessive, repetitive or continuous moisture before, during and after installation. Eliminate sources of moisture immediately.
- D. Adequate ventilation shall be maintained in the working area during installation and curing period.

1.11 WARRANTY

- A. Product is furnished as is to the contractor.
- B. Reference Division 01 for General Contractor Obligations.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.02 MONOLITHIC SOUND ABSORBING GYPSUM BOARD SYSTEM

- A. Sound Absorbing Gypsum Ceiling and Suspension System: TYPE ACTXX:
1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: USG Interiors, LLC, "USG ENSEMBLE[™] ACOUSTICAL DRYWALL CEILING".
 2. Armstrong ACOUSTIBUILT Seamless Acoustical Ceiling System.
 3. Substitutions: See Section 01 6000 - Product Requirements.

2.03 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Perforated Gypsum Board suspension system: complies with applicable requirements per ASTM C 645, direct-hung system composed of Index support bars and cross-furring drywall suspension tees that interlock.
1. Framing System:
 - a. Deflection criteria: L/240 per ASTM C635.
 - b. Galvanized Steel: G40 double-web tee, hot-dipped galvanized steel.
 2. Framing Members:
 - a. Index support bars: ISB 109.
 - b. USG Drywall Suspension system main tees: DLGW26.
 - c. USG ISB Cross Brace Clip: ISBAC.
 3. Attachment devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements, if applicable.
 4. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

- a. Zinc- Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
- b. Size: Minimum 12 gage per ASTM C636.

2.04 HIGHLY ENGINEERED GYPSUM-BASED PANEL PRODUCT FOR CEILING APPLICATION

- A. Highly Engineered Acoustical Gypsum-Based Panel product for Ceiling application.
 - 1. Perforated non-fire rated gypsum panel with acoustically transparent scrim: complies with ASTM C1396 Non-Type X.
 - 2. Subject to compliance with project requirements, the base panel is made from the following: USG Corporation, LLC, "USG Sheetrock® Brand EcoSmart FC 30 Ensemble™ Panels 5/8".
 - 3. ISO 14040 Environmental Management, Life Cycle Assessment, Principles and Framework:
 - a. Carbon emissions per Product Category Rules for North American Gypsum Boards; FPIInnovations - Gypsum PCR-2013: v1; Global Warming Potential of [193 kg CO2 eq./1000 ft2 for Eastern USA] [211 kg CO2 eq./1000 ft2 for Western USA].
 - b. Water reduction per Product Category Rules for North American Gypsum Boards; FP Innovations - Gypsum PCR-2013: v1 yields a net use of fresh water value of [0.752 m3/1000 ft2 for Eastern USA] [0.953 m3/1000 ft2 for Western USA].
 - 4. UL Type Designation "FC30" (prior to modifications)
 - 5. ASTM C 1396/C 1396M: 5/8" wallboard, non-type X (prior to modifications).
 - 6. ASTM E136 Non-combustibility: Meets or exceeds criteria.
 - 7. ASTM C473:
 - a. Core Hardness: Meets or Exceeds 11 (ASTM C473 B)
 - b. Flexural Strength (lbf).
 - 1) Parallel: Not less than 46.
 - 2) Perpendicular: Not less than 147.
 - c. Nail Pull Resistance (lbf) ASTM C473 (B): Not less than 87.
 - 8. Thickness: 5/8 inch (12.7 mm).
 - 9. Length: [9'-4" (2845 mm)],
 - 10. Widths: 48"(1220 mm).
 - 11. Weight: 1.65-1.75 lbs./sq. ft.
 - 12. Long Edges: Tapered.

2.05 ACOUSTICAL BACKER PANEL

- A. Acoustical Backer Panel: USG Interiors, LLC, "USG Ensemble™ High-NRC Backer Panel".
 - 1. Classification: Provide un-faced acoustical panels with the following physical attributes:
 - a. NRC: Not less than 0.80.
 - b. CAC: Not less than 44.
 - c. Edge/Joint Detail: SQ Square.
 - d. Panel Thickness: 1 inch (25.4 mm).
 - e. Modular Size: 16 by 48 inches (406 by 1220 mm).
 - f. Recycled Content: 66%.
 - 2. High Recycled Content Product: Classified as containing greater than 50% total recycled content. Total recycled content is based on product composition of post-consumer and pre-consumer post-industrial recycled content per FTC guidelines.
 - 3. VOC Emissions: Meets CA Specification 01350, CHPS listed for low emitting materials.

2.06 CEILING PANEL JOINT TREATMENT

- A. Perforated Gypsum Board Joint Treatment.
 - 1. General: Comply with ASTM C 475/C 475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board:
 - a. USG Sheetrock® Brand Paper Joint Tape.
 - b. USG Sheetrock® Brand All Purpose Joint Compound

- c. USG Sheetrock® Brand Ensemble® Ceiling Compound
- 2. Application:
 - a. Joint Compound for Interior Gypsum Board: For each coat, use formulation that complies with USG Ensemble™ Acoustical Monolithic Ceiling System applied on previous and or successive coats.
- 3. Prefilling:
 - a. At open joints or beveled panel edges, use USG Sheetrock® Brand Easy Sand setting-type Compound.
- 4. Embedding and First Coat:
 - a. For embedding tape, use USG Sheetrock® Brand All Purpose Joint Compound and embed USG Sheetrock® Brand Paper Joint Tape.
- 5. Finish Coat:
 - a. For finish coats on joints, fasteners, and trim flanges, as well as all 3 finish coats over joint tape, use USG Sheetrock® Brand Ensemble® Ceiling Compound. Finish to create a final coat equal to a Level 4 finish. DO NOT SKIM COAT OVER PERFORATIONS.

2.07 CEILING PANEL SPRAY-APPLIED FINISH

- A. Acoustically Transparent Finish
 - 1. USG Interiors, LLC, "USG Ensemble™ Spray-Applied Finish":
 - a. Finish: Fine Finish.
 - b. Color: White (standard)
 - c. Color. Custom colors available 10/2018. Submit one of the following color numbers:
 - 1) Benjamin Moore
 - 2) Sherwin Williams
 - 3) Pantone
 - 2. Classification: Provide acrylic based spray-applied finish complying with USG Ensemble™ Spray-Applied Finish.

2.08 ACCESSORIES

- A. Gypsum Board Trim Accessories.
 - 1. Trim Accessories: Galvanized steel sheet per ASTM 1047: Provide manufacturer approved and tested metal trim that is chemically compatible with the specified ceiling system.
 - a. USG Sheetrock Brand Metal Trim:
 - 1) Corner Bead
 - 2) Reveal Joint
 - 3) L Bead
 - 4) U Bead
 - 5) Control Joint
 - 6) USG Sheetrock® Brand Paper Faced Metal Trim.
- B. Extruded-Aluminum Edge Moldings and Trim.
 - 1. Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following: Provide manufacturer approved and tested metal trim that is chemically compatible with the specified ceiling system.
 - a. Drywall Ceilings: USG Compasso™ Elite for Drywall, height: [2 1/2" (40)], [4" (100)], [6" (150)] or [8" (200)].
 - b. Drywall to upper grid ceiling: USG Compasso™ Elite Transitions DAS, height: [2" (50)], [3" (75)], [4" (100)], [5" (125)] or [6" (150)].

END OF SECTION

**SECTION 09 6430
ENGINEERED WOOD FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES V.20

- A. Engineered Wood Plank Flooring, Glue Down.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete subfloor surface.

1.03 REFERENCE STANDARDS

- A. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- B. NWFA (IG) - Installation Guidelines; current edition located at www.nwfa.org.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for flooring and floor finish materials.
- C. Shop Drawings: Indicate floor joint pattern, termination details, indicate provisions for expansion and contraction.
- D. Samples: Submit two samples 36 by 36 inch in size illustrating floor finish, color, and sheen.
- E. Installation Instructions: Indicate standard and special installation procedures.
- F. Maintenance Data: Include maintenance procedures and recommended maintenance materials.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with NWFA (IG).
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 FIELD CONDITIONS

- A. Do not install wood flooring until wet construction work is complete and ambient air at installation space has moisture content stabilized at maximum moisture content of 40 percent.
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.
- C. Maintain minimum room temperature of 65 degrees F for a period of two days prior to delivery of materials to installation space, during installation, and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hardwood Strip and Plank Flooring:
 - 1. Craft Artisan Wood Floors; Messina: www.craftfloor.com/.
 - 2. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Engineered Wood Flooring - Type WDF-01:
 - 1. Veneer: Hickory, North America.
 - 2. Core: Canadain Spruce.
 - 3. Grade: Select Grade.
 - 4. Actual Thickness: 5/8".
 - 5. Actual Width: 8 inches.
 - 6. Wear Layer: 3 mm.

7. Texture: Wire-Brushed.
 8. Length: Up to 96 inches.
 9. Finish: Aluminum Oxide Finish.
 10. Product: Craft Artisan Wood Floors; Messina: www.craftfloor.com/.
- B. Adhesive: As recommended by manufacturer, CARB2 Compliant.
- C. Provide a urethane top coating for finish protection. Basis of Design: BONA Traffic HD.

2.03 ACCESSORIES

- A. Transition Strip:
1. Manufacturer provided floor trims & molding. Match WDF-01.
 - a. Reducer Strip.
 - b. T-Molding.
 - c. Threshold.
- B. Stair Nosings.

END OF SECTION

**SECTION 09 6500
RESILIENT FLOORING**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Static control resilient tile flooring.
- C. Resilient base.
- D. Resilient stair accessories.
- E. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- B. ASTM F150 - Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring; 2006 (Reapproved 2013).
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- D. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).
- E. ASTM F1700 - Standard Specification for Solid Vinyl Tile; 2013a.
- F. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).
- G. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2015.
- H. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; www.baaqmd.gov; 2002.
- I. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.
- J. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- E. Mockup: may be required from installer to convey installation of componets with accessories.
- F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 10 percent or 45 square feet of each type and color.

3. Extra Wall Base: 20 linear feet of each type and color.
4. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect roll materials from damage by storing on end.

1.06 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

- A. Rubber Tile - Type RBT: Homogeneous, color and pattern throughout thickness.
 1. Manufacturers:
 - a. Nora; Kivo: www.nora.com/.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
 3. Size: 36 by 36 inch nominal.
 4. Total Thickness: 0.125 inch.
 5. Texture: Hammered.
 6. Color: Flint.
- B. Static Control Tile - Type SDT: Homogeneous; color and pattern throughout thickness.
 1. Manufacturers:
 - a. Roope; ESD Vinyl Static Control Tile: www.roppe.com/.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 2. Minimum Requirements: Solid vinyl tile complying with ASTM F1700, Class 1, Type A.
 3. Electrical Resistance:
 - a. Conductive Tile: Resistance between 25 kilohms and 1.0 megohms as tested in accordance with ASTM F150.
 - b. Dissipative Tile: Resistance between 1.0 megohms and 1000 megohms as tested in accordance with ASTM F150.
 4. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648, NFPA 253, ASTM E 648, or NFPA 253.
 5. VOC Content Limits: As specified in Section 01 6116.
 6. Tile Size: 12 by 12 inch.
 7. Total Thickness: 0.125 inch.
 8. Color: 751 Hazel Grey.

2.02 STAIR COVERING

- A. Stair Treads with Integral Risers: Rubber; full height of riser, full width and depth of tread in one piece; tapered thickness.
 1. Manufacturers:
 - a. Nora; Satura: www.nora.com/.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 2. Minimum Requirements: Comply with ASTM F2169, Type TS, rubber, vulcanized thermoset.
 3. Nominal Thickness: 0.1875 inch.
 4. Nosing: Angled.
 5. Striping: 2 inch wide contrasting color abrasive strips.
 6. Tread Texture: Raised.
 7. Color: To be selected by Architect from manufacturer's full range.

2.03 RESILIENT BASE

- A. Resilient Base - Type RBB: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - 1. Height: 4 inch.
 - 2. Thickness: 0.125 inch.
 - 3. Finish: Satin.

2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Leveling and Patching compound: As recommended by flooring manufacturer.
- C. Moisture Membrane: As required or recommended by flooring manufacturer.
- D. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer based on application type.
 - 1. Provide only products having lower volatile organic compound (VOC) content than required by the more stringent of the South Coast Air Quality Management District Rule No.1168 and the Bay Area Air Quality Management District Regulation 8, Rule 51.
 - 2. Provide product compatible with concrete subfloor relative humidity and ph levels.
- E. Moldings, Transition and Edge Strips: Metal, stainless steel or anodized aluminum.
 - 1. Products: Schluter Systems; Schiene, Deco or Reno style trim.
- F. Copper Grounding Strips: Type and size as recommended by static control flooring manufacturer.
- G. Filler for Coved Base: Plastic.

END OF SECTION

**SECTION 09 6700
FLUID-APPLIED FLOORING**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Fluid-applied flooring and base with integral color patterns.
- B. Divider Strips and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- C. Samples: Submit two samples, 4 by 4 inch in size illustrating color and pattern for each floor material for each color specified.
- D. Manufacturer's Installation Instructions: Indicate special procedures.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section.
 - 1. Minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in a dry, secure area.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.06 FIELD CONDITIONS

- A. Maintain minimum temperature in storage area of 55 degrees F.
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.
- C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fluid-Applied Flooring:
 - 1. Duracyl Global Flooring; Duracem: www.duracryl.com/the-atelier/duracem/.

2.02 FLUID-APPLIED FLOORING SYSTEMS

- A. Biopolymer Flooring, Type BPF-01: Biopolymer based flooring with recycled materials, monolithic concrete look, epoxy alternative.
 - 1. Product:
 - 2. Color: Carbon.

2.03 ACCESSORIES

- A. Base Caps & Flooring Trim: Extruded anodized aluminum with projecting base of 1/8 inch; color as selected.
- B. Cant Strips: Molded of flooring resin material.

- C. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
- D. Primer: Type recommended by fluid-applied flooring manufacturer.

END OF SECTION

**SECTION 09 6813
TILE CARPETING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.
- B. Removal of existing carpet tile.

1.02 RELATED REQUIREMENTS

- A. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.
- B. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2006 (Reapproved 2011).
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.
- F. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
- G. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.
- H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate layout of joints.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Concrete Sub-floor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Tile Carpeting, Type CPT-01: Pattern Perfect, Textured Patterned Loop, manufactured in one color dye lot.
 - 1. Product: Introspective Thoughts manufactured by Mohawk Group.
 - 2. Tile Size: 24 by 24 inch, nominal.
 - 3. Color: Elizabeth.
 - 4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 - 5. Fiber: Duracolor® Tricor Premium Nylon.
 - 6. Backing: Ecoflex One.
- B. Tile Carpeting, Type CPT-02: Pattern Perfect, Textured Patterned Loop, manufactured in one color dye lot.
 - 1. Product: Quiet Musing manufactured by Mohawk Group.
 - 2. Tile Size: 24 by 24 inch, nominal.
 - 3. Color: Elizabeth.
 - 4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 - 5. Fiber: Duracolor® Tricor Premium Nylon.
 - 6. Backing: Ecoflex One.
- C. Tile Carpeting, Type CPT-03: Tufted, Textured Patterned Multi-Colored Loop, manufactured in one color dye lot.
 - 1. Product: Quiet Musing manufactured by Mohawk Group.
 - 2. Tile Size: 24 by 24 inch, nominal. Color: Elizabeth. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253. Fiber: Duracolor® Tricor Premium Nylon. Backing: Ecoflex One.
 - 3. Color: Elizabeth.
 - 4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 - 5. Fiber: Duracolor® Tricor Premium Nylon.
 - 6. Backing: Ecoflex One.
- D. Walk Off System: Zone 1, 2 and 3.
 - 1. Zone 1: Milliken Obex Bar.
 - 2. Zone 2: Milliken Obex Grid.
 - 3. Zone 3: Milliken Obex Tile.

2.02 ACCESSORIES

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

END OF SECTION

SECTION 09 6900 ACCESS FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fixed height, low-profile access flooring systems.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- C. ASTM E2322 - Standard Test Method for Conducting Transverse and Concentrated Load Tests on Panels used in Floor and Roof Construction; 2003 (Reapproved 2015).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. CISC (AF) - Recommended Test Procedures for Access Floors; 2007.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets including loading capacities, materials, finishes, dimensions of components, profiles, and accessories.
- C. Shop Drawings: Indicate floor layout, appurtenances or interruptions, edge details, ramps.
- D. Manufacturer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Design floor system structure layout for this project under direct supervision of a Professional Structural Engineer experienced in design of floors of the type required and licensed in the State of Arkansas.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing the type of work required in this section and approved by access flooring manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Access Flooring - Low-Profile Fixed Height:

2.02 PERFORMANCE REQUIREMENTS

- A. General: Comply with the following system requirements and as indicated for specified components.
- B. Concentrated Load: Over an area of 1 inch by 1 inch, 900 pounds at any location, when tested in accordance with CISC (AF).
- C. Ultimate Load: Over an area of 1 inch by 1 inch: Not less than twice design load or 1800 pounds, when tested in accordance with CISC (AF).
- D. Rolling Loads: Permanent deformation not to exceed 0.04 inch, when tested in accordance with CISC (AF).
- E. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 75, maximum; when tested in accordance with ASTM E84.
- F. Electrical Grounding Connection: Listed and classified by Underwriters Laboratories as suitable for the purpose specified and indicated.

2.03 ACCESS FLOORING - LOW-PROFILE FIXED HEIGHT

- A. Access Flooring – Low-Profile Fixed Height: Factory-fabricated system consisting of fixed height base units forming a grid of cable and wiring trenches that are covered with removable steel floor plates; provide components and accessories required for complete installation and as indicated.
 - 1. Products:
 - a. FreeAxez; Gridd 40: www.freeaxe.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. System designed for installation without adhesives or fasteners.
 - 3. Undersheet: Manufacturer's standard roll material.
 - a. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - b. Smoke Developed Index: 75 or less, when tested in accordance with ASTM E84.
 - 4. Base Units: Steel modules, octagonal shape, with integral support legs.
 - 5. Floor Plate Panels: Galvanized steel plate of size and shape to cover trench spaces and to create a uniform floor surface.
 - 6. Border Components: Manufacturer's standard components to infill gaps between the standard components and edges of field penetrations and boundary walls.

2.04 ACCESSORIES - LOW-PROFILE FIXED HEIGHT

- A. Exposed Edge and Corner Trim: Manufacturer's standard steel trim; install at locations where underfloor cavity is not enclosed by abutting walls or other construction.
- B. Ramp: Manufacturer's standard construction.
- C. Grommet Units: Base units with pass-through for power harnesses and communication cables.

2.05 FABRICATION

- A. Fabrication Tolerances:
 - 1. Floor Panel Flatness: Plus or minus 0.02 inch in any direction.
 - 2. Floor Panel Width or Length From Specified Size: Plus or minus 0.02 inch.
 - 3. Floor Panel Squareness: Plus or minus 0.03 inch difference between opposite diagonal dimensions.

END OF SECTION

SECTION 09 7200 WALL COVERINGS

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Surface preparation and prime painting.
- B. Wall covering and borders.
- C. Specialty wallcoverings including dry-erase and digitally printed vinyl.

1.02 REFERENCE STANDARDS

- A. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes; 2002 (Reapproved 2013).
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2015.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Shop Drawings: Indicate wall elevations with seaming layout.
- D. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Wall Covering Materials: 30 linear feet (or min. 5%) of each color and pattern of wall covering; store where directed.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.01 WALL COVERINGS

- A. General Requirements:
 - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.
- B. Textile Wall Covering - Type TWC-01: High Performance Textile Wallcovering, made with Polyolefin/Polyolefin Blend, Polyethylene .
1. Roll Width: 54 inches.
 2. Backing: Acrylic.
 3. Fire Rating: ASTM E84 (Adhered) and IBC Section 803.1.2 - Class A.
 4. Finish: PFAS-free spill- and stain-resistant treatment.
 5. Content: 59% Polyethylene, 37% Olefin, 4% Recycled Polyester.
 6. Weight: 16.22 oz per linear yard.
 7. Color: Spring.
 8. Manufacturers:
 - a. Wolf-Gordon; Arima: www.wolfgordon.com/.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. PVC Free Vinyl Wall Covering, Type VWC-01: Type II, W-101 (Fed. Spec. CCC-W-408A/D)
1. Roll Width: 52/54".
 2. Backing: Bio-sources osnaburg.
 3. Content: 100% Circon Vinyl.
 4. Repeat" 28"V x 52"H.
 5. Fire Rating: ASTM E84 Class A, CAN/ULC S102.
 6. Weight: 20 oz.
 7. Manufacturers:
 - a. Momentum Textiles; Loma: www.momentumtextilesandwalls.com/.
 - b. Substitutions: See Section 01 6000-Product Requirements.
- D. Specialty Wallcovering: Type SWC-01: (Dry-Erase Wallcovering).
1. Material: Embossed lenticular vinyl surface for projections and dry erase markers.
 2. PE50: 49/50 inch width, non-woven backing, white only, matte finish.
 3. Manufacturer: Koroseal Interior Products, LLC; www.koroseal.com/products/walltalkers
 - a. Product: Walltalkers Project-rite.
 4. Accessories:
 - a. Aluminum Tray; Silver Quantum Trim
 - b. J Cap Wallcovering Trim; Jc12-00 Clear Satin anodized aluminum
 - c. Silver Aluminum Marker Caddy
 - d. Aluminum Paper Rail: PR12-00
 - e. Tack Rail: T112-ZZ; 1 inch tack rail with tac-wall insert
 - f. Presentation Starter Kit: Provide one Walltalkers starter kit containing eight dry erase markers, one eraser, two dry-erase cleaning cloths, one empty bottle for water, and one 8 ounce bottle liquid surface cleaning solution for each room installed with dry-erase wallcovering.
 - 1) RK1RSK2: Regular starting kit with standard dry erase markers.
 - 2) Braod Tip Dry Erase Markers: EC12-99 & EC04-00 in Red, Blue, Green and Black.
 - 3) Erasing Components: DEFE-99 Eraser, DECC-Y1 Cleaning Cloth and RCC8 Liquid Surface Cleaner.
- E. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.
- F. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.
- G. Substrate Primer and Sealer: Alkyd enamel type.

END OF SECTION

**SECTION 09 9000
PAINTING AND COATING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Exposed surfaces of steel lintels and ledge angles.
 - 3. Surfaces inside cabinets.
 - 4. Prime surfaces to receive wall coverings.
 - 5. Mechanical and Electrical:
 - a. In finished areas, paint all insulated and exposed pipes, unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Ceramic and other tiles.
 - 7. Glass.
 - 8. Concealed pipes, ducts, and conduits.

1.02 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. Master Painter's Institute (MPI) product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on aluminum sheet, 6 x 6 inch in size.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures.

- E. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Coatings: 1 gallon of each color; store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.06 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 3 feet long by 3 feet wide, illustrating special coating color, texture, and finish.
- C. Provide mock-up on-site of each accent paint colors selected by Architect, minimum 3 feet long by 3 feet wide, in location as directed by Architect. Accent colors to be reviewed by Architect for final approval PRIOR to accent painting starting. Proceeding with Accent painting without approval is done so at Contractor's own risk.
- D. Provide door and frame assembly illustrating paint coating color, texture, and finish.
- E. Locate where directed.
- F. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Provide all paint and coating products from the same manufacturer to the greatest extent possible.
- C. Paints:
 - 1. Benjamin Moore & Co: www.benjaminmoore.com/#sle.
 - 2. PPG Paints: www.ppgpaints.com/#sle.
 - 3. Pratt & Lambert Paints: www.prattandlambert.com/#sle.

- 4. Sherwin- Williams Company: www.sherwin-williams.com/#sle.
- D. Transparent Finishes:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- E. Stains:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- F. Primer Sealers: Same manufacturer as top coats.
- G. Block Fillers: Same manufacturer as top coats.
- H. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
 - 1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Colors: To be selected from manufacturer's full range of available colors.
 - 1. Selection to be made by Architect after award of contract.
 - 2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner. Accent colors will be no more than 50% of the total project scope and will terminate at edges and/or inside corners.
 - 3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint CE-OP-3L - Masonry/Concrete, Opaque, Latex, 3 Coat:
 - 1. One coat of block filler.
 - 2. Semi-gloss: Two coats of latex enamel; ____.
- B. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
 - 1. One coat of alkyd primer.
 - 2. Semi-gloss: Two coats of alkyd enamel; ____.
- C. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
 - 1. One coat galvanize primer.
 - 2. Semi-gloss: Two coats of alkyd enamel; ____.
- D. Paint MgE-OP-3L - Galvanized Metals, Latex, 3 Coat:
 - 1. One coat galvanize primer.
 - 2. Semi-gloss: Two coats of latex enamel; ____.

2.04 PAINT SYSTEMS - INTERIOR

- A. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat:
 - 1. One coat of latex primer sealer.
 - 2. Semi-gloss: Two coats of latex enamel; _____.
- B. Paint WI-TR-VS - Wood, Transparent, Varnish, Stain:
 - 1. One coat of stain; _____.
 - 2. One coat sealer ; _____.
 - 3. Satin: One coat of varnish; _____.
- C. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
 - 1. One coat of latex primer.
 - 2. Gloss: Two coats of latex enamel; _____.
- D. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
 - 1. Touch-up with latex primer.
 - 2. Semi-gloss: Two coats of latex enamel; _____.
- E. Paint CI-OP-3E - Concrete/Masonry, Epoxy Enamel, 3 Coat:
 - 1. One coat of catalyzed epoxy primer.
 - 2. Gloss: Two coats of catalyzed epoxy enamel; Full Gloss.
- F. Paint GI-OP-3E -Gypsum Board/Plaster, Epoxy Enamel, 3 Coat:
 - 1. One coat of catalyzed epoxy primer.
 - 2. Semi-gloss: Two coats of precatalyzed Epoxy; _____.
- G. Paint GI-OP-3LA - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat:
 - 1. One coat of alkyd primer sealer.
 - 2. Semi-gloss: Two coats of latex-acrylic enamel; _____.
 - 3. Satin: Two coats of latex-acrylic enamel; _____.
 - 4. Flat: Two coats of latex enamel-acrylic; _____.
- H. Paint FI-OP-3A - Fabrics/Insulation Jackets, Alkyd, 3 Coat:
 - 1. One coat of alkyd primer sealer.
 - 2. Eggshell: Two coats of alkyd enamel; _____.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.

- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- I. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- J. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- L. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- M. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- N. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- O. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's instructions.
- C. Apply each coat to uniform appearance.
- D. Sand wood surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

3.06 SCHEDULE - PAINT SYSTEMS

- A. Gypsum Board: Finish all surfaces exposed to view, except _____.
 - 1. Interior Ceilings and Bulkheads: GI-OP-3LA, flat.
 - 2. Interior Walls: GI-OP-3LA, satin.
 - 3. Interior Walls at Restrooms, Laundry Rooms, Janitors Closets: GI-OP-3E, semigloss.
- B. Steel Doors and Frames: Finish all surfaces exposed to view; MI-OP-3A, semi-gloss.

END OF SECTION

**SECTION 09 9113
EXTERIOR PAINTING**

PART 1 GENERAL V.23

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Exposed surfaces of steel lintels, ledge angles, and exterior primed or unfinished metals.
 - 2. Mechanical and Electrical:
 - a. On the roof and outdoors, paint equipment that is exposed to weather or to view, including factory-finished materials.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Non-metallic roofing and flashing.
 - 6. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, zinc, and lead.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other types of tiles.
 - 9. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
 - 10. Exterior insulation and finish system (EIFS).
 - 11. Glass.
 - 12. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- E. SSPC-SP 1 - Solvent Cleaning; 2015.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.

- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five (5) years experience.
- C. Provide field testing for adhesion per ASTM D4551 for paint applied to steel and galvanized steel surfaces in locations directed by Architect, quantity of 2 locations.

1.05 MOCK-UP

- A. Locate where directed by Architect.
- B. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.08 WARRANTY

- A. See section 01 7800 for CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Manufacturers Requirements: Provide standard manufacturers warranty.
- C. Installers Requirements: Provide guarantee that surface cleaning and preparation has been performed as specified and that product(s) specified have been used at specified application. Provide 5 year warranty for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:

1. Base Manufacturer: Sherwin Williams.
2. Behr Process Corporation: www.behr.com/#sle.
3. PPG Paints: www.ppgpaints.com/#sle.
4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 2. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 3. Supply each paint material in quantity required to complete entire project's work from a single production run.
 4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- C. Colors: As indicated in Color Schedule.
 1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint WE-OP-3L - Wood, Opaque, Latex, 3 Coat:
 1. One coat of latex primer sealer, all side of wood surfaces.
 2. On backside of concealed wood trim: One coat of latex primer sealer.
 3. Semi-gloss: Two coats of latex enamel.
- B. Paint CE-OP-3L - Masonry/Concrete, Opaque, Latex, 3 Coat:
 1. One coat of block filler. Sherwin Williams Loxon Block Surfer A24W200, coordinate requirements with coating manufacturer.
 2. Concrete and Masonry Coatings per Section 09 9723.
- C. Paint GE-OP-3L - Exterior Gypsum Board and Exterior Plaster, Opaque, Latex, 3 Coat:
 1. One coat of latex primer sealer. Loxon Concrete & Masonry Primer Sealer, A24W8300
 2. Flat: Two coats of latex; A-100 Exterior Latex Flat, A6 Series.
- D. Paint ME-OP-3A - Ferrous Metals, Unprimed, Acrylic, 3 Coat:
 1. One coat of acrylic primer. Sherwin Williams B66-310 Series
 2. Semi-gloss: Two coats of acrylic enamel; Sherwin Williams B66-650 Series.
- E. Paint ME-OP-3B - Ferrous Metals, Unprimed, Acrylic, 2 Coat: Exposed Exterior Structural Steel
 1. Touch Up of manufacturer acrylic primer: As recommended by Tnemec
 2. Semi-gloss: Two coats of HDP acrylic enamel; Tnemec Enduratone Series 1029.
- F. Paint ME-OP-2A - Ferrous Metals, Primed, Acrylic, 2 Coat:
 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 2. Semi-gloss: Two coats of acrylic enamel; Sherwin Williams B66-650 Series.
- G. Paint MgE-OP-3A - Galvanized Metals, Acrylic, 3 Coat:
 1. One coat galvanize primer.
 2. Semi-gloss: Two coats of acrylic enamel; Sherwin Williams B66-650 Series.
- H. Paint MgE-OP-3X - Exterior Metal Handrails & Door Frames, Acrylic, 3 Coat:
 1. One coat ProCryl Universal Primer B66-310 Series.
 2. Semi-gloss: Two coats of DTM acrylic enamel; Sherwin Williams B66-200 Series.

2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

END OF SECTION

SECTION 09 9123 INTERIOR PAINTING

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Prime surfaces to receive wall coverings.
 - 3. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Glass.
 - 10. Concealed pipes, ducts, and conduits.

1.02 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- E. SSPC-SP 1 - Solvent Cleaning; 2015.
- F. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
- G. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).
- H. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.06 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 3 feet long by 3 feet wide, illustrating each paint color, texture, and finish.
- C. Provide mock-up on-site of each accent paint colors selected by Architect, minimum 3 feet long by 3 feet wide, in location as directed by Architect. Accent colors to be reviewed by Architect for final approval PRIOR to accent painting starting. Proceeding with Accent painting without approval is done so at Contractor's own risk.
- D. Provide door and frame assembly illustrating paint color, texture, and finish.
- E. Locate where directed by Architect.
- F. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Base Manufacturer: Sherwin Williams Company.
 - 2. Behr Process Corporation: www.behr.com/#sle.
 - 3. Pittsburgh Paints: www.ppgpaints.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Block Fillers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Colors: As indicated on drawings.
 - 1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
 - 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat:
 - 1. One coat of latex primer sealer. PrepRite ProBlock Latex Primer Sealer B51 Series
 - 2. Semi-gloss: Two coats of latex enamel; Pro Industrial Acrylic Semi Gloss B66-650 Series.
- B. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
 - 1. One coat of acrylic primer. ProCryl Universal Primer B66-310 Series
 - 2. Semi-gloss: Two coats of acrylic enamel; Pro Industrial Semi-Gloss B66-650 Series.
- C. Paint MI-OP-2A - Ferrous Metals, Primed, Acrylic, 2 Coat:
 - 1. Touch-up with recommended primer.
 - 2. Semi-gloss: Two coats of acrylic enamel; Pro Industrial Semi Gloss B66-650 Series.
- D. Paint MI-OP-2L - Ferrous Metals / Roof Deck / Exposed Interior Structure, Primed, Latex, 2 Coat:
 - 1. Touch-up with recommended primer. Pro-Cryl B66-310 Series
 - 2. Semi-gloss: Two coats of water borne acrylic dryfall Pro Industrial Semi Gloss B42-80 Series. .
- E. Paint CI-OP-3E - Concrete/Masonry, Epoxy Enamel, 3 Coat:
 - 1. One coat of catalyzed epoxy primer. Loxon Block Surfacer A24W200
 - 2. Gloss: Two coats of catalyzed epoxy enamel: Full Gloss. Pro Industrial Precatalyzed Gloss Epoxy B73-300 Series .
- F. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
 - 1. One coat of alkyd primer sealer. ProMar 200 Primer B28W2600 Series
 - 2. Semi-gloss: Two coats of latex enamel.
 - 3. Eggshell: Two coats of latex enamel; ProMar 200 B20-2600 Series.

- 4. Flat: Two coats of latex enamel; B30-2600 Series (ceilings).
- G. Paint GI-OP-3M - Gypsum Board/Plaster, Epoxy Enamel, 3 Coat:
 - 1. One coat of latex primer sealer. ProMar 200 Latex Primer B28W2600 Series
 - 2. Gloss: Two coats of water based catalized epoxy enamel; Pro Industrial Epoxy B73-300 Series.
- H. Paint FI-OP-3A - Fabrics/Insulation Jackets, Alkyd, 3 Coat:
 - 1. One coat of alkyd primer sealer.
 - 2. Eggshell: Two coats of alkyd enamel.

2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

END OF SECTION

SECTION 10 1400 SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Room and door signs.
- B. Interior directional and informational signs.
- C. Emergency evacuation maps.
- D. Building identification signs.
- E. Plaque.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2009.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through WER Architects at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through WER Architects prior to fabrication.
- D. Samples: Submit one sample of sign type F and H, of size similar to that required for project, illustrating sign style, font, and method of attachment.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flat Signs:
 - 1. Image 360: www.image360.com
 - 2. Archway Graphics: www.archwaygraphics.com
 - 3. TakeForm: www.takeform.net
- B. Plaques:
 - 1. Archway Graphics: www.archwaygraphics.com
 - 2. DFI Architectural Signs Inc.: www.dfisigns.com
 - 3. Image 360 Signs: www.image360.com

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Material: Round-Corner non-glare plex top peice (P-99), layers together equally approx. 1/4 inch thick with printed second surface (artwork indicated on drawing)
 - 3. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 4. Character Height: minimum 5/8 inch.
 - 5. Sizes: As indicated on drawings.
 - 6. Office & Classroom Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 - 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs:
 - 1. Sign Type: Same as room and door signs.
 - 2. Sizes: As indicated on drawings.
 - 3. Wording of signs is scheduled on drawings.
- D. Emergency Evacuation Maps:
 - 1. Allow for one map per elevator lobby and classroom wing (total of 7)
 - 2. Map content to be provided by Owner.
 - 3. Include Middle School Evacuation sign.
- E. Plaque: See drawings for details.

2.03 SIGN TYPES

- A. Flat Signs: Signage media without frame.
 - 1. Edges: Square.
 - 2. Corners: Radiused.
 - 3. Wall Mounting of One-Sided Signs:
 - a. When mounted on Glass: Tape adhesive with acrylic backer that matches flat sign.
 - b. When mounted on Gypsum Board: Tape adhesive.
 - c. When mounted on brick or block wall: Brushed nickel standoffs
- B. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Montserrat.
 - 2. Character Case: Upper case only.
 - 3. Background Color: As scheduled.
 - 4. Character Color: Contrasting color.

2.04 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
 - 1. Total Thickness: 1/16 inch.

2.05 PLAQUES

- A. Metal Plaques:
 - 1. Metal: Aluminum casting.
 - 2. Metal Thickness: 1/8 inch, minimum.

3. Text and Typeface:
 - a. Character Font: Montserrat, Raised Satin Finish.
4. Border Style: As indicated on drawings.
5. Background Texture: Sand. - black
6. Mounting: Blind studs.

2.06 OTHER GRAPHICS

- A. Window Graphics - Refer to Section 08 8720 Digital Window Tint Films.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

**SECTION 10 1416
PLAQUES**

PART 2 PRODUCTS

1.01 PLAQUES

END OF SECTION

**SECTION 10 2113.19
PLASTIC TOILET COMPARTMENTS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal and Vestibule screens.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 3 x 3 inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

1.04 WARRANTY:

- A. Provide manufacturer's 10 year warranty against breakage, corrosion, and delamination under normal conditions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
 - 1. Scranton Products; Aria Partitions: www.scrantonproducts.com/#sle.
 - 2. Bobrick; Product: Sierra Series 1092.
 - 3. Global Partitions: www.globalpartitions.com
 - 4. Substitutions: Section 01 6000 - Product Requirements.

2.02 COMPONENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), floor-mounted headrail-braced.
 - 1. Color: Selected from full range of manufacturer's colors tested to meet NFPA 286.
 - 2. Texture: Selected from manufacturer's full range.
- B. Door and Panel Dimensions:
 - 1. Thickness: 1 inch.
 - 2. Door Width: 24 inch.
 - 3. Door Width for Handicapped Use: 36 inch.
 - 4. Height: 72 inch.
 - 5. Thickness of Pilasters: 1 inch.
- C. Urinal Screens: Wall mounted with two panel brackets, and headrail braced vertical upright consisting of pilaster anchored to floor.

2.03 ACCESSORIES

- A. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

- B. Wall and Pilaster Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.
- C. Head Rails: Hollow anodized aluminum tube, 1 x 1-5/8 inch size, with anti-grip strips and cast socket wall brackets.
- D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.
- E. Hinges: Stainless steel, manufacturer's standard finish.
 - 1. Continuous-type hinge, self closing, 16 ga minimum, piano type with emergency access feature.
- F. Door Hardware: Stainless steel, manufacturer's standard finish.
 - 1. Door Latch: Occupancy Type with exterior emergency access feature.
 - 2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
 - 3. Provide door pull for outswinging doors.
- G. Coat Hook: One per compartment, mounted on door.

END OF SECTION

**SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Residential toilet, shower, and bath accessories.
- D. Electrically operated paper towel dispensers.
- E. Diaper changing stations.
- F. Utility room accessories.

1.02 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004 (Reapproved 2010).

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. American Specialties, Inc: www.americanspecialties.com/#sle.
 - 2. Bobrick Washroom Equipment, Inc.: www.bobrick.com
 - 3. Bradley Corporation: www.bradleycorp.com/#sle.
 - 4. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Adhesive: Two component epoxy type, waterproof.
- D. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- E. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Brushed Brass, unless noted otherwise.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Manufacturer:
 - 1. Bradley Corp: www.bradleycorp.com/.
- B. Toilet Paper Dispenser **(TA-1)**: Double Roll, surface-mounted with shelf, brushed
 - 1. Product: Elvari Toilet Paper Dispenser with Shelf 5B2-110089.
- C. Paper Towel Dispenser **(TA-2)**: Folded paper type, brass, surface-mounted, with viewing slots on sides as refill indicator and tumbler lock.
 - 1. Capacity: 400 multifold minimum.
 - 2. Products: Elvari Surface-Mounted Towel Dispenser 2B1-110000.
- D. Combination Towel Dispenser/Waste Receptacle **(TA-3)**: Recessed with projecting waste receptacle, Brass; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
 - 1. Waste receptacle liner: Reusable, heavy-duty vinyl.
 - 2. Towel dispenser capacity: 600 C-Fold.
 - 3. Waste receptacle capacity: 12 gallons.
 - 4. Products: Elvari Surface-Mounted Towel Dispenser/Waste Receptacle 2B5-113600.
- E. Soap Dispenser **(TA-6)**: Liquid soap dispenser, wall-mounted, surface, with brass cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gage refill indicator, tumbler lock.
 - 1. Products: Elvari Sensored Liquid or Foam Soap Dispenser, Surface Mounted 6B1-119300.
- F. Grab Bars **(TA-7)**: Brass, nonslip grasping surface finish.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Length and Configuration: As indicated on drawings.
 - c. Products: Elvari Grab Bars 8B1.
- G. Sanitary Napkin Disposal Unit **(TA-8)**: Brass, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 - 1. Products: Elvari Napkin Disposal, Surface Mounted 4B2-110000.
- H. Framed Mirror: **(TA-11)**: Tempered glazing with 3/4 inch x 3/4 inch stainless steel frame.
 - 1. Product: Elvari Frame and Frameless Mirrors 7B1-0024360.
- I. Robe Hook **(TA-15)**: Heavy-duty brass, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.
 - 1. Product: Elvari Coat/Robe Hook 9B1.

2.05 DIAPER CHANGING STATIONS

- A. Diaper Changing Station **(TA-10)**: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 - 1. Material: Stainless steel.
 - 2. Mounting: Surface.
 - 3. Color: from manufactures standard color ranges..
 - 4. Minimum Rated Load: 250 pounds.
 - 5. Products:
 - a. American Specialties, Inc.: www.americanspecialties.com.
 - b. Bradley Corporation: www.bradleycorp.com.
 - c. Koala Kare Products: www.koalabear.com..

2.06 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder **(MBH-1)**: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 - 1. Provide one at each mop sink, typical.
 - 2. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.

3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
4. Length: 36 inches.
5. Products: B239 manufactured by Bobrick.

END OF SECTION

**SECTION 10 4400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.04 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Ansul, a Tyco Business; Cleanguard: www.ansul.com/#sle.
 - 2. Pyro-Chem, a Tyco Business: www.pyrochem.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group - JL Industries: www.activarcpg.com/#sle.
 - 2. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 3. Potter-Roemer: www.potterroemer.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Stored Pressure Operated: Deep Drawn.
 - 2. Class: A:B:C type.
 - 3. Size: 10 pound.
 - 4. Temperature range: Minus 65 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

- A. Cabinet Configuration: Semi-recessed type, coordinate with wall cavity depth.
 - 1. Size to accommodate accessories.
- B. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.
- C. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.

- D. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- E. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.
- F. Finish of Cabinet Interior: White colored enamel.

END OF SECTION

SECTION 10 5100 LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plastic Laminate Lockers.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan.
- D. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Plastic Laminate Lockers: www.ofs.com
 - 1. OFS Brands; Intermix Lockers: www.ofs.com/.

2.02 PLASTIC LAMINATE LOCKERS

- A. Lockers: Factory assembled, made of 3/4" thick particle board cores faced with TFL laminate and PP banding; fully finished inside and out; each locker capable of standing alone.
 - 1. Doors: Two-Hing Z-Shape
 - 2. Locks: Shared User Keyless Pearl Lock.
 - 3. Interior: 2 Coat Hooks w/ top section having 3 stationary shelves and bottom section having 1 half and 1 full station shelf.
 - 4. Pull: Oval.
 - 5. Power: Oen 15 amp outlet, and two 21 amp USB charging ports (daisy chainable)

END OF SECTION

SECTION 10 7316.13 METAL CANOPIES

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Freestanding and building attached shop fabricated metal canopies.

1.02 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- B. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).
- D. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).
- E. ASTM E2950 - Standard Specification for Metal Canopy Systems; 2014.
- F. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2013a.
- G. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.
- C. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing profiles, sections of components, finishes, and fastening details.
- D. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State of Arkansas.
 - 1. Comply with applicable code for submission of design calculations as required for acquiring permits.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site ready for erection.
- B. Package using methods that prevent damage during shipping and storage on site.
- C. Store materials under cover and elevated above grade.

1.06 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Metal Canopies: Correct defective work within a two year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Canopies:

1. Mapes Canopies, www.mapes.com/canopies.
2. Peachtree Covers, www.peachtreecovers.com
3. Rusco Custom Canopies, Knoxville, TN. 1-865-938-4717.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 METAL CANOPIES

- A. Shop Fabricated Metal Canopy Type: _____.
 1. Pre-engineered system complying with ASTM E2950.
 2. Design and fabricate metal canopy system to resist wind, snow, live, and seismic loads without failure, damage, or permanent deflection in accordance with ASCE 7:
 - a. Loads: In compliance with local building codes, and as shown on Structural Drawings.
 3. Thermal Movement: Design canopy system to accommodate thermal movement caused by ambient temperature range of 120 degrees F and surface temperature range of 180 degrees F without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.
- B. Configuration: Column layout, canopy clearance, fascia profile, and roof covering design as indicated on drawings.

2.03 COMPONENTS

- A. Structural Framing:
 1. Columns: to be made from radius cornered aluminum tubular extrusion of size and indicated on architectural drawings. Minimum column size to be 6 inch by 6 inch and 0.188 inch thick.
 2. Beams: to be open topped aluminum tubular extrusion of size indicated on architect drawings. Size of beam used shall accommodate applied loadings without over-stress or over-deflection. Minimum beam size shall be 6 inch by 6 inch and 0.188 inch thick.
- B. Covering:
 1. Sheet Metal Decking: Interlocking metal panels.
 - a. Panel Size: 16 inches wide by 3 inches deep; 12 gauge, 0.080 inch thickness.
 - b. Extruded Aluminum: ASTM B221 (ASTM B221M)
 - c. Sheet Aluminum: ASTM B209 (ASTM B209M)
 - d. Provide canopy manufacturer's standard clip type fasteners for attaching covering to structural beams.
- C. Fascia: Manufacturer's standard flat profile.
- D. Anchor Bolts: ASTM A307 or ASTM A572/A572M, formed with bent shank, assembled with template for casting into concrete.
 1. Minimum exposed thread of 7 inches above footing and 23 inch minimum embedment.
 2. Provide nuts and washers as required for column leveling and plumbing.
- E. Concrete Footings: Refer to Section 03 3000 for additional requirements. Footings to be designed by Canopy provider and sized to accommodate all applicable loads.

2.04 SHOP FABRICATION

- A. Provide a complete system ready for erection at project site.
- B. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.
- C. Perform welding in accordance with AWS D1.1/D1.1M.
- D. Fabricate connections for bolt, nut, and washer connectors.

2.05 ACCESSORIES

- A. Structural Bolts: ASTM F3125/F3125M, Grade A325, minimum 3/4 inch diameter.
- B. Trim, Closure Pieces, and Flashings: Same material, thickness and finish as sheet metal decking; factory-fabricated to required profiles.

1. Exposed Fasteners: Not permitted.
- C. Fasteners, Non-Structural: ASTM F593 stainless steel or ASTM A307 carbon steel.

2.06 FINISHES

- A. High performance Organic Coating Finish:
 1. Fluoropolymer Two-Coat Coating system: Manufacturer's two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 2. Fluoropolymer Three-Coat Coating system: Manufacturer's three-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat and clear fluoropolymer topcoat, with both color coat and clear top coat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
- B. Color: Selected from Manufacturer's full line, including metallics, of available colors.

2.07 DESIGN & ASSEMBLY

- A. Wall supported model: Caonpy shall drain from the decking to the perimeter gutter, and discharge from the bottom of the gutter into the support tube columns. Columns shall discharge water at grade or be connected to storm drain systems. Refer to drawings. Downspouts can be used to drain the water from the overhead supported caonpy to the ground upon the architect's request.
- B. Self supported model: Caonpy shall drain from the decking to the perimeter gutter, and discharge from the bottom of the gutter out of a drain supper. Downspouts can be used to drain the water from the overhead supported caonpy to the ground upon the architect's request.

END OF SECTION

**SECTION 11 3013
RESIDENTIAL APPLIANCES**

PART 2 PRODUCTS

**SECTION 11 5213
PROJECTION SCREENS**

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Front projection screen assemblies.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Wiring diagrams for motor operators and actuators, and controls and switches.
- C. Shop Drawings: For custom installations, indicate dimensions, verified field measurements, mounting details, and interface with adjacent construction.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.
- F. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.
- G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver projection screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.
- B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F, and stack in accordance with manufacturer's recommendations.
- C. Acclimate screens to building temperatures for 24 hours prior to installation, in accordance with manufacturer's recommendations.

1.05 FIELD CONDITIONS

- A. Maintain interior of building between 60 degrees F and 80 degrees F during and after installation of projection screens.

1.06 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.

PART 2 PRODUCTS

2.01 FRONT PROJECTION SCREENS

- A. Manufacturers:
 - 1. Da-Lite Screen Company; Tensioned Advantage Electrol: www.da-lite.com/#sle.
 - 2. Draper, Inc (Motorized); _____: www.draperinc.com/#sle.
- B. Front Projection Screens: Factory assembled unless otherwise indicated.

1. Type 1: Located in _____ : Manual, matte light diffusing fabric screen, horizontally tensioned , ceiling recessed Provide 1 pull rod per screen at all manual screen locations.
 - a. Screen Viewing Area: ____ inch high by ____ inch wide.
 2. Type 2: Located in _____ : Motorized, matte light diffusing fabric screen, horizontally tensioned, wall mounted.
 - a. Screen Viewing Area: ____ inch high by ____ inch wide.
 3. Format: 16:10 Wide - 1.60:1.
- C. Matte Light Diffusing Fabric: Light diffusing screen fabric; washable, flame retardant and mildew resistant.
1. Material: Matte white vinyl on fiberglass backing, with nominal gain of 1.0 over viewing angle not less than 70 degrees from axis, horizontally and vertically.
 2. Seams: No seams permitted in fabric up to 96 inch high by 72 inch wide.
- D. Masking Borders: White, on four sides.
- E. Extra Drops: White; 11 inch long or as necessary for drop height as indicated on plans.
- F. Concealed-in-Ceiling Screen Cases: Steel; integral roller brackets.(Type 2)
1. Door Slat: Self trim; self-closing and -opening.
 2. Case Finish: Baked enamel.
 3. Case Color: White.
 4. End Caps: Steel; finished to match case.
 5. Electrically-Operated Screens: 1-1/2 inch aluminum door roller.
- G. Electrically-Operated Screens:
1. Roller: Steel, 2 inch in diameter, with locking device.
 2. Vertical Tensioning: Screen fabric weighted at bottom with steel bar and plastic end caps.
 3. Horizontal Tensioning: Tab-guided cable system.
- H. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings. Include pull rods at all manual locations.

2.02 ELECTRICAL COMPONENTS

- A. Electrical Components: Listed and classified by UL as suitable for the purpose specified and indicated.
- B. Motors: Direct drive, 110 V, 60 Hz.
1. Screen Motor: Mounted inside roller; three wire with ground; quick reverse type and lifetime lubricated; equipped with thermal overload cut-off, internal junction box, electric brake, and pre-set accessible limit switches.
 - a. Electrical Characteristics: 1.2 amps.
 - b. Motor mounted on sound absorber.
 2. Door and Adjustable Masking Motor: Mounted inside roller; three wire with ground; quick reverse type; equipped with thermal overload cut-off.
 - a. Electrical Characteristics: 1.2 amps.
- C. Controls: Three (3) position control switch with plate.

END OF SECTION

SECTION 12 2400 WINDOW SHADES

PART 1 GENERAL V.20

1.01 SECTION INCLUDES

- A. Interior manual roller shades.
- B. Interior motorized roller shades.
- C. Motor controls.

1.02 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.
- C. WCMA A100.1 - Safety of Corded Window Covering Products; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
- D. Selection Samples: Include fabric samples in full range of available colors and patterns.
- E. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum two years of documented experience with shading systems of similar size and type.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

1.06 WARRANTY

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Chain and Hardware: 25 years.
 - 2. Fabric / Shadecloth: 25 years.
 - 3. Electric Motors: Five years.
 - 4. Electronic Control Equipment: Five years.
 - 5. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Interior Manually Operated Roller Shades:
 - 1. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.

2. Hunter Douglas Architectural; RB500 Manual Roller Shades:
www.hunterdouglasarchitectural.com/#sle.
 3. Levolor: www.levolor.com/commercial/#sle.
 4. MechoShade Systems LLC; Mecho/5 System: www.mechoshade.com/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Interior Motorized Roller Shades, Motors and Motor Controls:
1. Draper, Inc; Motorized FlexShade: www.draperinc.com/#sle.
 2. Hunter Douglas Architectural; RB500 Motorized Roller Shades:
www.hunterdouglasarchitectural.com/#sle.
 3. Levolor: www.levolor.com/commercial/#sle.
 4. MechoShade Systems LLC; UrbanShade Single Roller - Motorized:
www.mechoshade.com/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements..

2.02 ROLLER SHADES

- A. General:
1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
 2. Provide shade system that operates smoothly when shades are raised or lowered.
- B. Roller Shades Manual - Basis of Design: MechoShade Systems LLC; Mecho/5 System; www.mechoshade.com/#sle.
1. Description: Single roller, manually operated fabric window shades.
 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 3. Roller Tubes:
 - a. Material: Extruded aluminum.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
 - d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
 4. Hembars: Designed to maintain bottom of shade straight and flat.
 5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
 - a. Provide a permanently lubricated brake assembly mounted on an oil-impregnated hub with wrapped spring clutch.
 - b. Brake must withstand minimum pull force of 50 pounds in the stopped position.
 - c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
 6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 pound minimum breaking strength. Provide upper and lower limit stops.
 - a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
 7. Location: Typical Offices.
 8. Accessories:
 - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
- C. Roller Shades Type Motorized - Basis of Design: MechoShade Systems LLC; ElectroShade with WhisperShade IQ2 EDU, line voltage (120 VAC); www.mechoshade.com/#sle.
1. Description: Single roller, motor operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.

2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
3. Roller Tubes:
 - a. Material: Extruded aluminum.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
4. Hembars: Designed to maintain bottom of shade straight and flat.
5. Intelligent Encoded Electronic Drive System:
 - a. Line Voltage EDU (120 VAC):
 - 1) Audible Noise: 46 dBA or less measured 3 feet from the motor unit, depending on motor torque.
 - b. Modes of Operation:
 - 1) Uniform Mode: Allows for shades to move only to defined intermediate stop positions in order to maintain aesthetic uniformity.
 - 2) Normal Mode: Allows for shades to move to defined intermediate stop positions plus any position between defined upper and lower limits.
 - 3) Maintenance Mode: Prevents shade from moving to newly commanded positions via dry contact or network control commands until EDU has been serviced and/or Maintenance Mode has been cleared/disabled.
 - c. Control Methods: Support both local isolated dry contact input and network control.
 - 1) Local isolated dry contact inputs support local switch control and third party system integration without separate interface.
 - 2) Bi-directional network communication enables commanding the operation of large groups of shades over a common backbone.
 - 3) Provide a minimum of three customizable preset positions accessible over the local dry contact control inputs and over the network connection.
 - 4) Provide a minimum of 32 customizable preset positions (including the three local switch presets) accessible via network commands.
6. Location: Executive Offices, Break Rooms, Training Room, Conference Rooms, Board Room.
7. Accessories:
 - a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.

2.03 SHADE FABRIC

- A. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 1. Material: Vinyl coated polyester, single thickness non-raveling 0.030-inch (0.762 mm) thick, woven from 0.018-inch (0.457mm) diameter extruded vinyl yard comprising of 21 percent polyester and 79 percent reinforced vinyl.
 2. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large and small tests.
 3. Openness Factor: 3%.
 4. Color: As selected by Architect from manufacturer's full range of colors.
 5. Location: Typical throughout unless noted otherwise.
- B. Fabric: Blackout Cloth: Non-flammable, color fast, impervious to heat and moisture, able to retain its shape under normal operation.
 1. Material: Opaque vinyl material comprising of 37 percent fiberglass base and 63 percent vinyl coating.
 2. Performance Requirements: Flammability: Pass NFPA 701-2015.
 3. Color: As selected by Architect from manufacturer's full range of colors.

4. Location: Training Room.

2.04 MOTOR CONTROLS

- A. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.
- B. Provide all components and connections necessary to interface with other systems as indicated.

2.05 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

END OF SECTION

**SECTION 14 2010
PASSENGER ELEVATORS**

PART 2 PRODUCTS

1.01 ELEVATORS

END OF SECTION

SECTION 21 0500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Above ground piping.
- B. Buried piping.
- C. Escutcheons.
- D. Expansions - hose and braid.
- E. Mechanical couplings.
- F. Pipe hangers and supports.
- G. Pipe sleeves.
- H. Piping specialties.
- I. Pressure gauges.
- J. Pressure relief valves.

1.03 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 21 0523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- C. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- D. Section 21 1200 - Fire-Suppression Standpipes: Standpipe design.
- E. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.04 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- B. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- C. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- D. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- E. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- F. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2016.
- G. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- H. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2018.
- I. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2016, with Errata (2017).
- J. ASME B16.25 - Buttwelding Ends; 2017.
- K. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2018.
- L. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
- M. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

- N. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.
- O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- P. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2019)e1.
- Q. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- R. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.
- S. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- T. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
- U. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.
- V. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- W. AWWA C606 - Grooved and Shouldered Joints; 2015.
- X. NFPA 3 - Recommended Practice for Commissioning of Fire Protection and Life Safety Systems; 2015.
- Y. NFPA 4 - Standard for Integrated Fire Protection and Life Safety System Testing; 2015.
- Z. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- AA. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2019.
- AB. NFPA 1963 - Standard for Fire Hose Connections; 2019.
- AC. UL (DIR) - Online Certifications Directory; Current Edition.
- AD. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.
- AE. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- D. Project Record Documents: Record actual locations of components and tag numbering.
- E. Operation and Maintenance Data: Include installation instructions and spare parts lists.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
 - 1. Minimum three years experience.
 - 2. Approved by manufacturer.
- C. Conform to UL and FM requirements.
- D. Valves: Bear UL and FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.

- E. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Combined Sprinkler, Standpipe, and Hose System:
 - 1. Comply with NFPA 13 and NFPA 14.
 - 2. See Sections 21 1300 and 21 1200.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.02 BURIED PIPING

- A. Steel Pipe: ASTM A53/A53M Schedule 40, ASTM A135/A135M Schedule 10, ASTM A795/A795M Standard Weight, or ASME B36.10M Schedule 40, black, with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
 - 1. Steel Fittings: ASME B16.9, wrought steel, butt welded, ASME B16.25, butt welded ends, ASTM A234/A234M, wrought carbon steel or alloy steel, ASME B16.5, steel flanges and fittings, or ASME B16.11, forged steel socket welded and threaded; with double layer, half-lapped polyethylene tape.
- B. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: AWWA C110/A21.10, standard thickness.
 - 2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket.

2.03 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A53 Schedule 40 or ASTM A135/A135M Schedule 10, black.
 - 1. Steel Fittings: ASME B16.5, steel flanges and fittings.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - 5. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.04 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc-coated or cast-iron pipe.

2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- C. Pipe Passing Through Quarry Tile, Terrazzo, or Ceramic Tile Floors:
 1. Brass pipe.
 2. Connect sleeve with floor plate.
- D. Not required for wall hydrants for fire department connections or in drywall construction.
- E. Clearances:
 1. Provide allowance for insulated piping.
 2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
 3. Rated Openings: Caulked tight with firestopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

2.05 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 1. Manufacturers:
 - a. AFCON, a brand of Anvil International; _____: www.anvilintl.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
 1. Manufacturers:
 - a. AFCON, a brand of Anvil International; _____: www.anvilintl.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Hangers for Pipe Sizes 1/2 through 8 inch: Carbon steel, adjustable swivel, split ring. Tolco 200 or approved equal.
- D. Multiple or Trapeze Hangers: Steel channels or pipe with welded spacers and hanger rods.
 1. Rings used as support shall be Heavy Duty and capable of supporting the total load of the pipe being supported. Tolco 200H or approved equal.
- E. Wall support: Welded knee-brace and U-Bolt or strut and clamp. Tolco Figure 31-M or A-12 TolStrut with 2STR Strap.
- F. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- G. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- H. Vertical Support: Steel riser clamp. Tolco Figure 6 or approved equal.
- I. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- J. Seismic Hangers and Couplings:
 1. Provide coupling with a factory set disengagement rating of 140 percent to 160 percent of the static weight.
 2. Provide resettable and reusable, break away couplings.
 3. Provide tether cables to avoid excessive seismic joint movement.
 4. Coupling to be manufactured from non-corrosive materials.
 5. Manufacturers:
 - a. The Metraflex Company; Seismic BreakAway Hanger: www.metrafire.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.06 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Manufacturers:
 1. The Metraflex Company; FireLoop: www.metrafire.com/#sle.
 2. Flex-Hose Co. Inc; _____: www.flexhose.com/#sle.
 3. Flex-Weld, Inc; _____: www.kelcoind.com/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Provide flexible loops with two flexible sections of hose and braid, two 90-degree elbows, and 180-degree return with support bracket and air release or drain plug.
- C. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.
- D. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
 - 1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
 - 2. Accommodate the Following:
 - a. Axial Deflection in Compression and Expansion: _____ inch.
 - b. Lateral Movement: _____ inch.
 - c. Angular Rotation: 15 degrees.
 - d. Force developed by 1.5 times specified maximum allowable operating pressure.
 - 3. End Connections: Same as specified for pipe jointing.
 - 4. Provide necessary accessories including, but not limited to, swivel joints.

2.07 MECHANICAL COUPLINGS

- A. Rigid Mechanical Couplings for Grooved Joints:
 - 1. Dimensions and Testing: Comply with AWWA C606.
 - 2. Minimum Working Pressure: 175 psig.
 - 3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
 - 4. Housing Coating: Factory applied orange enamel.
 - 5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
 - 6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.

2.08 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
 - 1. Activate electric alarm.
 - 2. Test and drain valve.
 - 3. Replaceable internal components without removing valve from installed position.
- B. Preaction Valve:
 - 1. Operated by detection system listed for releasing service and independent of building fire alarm system with provisions for indicated remote, local, and manual releases.
 - 2. Incorporate mechanical latching mechanism with valve clappers independent of system water pressure fluctuations.
 - 3. Provide test detection device for each actuation circuit adjacent to each controlled valve in accordance with NFPA 13.
- C. Auxiliary Drains: Condensate collection drain for each section of trapped pipe in preaction or dry fire protection system.
- D. Backflow Preventer: Double-check valve assembly backflow preventer with drain and butterfly valve on each end.
- E. Test Connections:
 - 1. Combination Inspector's Test Connection and Drain Valve:
 - a. Provide test connections approximately 6 feet above floor for each or portion of each sprinkler system equipped with an alarm device, located at most remote part of each system.
 - b. Route combination test connection and drain valve to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
 - c. Supply discharge orifice with same size as corresponding sprinkler orifice.
 - d. Limit vertical height of exterior wall penetration to 2 feet above finished grade.
 - 2. Backflow Preventer Test Connection:

- a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5-inch National Standard male hose threads with cap and chain.
 - b. Provide one valve for each 250 gpm of system demand or fraction thereof.
 - c. Provide permanent sign reading "Test Valve." See Section 21 0553.
- F. Electric Alarm: Electrically operated red-enameled gong with pressure alarm switch.
- G. Water Flow Switch: Vane-type switch for mounting horizontally or vertically, with two contacts; rated 10 A at 125 VAC and 2.5 A at 24 VDC.
- H. Fire Department Connections:
 - 1. Type: Exposed, projected wall mount made of corrosion-resistant metal complying with UL 405.
 - a. Inlets: Two-way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or authority having jurisdiction. Brass caps with gaskets, chains, and lugs.
- I. Supervisory Switches:
 - 1. Manufacturers:
 - a. Potter Electric Signal Company, LLC; CoilKeeper Solenoid Supervisory Switch: www.pottersignal.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.09 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Diameter: 4-1/2 inch.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Display in psi and kPa.

2.10 PRESSURE RELIEF VALVES

- A. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
 - 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 2. Place hangers within 12 inches of each horizontal elbow.
 - 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- I. Do not penetrate building structural members unless indicated.
- J. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 3. All Rated Openings: Caulk tight with firestopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.
- K. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a watertight seal.
 6. Install in accordance with manufacturer's recommendations.
- L. Escutcheons:
1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
 2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
 3. Attach plates at the underside only of suspended ceilings.
 4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- M. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
- N. Die-cut threaded joints with full-cut, standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 21 0523

GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Iron butterfly valves with indicators.
- B. Check valves.
- C. Trim and drain valves.

1.02 RELATED REQUIREMENTS

- A. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.
- B. Section 21 1300 - Fire-Suppression Sprinkler Systems.
- C. Section 28 4600 - Fire Detection and Alarm.

1.03 ABBREVIATIONS AND ACRONYMS

- A. EPDM: Ethylene-propylene diene monomer.
- B. PTFE: Polytetrafluoroethylene.

1.04 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- B. FM (AG) - FM Approval Guide; current edition.
- C. FM 1112 - Examination Standard for Indicating Valves (Butterfly or Ball Type); 2020.
- D. FM 1140 - Approval Standard for Quick Opening Valves 1/4 Inch through 2 Inch Nominal Size; 1998.
- E. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2019.
- G. UL (DIR) - Online Certifications Directory; Current Edition.
- H. UL 258 - Shutoff Valves for Trim and Drain Purposes for Fire Protection Service; Current Edition, Including All Revisions.
- I. UL 1091 - Standard for Butterfly Valves for Fire-Protection Service; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

- B. Manufacturer Qualifications:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- C. Where listed products are specified, provide products listed, classified, and labeled by FM (AG) or UL (DIR) as suitable for the purpose indicated.
- D. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- E. Installer Qualifications:
 - 1. Company specializing in performing the work of this section with minimum five years documented experience.
 - 2. Trained and approved by manufacturer to design, install, test and maintain the equipment specified herein.
 - 3. Complies with manufacturer's certification requirements.
 - 4. Complies with manufacturer's insurance requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors and maintain at higher than ambient dew point temperature.
 - b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
- C. Use the following precautions for handling:
 - 1. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:
- B. FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:
 - 1. Automated Sprinkler Systems:
 - a. Indicator posts.
- C. Comply with 1 and 1 for valves.
- D. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.

2.02 IRON BUTTERFLY VALVES WITH INDICATORS

- A. UL 1091 and FM 1112 listed.
- B. Minimum Pressure Rating: 175 psig.
- C. Body Material: Cast or ductile iron.
- D. Seat: EPDM.
- E. Stem: Stainless steel.
- F. Disc: Ductile iron with EPDM coating.
- G. Actuator: Worm gear or traveling nut.
- H. Supervisory Switch: Internal or external.
- I. Body Design: Grooved-end or wafer style.

2.03 TRIM AND DRAIN VALVES

- A. Ball Valves:
 - 1. Description:
 - a. UL 258 or FM 1140 listed.
 - b. Pressure Rating: 175 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass or bronze.
 - e. Port Size: Full or standard.
 - f. Seat: PTFE.
 - g. Stem: Bronze or stainless steel.
 - h. Ball: Chrome-plated brass.
 - i. Actuator: Hand-lever.
 - j. End Connections: Threaded or grooved.
 - k. End Connections for Valves 1 NPS through 2-1/2 NPS: Threaded ends.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Confirm valve interior to be free of foreign matter and corrosion.
- B. Remove packing materials.
- C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
- D. Examine valve threads and mating pipe for form and cleanliness.

3.02 INSTALLATION

- A. Install valves in accessible locations to allow for operation, inspections, tests, and maintenance.
- B. Install listed valves in accordance with their listing.
- C. Install valves in accordance with manufacturer's instructions.
- D. Support valves independently of adjacent piping.
- E. Comply with specific valve installation requirements and application in the following Sections:
- F. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.
 - 1. Install permanent identification signs indicating portion of system controlled by each valve.
- G. Install check valve in water supply connections and backflow preventer at potable water supply connections.
- H. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.
- I. Valves in horizontal piping installed with stem at or above the pipe center.
- J. Position valves to allow full stem movement.
- K. Install valve tags. Comply with Section 21 0553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

END OF SECTION

SECTION 21 0548

VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Seismic restraints for Fire Protection piping, components, and equipment.
- B. For equipment and situations not addressed in this section, Section 230548 takes precedence.

1.03 RELATED REQUIREMENTS

- A. Section 01 4533 - Code-Required Special Inspections and Procedures.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 23 0548 - Vibration And Seismic Controls For HVAC Piping And Equipment
- D. Section 21 05 00 Common Work Results for Fire Suppression

1.04 DEFINITIONS

- A. Fire Suppression Component: Where referenced in this section in regards to seismic controls, applies to any portion of the fire suppression system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.05 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2002.
- C. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- D. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- E. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2018.
- F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- G. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- H. FM 1950 - Seismic Sway Braces for Automatic Sprinkler Systems; 2010.
- I. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).
- K. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 203A - Standard for Sway Brace Devices for Sprinkler System Piping; Current Edition, Including All Revisions.
- N. FM DS 2-8

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.07 PERFORMANCE REQUIREMENTS

- A. Seismic Restraint Loading:
1. Site Class as defined in the ICC (IBC).
 2. Occupancy Category as defined in the ICC (IBC).
 3. Seismic Design Category as defined in the ICC (IBC).
 4. Design Spectral Response Acceleration at Short Periods (0.2 Second).
 5. Least radius of gyration for rigid bracing shall not be less than $l/r=200$.
 6. See drawings for seismic design criteria.

1.08 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
1. Seismic Controls: Include seismic load capacities.
- C. Shop Drawings - Seismic Controls:
1. Include dimensioned plan views and sections indicating proposed fire suppression component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
 2. Identify mounting conditions required for equipment seismic qualification.
 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
 4. Indicate proposed arrangement of distributed system trapeze support groupings.
 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
 6. Indicate locations of seismic separations where applicable.
 7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- D. Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed fire suppression components necessary for determining seismic design forces required to design appropriate seismic controls.
 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- E. Certification for seismically qualified equipment; identify basis for certification.
- F. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

- G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Evidence of qualifications for seismic controls designer.
- I. Evidence of qualifications for manufacturer.
- J. Manufacturer's detailed field testing and inspection procedures.
- K. Field quality control test reports.

1.09 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located or NICET Level III and with minimum five years experience designing seismic restraints for nonstructural components.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- F. 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.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide fire suppression component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor fire suppression components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.
- C. Component Importance Factor (Ip): Fire suppression components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.
- D. Seismic Qualification of Equipment:
 - 1. Provide special certification for fire suppression equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
 - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 - 3. Notify Architect Engineer and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Seismic Restraints:
 - 1. Provide seismic restraints for fire suppression components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.

2. Seismic Restraint Exemptions, All Seismic Design Categories:
 - a. Fire Suppression Piping Exemptions, All Seismic Design Categories:
 - 1) Lateral sway bracing for piping individually supported within 6 inches of the structure measured between the top of pipe and the point of attachment to the structure, where all conditions for exception specified in NFPA 13 are met.
 - 2) Lateral sway bracing for branch lines smaller than 2-1/2 inches in diameter, where branch line restraint is provided in accordance with NFPA 13.
 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. ASHRAE (HVACA).
 - b. FEMA 412.
 - c. FEMA 413.
 - d. FEMA 414.
 - e. FEMA E-74.
 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
 5. Seismic Restraint Systems:
 - a. Arrange restraint elements to avoid obstruction of sprinklers in accordance with NFPA 13.
 - b. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - c. Use only one restraint system type for a given fire suppression component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
 - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain fire suppression component in all lateral directions; consider bracket geometry in anchor load calculations.
 - e. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported fire suppression component weight.
 - f. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
- F. Seismic Attachments:
1. Comply with support and attachment requirements of NFPA 13.
 2. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
 3. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
 4. Do not use power-actuated fasteners.
 5. Do not use friction clips (devices that rely on mechanically applied friction to resist loads) except where listed for such use. Beam clamps may be used for supporting sustained loads where provided with restraining straps, but not for sway bracing attachments as prohibited by NFPA 13.
 6. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 7. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

- G. Seismic Interactions:
 - 1. Include provisions to prevent seismic impact between fire suppression components and other structural or nonstructural components.
 - 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
 - 3. Comply with minimum clearance requirements between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.
- H. Seismic Relative Displacement Provisions:
 - 1. Use suitable fittings or flexible connections, in accordance with NFPA 13, to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.
 - 2. Provide clearance around fire suppression system piping extending through walls, floors, platforms, and foundations in accordance with NFPA 13.

2.02 SEISMIC RESTRAINT SYSTEMS

- A. Manufacturers:
 - 1. Subject to compliance with requirements, provide products by one of the following, as appropriate:
 - a. Seismic Restraint Systems:
 - 1) Eaton Corporation; TOLCO: www.eaton.com.
 - 2) AFCON: www.afcon.org
 - 3) Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Where required by NFPA 13, provide products listed as complying with UL 203A or FM 1950.
- D. Rigid Restraints: Use steel pipe for structural element; suitable for both compressive and tensile design loads.
 - 1. Material: Schedule 40 pipe or other calcualted rigid bracing element.
- E. General Requirements for Restraint Components:
 - 1. Products to be listed in accordance with the requirements of NFPA 13.
 - 2. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to the Authority Having Jurisdiction.
 - a. 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. Follow manufacturer's maximum design loads reduced as appropriate.
 - 3. Size: Based on the lesser of bracing element capacity or anchor load taking into account brace geometry.
 - 4. Mechanical Anchor Bolts: Drilled-in, 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. Minimum length of eight times diameter.
 - 5. Adhesive Anchor Bolts: 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 E488/E488M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect Engineer in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
 - 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
 - 2. Verification of required clearances between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Comply with the requirements of NFPA 13.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Secure fasteners according to manufacturer's recommended torque settings.
- E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Seismic Controls:
 - 1. Comply with the requirements of ASCE 7, FEMA E-74, NFPA 13, and applicable local building codes.
 - 2. Seismic Restraint Systems:
 - a. Provide seismic bracing.
 - b. Provide end of line restraint.
 - c. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - d. Install restraints within permissible angles in accordance with seismic design.
 - e. When used, install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.05 ATTACHMENTS

- A. Statement of special inspections.

END OF SECTION

SECTION 21 0553

IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Nameplates.
- B. Pipe markers.
- C. Ceiling tacks.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Control Panels: Nameplates.
- B. Instrumentation: Nameplates.
- C. Major Control Components: Nameplates.
- D. Piping: Pipe markers.
- E. Pumps: Nameplates.
- F. Small-sized Equipment: Nameplates.
- G. Valves: Nameplates and ceiling tacks where above lay-in ceilings.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc.: www.pipemarker.com.
 - 2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: Red.
 - 4. Thickness: 1/16 inch.
 - 5. Plastic: Comply with ASTM D709.
- C. Metal rectangular nameplates to be used valves. Indicate "NORMALLY OPEN" or "NORMALLY CLOSED" on all valves.

2.03 PIPE MARKERS

- A. Manufacturers:
 - 1. Brimar Industries, Inc.; F3 R/W, 28038, or 1F1 R/W: www.pipemarker.com.
 - 2. Kolbi Pipe Marker Co.; Model Adhesive Style B, C, or D: www.kolbipipemarkers.com.
 - 3. Craftmark.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Color: Comply with ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
 - 1. Underground tape to be detectable-type and run continuously and be electrically continuous from an accessible location to another accessible location to facilitate detection.
- F. Lettering to be "FIRE PROTECTION WATER" or submit other text as appropriate.
- G. Color code as follows:
 - 1. Fire Quenching Fluids: Red with white letters.

2.04 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark Pipe Markers; Ceiling Valve Marker: www.craftmarkid.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Adhesive vinyl with 3/4 inch diameter color coded head.
- C. Color code as follows:
 - 1. Sprinkler Valves: Red.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install valve nameplates with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe. Underground tape to be detectable-type and run continuously and be electrically continuous from an accessible location to another accessible location to facilitate detection.
- F. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in intersection of grid closest to equipment.

END OF SECTION

SECTION 21 1300
FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. Preaction sprinkler system.
- C. System design, installation, and certification.
- D. Fire department connections.

1.03 RELATED REQUIREMENTS

- A. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.
- B. Section 21 0523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- C. Section 21 0548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
- D. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.
- E. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.
- F. Section 28 4600 - Fire Detection and Alarm.

1.04 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; current edition.
- B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.
- D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- F. ITS (DIR) - Directory of Listed Products; current edition.
- G. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 1963 - Standard for Fire Hose Connections; 2019.
- I. UL (DIR) - Online Certifications Directory; Current Edition.
- J. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
 - 1. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.

2. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect Engineer.
- D. Designer's qualification statement.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements for additional provisions.
 2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
 3. Sprinkler Wrenches: For each sprinkler type.

1.07 QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Comply with UL (DIR) requirements.
- C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section documented experience and approved by manufacturer.
- F. Equipment and Components: Provide products that bear UL (DIR) label or marking.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for entire building.
- B. Occupancy: Light hazard; comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from water flow test data.
- D. Interface system with building fire and smoke alarm system.
- E. Provide fire department connections where indicated.
- F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.
- G. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 6. Other Types: As required.

2.02 SPRINKLERS

- A. Suspended Ceiling Type: Concealed pendant type with matching push on escutcheon plate.
 1. Response Type: Quick.

2. Coverage Type: Standard.
3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- B. Exposed Area Type: Upright type with guard as noted on drawings.
 1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Finish: Brass.
 4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- C. Sidewall Type: Concealed horizontal sidewall type with matching push on cover plate.
 1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- D. Dry Sprinklers: Concealed pendant type with matching push on cover plate.
 1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- E. Guards: Finish to match sprinkler finish.
- F. Flexible Drop System: Stainless steel, multiple use, open gate type.
 1. Application: Use to properly locate sprinkler heads.
 2. Include all supports and bracing.
 3. Provide braided type tube as required for the application.
 4. Manufacturers:
 - a. Victaulic Company; Vic-Flex: www.victaulic.com/#sle.

2.03 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
 1. Activate electric alarm.
 2. Test and drain valve.
 3. Replaceable internal components without removing valve from installed position.
- B. Preaction Valve:
 1. Operated by detection system listed for releasing service and independent of building fire alarm system with provisions for local, manual, and indicated remote releases.
 2. Incorporate mechanical latching mechanism incorporating valve clappers independent of system water pressure fluctuations.
 3. Provide test detection device for each actuation circuit adjacent to each controlled valve in accordance with NFPA 13.
- C. Backflow Preventer: Double check valve assembly backflow preventer with drain and butterfly valve on each end.
- D. Test Connections:
 1. Inspector's Test Connection for Preaction Systems:
 - a. Provide test connections approximately 6 ft above floor for each or portion of each sprinkler system equipped with an alarm device, located at the most remote part of each system.
 - b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
 - c. Supply discharge orifice with same size as corresponding sprinkler orifice.
 - d. Limit vertical height of exterior wall penetration to 2 ft above finished grade.
 2. Backflow Preventer Test Connection:
 - a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch National Standard male hose threads with cap and chain.
 - b. Furnish one valve for each 250 gpm of system demand or fraction thereof.

- c. Provide permanent sign reading "Test Valve" in accordance with Section 21 0553.
- E. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.
- F. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- G. Fire Department Connections:
 - 1. Type: Exposed, projected wall mount made of corrosion resistant metal complying with UL 405.
 - a. Inlets: Two way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
- H. Supervisory Switches:
 - 1. Manufacturers:
 - a. Potter Electric Signal Company, LLC; CoilKeeper Solenoid Supervisory Switch: www.pottersignal.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 PREACTION VALVE CONTROL PANEL

- A. Provide a modular type control panel for electrically operated detection and extinguishing systems for each preaction valve.
 - 1. Factory mount in surface mounted, steel cabinet with hinged doors, and cylinder lock.
 - 2. Provide factory wired assembly containing components and equipment as required to perform specified system operating and supervisory functions.
 - 3. Include isolation switch to allow system testing without activation of the preaction valve.
 - 4. Include trouble lights and trouble alarm.
 - 5. Provide UL (DIR) listed as an extinguishing system releasing panel and separate from the building's fire alarm control panel.
- B. Secondary Power Supply:
 - 1. Provide nickel cadmium, lead calcium, or sealed lead acid rechargeable storage batteries and battery charger.
 - 2. Storage Batteries:
 - a. Provide with sufficient ampere-hour rating to operate under supervisory and trouble conditions, including audible trouble signal devices under alarm conditions for an additional 10 minutes and as required in accordance with the equipment listing.
 - b. Prevent contact between terminals of adjacent cells, battery terminals, and other metal parts with separate cell construction.
 - 3. Battery Charger:
 - a. Provide solid-state automatic two rate type, capable of recharging completely discharged batteries to fully charged condition in 24 hours or less.
 - b. Locate charger within control panel or battery cabinet.
- C. Wiring: Refer to Section 26 0583.
- D. Supervision: Refer to Section 28 4600.

2.05 NITROGEN GENERATOR

- A. Nitrogen Generator:
 - 1. Provide FM (AG) approved system and accessories.
- B. Minimum Nitrogen Purity: 98 percent.
- C. Provide piping and accessories to connect to dry and preaction fire suppression systems.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.

- C. Provide approved double check valve assembly at sprinkler system water source connection.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- E. Locate outside alarm gong on building wall as indicated.
- F. Place pipe runs to minimize obstruction to other work.
- G. Place piping in concealed spaces above finished ceilings.
- H. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- I. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- J. Flush entire piping system of foreign matter.
- K. Install guards on sprinklers where indicated.
- L. Hydrostatically test entire system.
- M. Require test be witnessed by Fire Marshal.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION

SECTION 22 0510
BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 PROJECT MANAGEMENT

- A. Drawings are diagrammatic, all offsets, fitting, valves and accessories are not shown. Refer to all drawings in the contract documents and plan work accordingly. Coordinate with all trades and crafts.
- B. In case of interference between trades, Architect Engineer will decide which work is to take precedence regardless of work that might be installed.

1.03 CODES, ORDINANCES, INSPECTIONS, AND PERMITS

- A. Execute and inspect Work in accordance with local and state codes, laws, ordinances, rules and regulations applicable to particular class of Work.
- B. Should any part of Drawings or specifications be found to be in conflict with applicable codes or ordinances, notify the Architect Engineer, in writing, 72 hours prior to receiving of bids. After the receiving of bids, any discovery of code violations shall be promptly reported to the Architect Engineer. Any work performed knowingly in violation of codes shall be corrected without additional expense to the Owner or his representative.
- C. All plumbing work shall comply with latest local codes and the the State in which the Project is located plumbing code.
- D. Arrange with County, City, or State, if City has no ordinances covering work, for complete inspection, paying all charges pertaining thereto. Give proper authority all requisite notice relating to work under such; afford Architect Engineer and all authorized inspectors every facility for inspection and be responsible for all violations of law. Upon completion of Work, have Work inspected, if required, obtaining certificate of inspection and approval from inspecting agency and deliver such certificate to Architect Engineer. Comply with Division 01.

1.04 COORDINATION

- A. Conduct multi-trade coordination and preinstallation meetings to establish bottom elevations of all piping, ductwork and conduit before fabrication and installation. Comply with Division 01.
- B. All equipment shall be installed in accordance with the manufacturer's recommendations. It is the contractor's responsibility to follow all installation requirements and guidelines provided in the manufacture's installation manual. If there is a conflict with regards to installation, the contractor shall stop work and notify the design Architect Engineer representative.

1.05 SUBMITTALS

- A. Comply with Division 01.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for plumbing fixtures, plumbing specialties, plumbing equipment, and others as may be requested.
- C. Shop Drawings: Miscellaneous steel for pipe support, duct support, pipe guides, anchors, and miscellaneous steel used for supporting any mechanical equipment.

1.06 SUBSTITUTIONS

- A. Comply with Division 01.
- B. Any proposed substitutions of equipment shall be accompanied by shop drawings showing revised equipment layouts, piping diagrams, ductwork drawings and/or wiring diagrams. Where substituted equipment furnished requires use of larger, more, or differently arranged

connections, such connections shall be installed to the complete satisfaction of Architect Engineer without additional cost to Owner.

- C. Should a substitution be accepted and subsequently proven unsatisfactory for the service intended within the warranty period, the Contractor shall replace this material or equipment with that as originally specified, or corrected as directed by Architect Engineer.

1.07 CLEAN UP

- A. Comply with Division 01.
- B. Do not allow waste material or rubbish to accumulate in or about job site.
- C. Any discoloration or other damage to parts of building, its finish or furnishings due to failure to properly clean or keep clean mechanical systems shall be repaired without cost to Owner.

1.08 EQUIPMENT START-UP AND SYSTEM COORDINATION

- A. Comply with Division 01.
- B. The Contractor shall be responsible for placing all equipment and system components into operation. Individual components shall be coordinated with other parts of Mechanical, Electrical, Plumbing and/or Fire Protection Systems to ensure that the entire project functions as designed and described by the contract documents.

1.09 CUTTING AND PATCHING

- A. Comply with Section 01 1700 - Execution and Closeout Requirements.
- B. Provide all cutting and patching required to perform the mechanical work, when alteration, repair, renovation, or addition, to existing construction.

1.10 DEMOLITION

- A. Comply with Section 02 4100 - Demolition.
- B. Alterations and Minor Demolition: Comply with Section 01 1700 - Execution and Closeout Requirements.

1.11 RECORD DOCUMENTS

- A. Comply with Division 01.

1.12 OPERATION INSTRUCTIONS

- A. Comply with Division 01.
- B. Printed instructions, installed in a suitable frame with a glass front, covering the operation and maintenance of each major item of equipment, shall be posted at locations designated by the Architect Engineer. Provide 2 bound manuals containing complete repair parts lists, and operating service and maintenance instructions for all equipment provided.

1.13 INSTRUCTION

- A. Comply with Section 01 7900 - Demonstration and Training.

1.14 FLASHINGS

- A. Refer to Division 07 for roof flashings.

1.15 ACCESS PANELS

- A. Comply with Section 08 3100 - Access Doors.
- B. Provide access panels as necessary for servicing of fire dampers, smoke dampers, valves, VAV terminals and any other equipment in concealed spaces.

1.16 PAINT EXTERIOR PIPING

- A. All exterior steel piping shall be painted using a metal primer coat, second coat of enamel, top coat of enamel and a finish coat of gloss.
- B. Natural gas piping shall be painted yellow.

1.17 DOMESTIC WATER PIPING

- A. Valve, strainer and other domestic water piping specialties shall be bronze, brass, stainless steel or epoxy coated cast iron only for the services that are in contact with domestic water.
- B. No cast iron valves, strainers or any other accessories that contact domestic water are allowed without epoxy coating.

1.18 LOCAL SITE CONDITIONS

- A. Before bidding, make complete investigation at site in order to be informed as to location of utilities and as to conditions under which work is to be performed. Utility locations shown were obtained from surveys and/or local utility companies and are not to be assumed as being accurate.
- B. Make determination of soil conditions before bidding. These specifications and accompanying drawings in no way imply as to condition of soil to be encountered.

1.19 GUARANTY-WARRANTY

- A. This guarantee shall include capacity and integrated performance of component parts of various systems in strict accord with the true intent and purpose of these specifications. Conduct such tests as herein specified or as may be required by the Architect Engineer to demonstrate capacity and performance ability of various systems to maintain specified conditions.
- B. All materials and equipment shall be new and unused and shall carry a full year's warranty from time Owner accepts building or the date of substantial completion, whichever is earlier, regardless of start-up date of equipment, unless a longer warranty period is specified under other sections.

1.20 EQUIPMENT CONNECTIONS

- A. Each equipment item with drain connections, shall be provided with a properly-sized drain run to the nearest floor drain or as directed.
- B. Rough-in and make final connection to all equipment requiring same, furnished under other Divisions of these specifications or by the Owner.
 - 1. Provide necessary labor and materials, including stop valves, traps, pressure-reducing valves, etc. necessary. Trap and vent drainage connections as required.
 - 2. If equipment or fixtures to be furnished by Owner and/or Owner's vendor are not delivered prior to final acceptance, services shall be capped or plugged at walls or floor as directed, ready for future connection.
- C. No equipment or fixture shall be "roughed-in" until proper rough-in drawings are in the hands of the trade doing the work.

1.21 ELECTRICAL

- A. Furnish and install all electrical interlock, control and other wiring, not covered specifically under the electrical plans and specifications, for proper operation and control of all equipment specified under this Division of the specifications.
- B. Supervise and coordinate all electrical work in connection with mechanical system.

1.22 EXCAVATION, TRENCHING, AND BACKFILLING

- A. All excavation, trenching and backfilling in connection with the mechanical system, to a point 5'0" outside the building, is included as part of this Division.
- B. All excavation required shall be done as part of the bid price regardless of any implied conditions on the plans or in these specifications.
- C. Excavation to have 12 inch minimum and 24 inch maximum clearance on all sides. Do not carry excavation below required level unless indicated otherwise on the drawings. Excess excavation below required level shall be backfilled at no expense to Owner with earth, sand, gravel or concrete, as directed by Architect Engineer and thoroughly compacted. Remove any unstable soil and replace with gravel, crushed stone or clean sand and thoroughly compact. Architect Engineer will determine the depth of removal of any unstable soil encountered. Grade

ground adjacent to excavations to prevent water running in. Remove, by pumping or other means any water accumulated in excavation.

- D. Banks of trenches shall be vertical or as shown on the drawings. Width of trench to be 5 inches minimum, 8 inches maximum on each side of pipe bell. Bottom of trench for sewers and culverts shall be rounded so that an arc of circumference equal to 0.6 of outside diameter or pipe rests on undisturbed soil wherever practicable. Excavate bell holes accurately to size by hand. In rock, excavations shall be carried 8 inches below bottom of pipe. Use loose earth or gravel for backfill and tamp thoroughly.
- E. Bracing, sheathing and shoring shall be performed as necessary to complete and protect excavations indicated on the drawings, as required for safety, as directed by Architect Engineer, or to conform to governing laws.
- F. After piping, conduit, ducts, etc. have been installed, inspected, tested and approved by governing agency, backfill trenches with clean, stable soil free from stones. Place backfill in 4 inch layers, tamped under and around pipe and conduit to height of at least 2'0" above pipe. Tamping shall be done in such manner as not to disturb underlying work. Remainder of trenches and excavations shall be backfilled with clean, stable earth, deposited in 8 inch layers and brought up to rough grade, with each layer compacted to density of surrounding soil. Remove sheathing and shoring as backfill is placed and fill space with dry sand. Compaction tests in accordance with Division 31 may be required by the Architect Engineer, with the costs paid by the Contractor.
- G. Replace existing appurtenances removed or damaged in connection with work, and restore to original conditions, unless otherwise directed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 22 0519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Pressure gauges.
- B. Thermometers.
- C. Pressure-temperature test plugs.

1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi; 2004 (Reaffirmed 2017).
- C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- E. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2015.
- F. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2015.
- G. AWWA C702 - Cold-Water Meters -- Compound Type; 2015.
- H. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- I. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.
- J. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.
- K. NSF 61 - Drinking Water System Components - Health Effects; 2012.
- L. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C. Project Record Documents: Record actual locations of components and instrumentation.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements. for additional provisions.

1.05 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
 - 3. Omega Engineering a subsidiary of Spectris, Plc; www.omega.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 4-1/2 inch diameter.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Psi and kPa.

2.02 THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
 - 3. Watts Water Technologies, Inc: www.watts.com/#sle.
- B. General:
 - 1. Product Compliance: ASTM E1.
 - 2. Lens: Clear glass, except where stated.
 - 3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
 - 4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.
- C. Thermometers - Dial Type:

2.03 PRESSURE-TEMPERATURE TEST PLUGS:

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Watts Water Technologies, Inc: www.watts.com/#sle.
 - 3. Weiss Instruments, LLC: www.weissinstruments.com/#sle.
- B. Size: 500 psi capacity; 1/2 inch MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch pressure gauge or temperature probe.
- C. Wetted Materials per Temperature Range:
 - 1. Up to 200 degrees F: Brass probe with neoprene core.

2.04 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- D. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation. Provide siphon on gauges in steam systems.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- G. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

- H. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- I. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prefabricated trapeze-framed systems.
- B. Beam clamps.
- C. Pipe hangers.
- D. Pipe supports, guides, shields, and saddles.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 5000 - Metal Fabrications.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014 (Reapproved 2020).
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2018).
- H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.
- L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Materials for Metal Fabricated Supports: Comply with Section 05 5000.
 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- D. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

2.02 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

- A. Prefabricated Trapeze-Framed Metal Strut Systems:
 1. Strut Channel or Bracket Material:
 2. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

2.03 BEAM CLAMPS

- A. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- B. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.04 PIPE HANGERS

- A. Clevis Hangers, Adjustable:
 1. Manufacturers:
 2. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.

2.05 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Pipe Supports:
 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 2. Liquid Temperatures Up to 122 degrees F:
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.
- C. Pipe Supports, Thermal Insulated:
 1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

- b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Provide pipe supports for 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
- 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
 - b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
 - c. Minimum Thickness: 60 mil, 0.06 inch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect Engineer, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Secure fasteners according to manufacturer's recommended torque settings.
- I. Remove temporary supports.

END OF SECTION

SECTION 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Seismic control requirements.
- B. Seismic restraint systems.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 22 0529 - Hangers and Supports for Plumbing Piping and Equipment.

1.03 DEFINITIONS

- A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2002.
- D. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- E. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- F. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).
- H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 - 5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Seismic Controls: Include seismic load capacities.

PART 2 PRODUCTS

2.01 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide plumbing component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor plumbing components.
- B. Seismic Design Criteria: As indicated on drawings.
- C. Component Importance Factor (Ip): Plumbing components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to:
 - 1. Plumbing components required to function for life safety purposes after an earthquake.
 - 2. Plumbing components that support or otherwise contain hazardous substances.
- D. Seismic Restraints:
 - 1. Provide seismic restraints for plumbing components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 - 2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) Plumbing components where either of the following apply:
 - (a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - 2) Plumbing piping with component importance factor (Ip) of 1.5 and nominal pipe size of 2 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - b. Plumbing Piping Exemptions, All Seismic Design Categories:
 - 1) Plumbing piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
 - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
 - (c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a

component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.

- (d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
 - (e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor (Ip) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.
 - 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. FEMA 412.
 - b. FEMA 413.
 - c. FEMA 414.
 - d. FEMA E-74.
 - e. SMACNA (SRM).
 - 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
- E. Seismic Attachments:
- 1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
 - 2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
 - 3. Do not use power-actuated fasteners.
 - 4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
 - 5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 - 6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- F. Seismic Interactions:
- 1. Include provisions to prevent seismic impact between plumbing components and other structural or nonstructural components.
 - 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
- G. Seismic Relative Displacement Provisions:
- 1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.

- b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
- c. Design displacements at seismic separations.
- d. Anticipated drifts between floors.

END OF SECTION

SECTION 22 0719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Glass fiber insulation.
- B. Jackets and accessories.

1.03 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 09 9123 - Interior Painting: Painting insulation jacket.
- C. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.04 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- D. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2021a.
- E. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010 (Reapproved 2016).
- F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).
- G. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.08 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.

- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

- A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 650 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

2.03 JACKETS

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation; _____: www.jm.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive.
- B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch laps.
 - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.
- J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 7 feet (2 meters) above finished floor): Finish with aluminum jacket.
- K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- L. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULES

- A. Plumbing Systems:
 - 1. Domestic Hot Water Supply and Recirculation:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: 2 inch and smaller.
 - (a) Thickness: 1 inch.
 - 2) Pipe Size Range: Over [2] inch ([50] mm).
 - (a) Thickness: [1.5] inch ([40] mm).
 - 2. Domestic Cold Water:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All Sizes
 - (a) Thickness: [1] inch ([25] mm).
 - 3. Roof Drain Bodies:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All Sizes
 - (a) Thickness: [1] inch ([25] mm).
 - 4. Roof Drainage Above Grade:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All Sizes
 - (a) Thickness: [1] inch ([25] mm).
- B. Other Systems:

1. Heat Maintenance Cable:
 - a. Per Manufacturer's instructions.
2. Piping Exposed to Freezing with Heat Tracing:
 - a. Per Manufacturer's instructions.
3. Handicap Fixture Traps, Stops and Supplies:
 - a. Manufactured Glass Fiber covering with PVC jacket. (Refer to Fixture Schedules).
4. Provide aluminum jacket for all piping exposed to weather or damp locations.

END OF SECTION

SECTION 22 1005
PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
 - 1. Sanitary Sewer.
 - 2. Domestic Water.
 - 3. Storm Water.
 - 4. Natural Gas.
 - 5. Condensate Waste.
 - 6. Flanges, Unions, and Couplings.
 - 7. Pipe Hangers and Supports.
 - 8. Ball valves.
 - 9. Valves.
 - 10. Flow Controls.
 - 11. Check.
 - 12. Relief valves.
 - 13. Strainers.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- E. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2016.
- F. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV; 2017.
- G. ASME B31.1 - Power Piping; 2020.
- H. ASME B31.9 - Building Services Piping; 2020.
- I. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Potable Water Distribution Systems; 2020.
- J. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- L. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- M. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- N. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- O. ASTM B32 - Standard Specification for Solder Metal; 2020.
- P. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
- Q. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- R. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

- S. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.
- T. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- U. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- V. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- W. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- X. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2021.
- Y. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
- Z. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
- AA. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
- AB. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
- AC. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2017.
- AD. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- AE. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.
- AF. ASTM E84 - Standard Specification for "Standard Test Method for Surface Burning Characteristics of Building Materials" - (Flame Spread/Smoke Development).
- AG. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).
- AH. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
- AI. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.
- AJ. AWWA C606 - Grooved and Shouldered Joints; 2015.
- AK. AWWA C651 - Disinfecting Water Mains; 2014.
- AL. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2017 (Revised 2018).
- AM. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2012 (Revised 2018).
- AN. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- AO. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.
- AP. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- AQ. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- AR. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

- AS. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.
- AT. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
- AU. NSF 61 - Drinking Water System Components - Health Effects; 2020.
- AV. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. PVC Pipe: ASTM D2665 or ASTM D3034. Schedule 40 Solid Core
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B88, hard drawn, Type K.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: AWS A5.8, BCuP copper/silver braze.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
 - 3. Mechanical Press Sealed Fittings: Double pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.

2.06 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. PVC Pipe: ASTM D2665 or ASTM D3034. Schedule 40 Solid Core
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.07 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.08 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
 - 2. Joints: ASME B31.1, welded.
- B. Polyethylene Pipe: ASTM D2513, SDR 11.
 - 1. Fittings: ASTM D2683 or ASTM D2513 socket type.
 - 2. Joints: Fusion welded

2.09 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: ASME B31.1, welded.
 - 3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.10 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded or welded to ASME B31.1.

2.11 CONDENSATE WASTE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. Copper Tube: ASTM B306, DWV.
 - 1. Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn50 solder.

2.12 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches and Under:

1. Ferrous pipe: Class 150 malleable iron threaded unions.
 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Size Over 1 Inch:
1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
1. Dimensions and Testing: In accordance with AWWA C606.
 2. Housing Material: Provide ASTM A47/A47M malleable iron or ductile iron, galvanized.
 3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 4. When pipe is field grooved, provide coupling manufacturer's grooving tools.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.13 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 4. Vertical Pipe Support: Steel riser clamp.
 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
 6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High density polypropylene.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
 - e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.
- B. Plumbing Piping - Drain, Waste, and Vent:
1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
 2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 3. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 4. Wall Support for Pipe Sizes 4 inch and Over: Welded steel bracket and wrought steel clamp.
 5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - Water:
1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
 2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
 4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 5. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

6. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.14 BALL VALVES

- A. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union. Ductile iron valves shall have epoxy coated interiors.

2.15 FLOW CONTROLS

- A. Construction: Body and all internal components shall be constructed of stainless steel with major components constructed of type 304 stainless steel. Sizes ½ inch through 2 inch shall be rated to 200 PSIG maximum working pressure. Standard tapered female pipe thread, NPT. Rated to 300° F (148.9°C) maximum working temperature. Include check valve

2.16 SPRING LOADED CHECK VALVES

- A. Class 125, iron body, with epoxy coated interior, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.17 WATER PRESSURE REDUCING VALVES

- A. Up to 2 Inches:
 1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
- B. Over 2 Inches:
 1. ASSE 1003, cast iron body, with epoxy coated interior, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.18 RELIEF VALVES

- A. Pressure:
 1. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- B. Temperature and Pressure:
 1. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

2.19 STRAINERS

- A. Size 1-1/2 inch to 4 inch:
 1. Class 125, flanged iron body, epoxy coated, Y pattern with 1/16 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
 - 1. All exterior steel piping shall be painted using a metal primer coat, second coat of enamel, top coat of enamel and a finish coat of gloss.
 - 2. Natural gas piping shall be painted yellow.
- L. Excavate in accordance with Section 31 2316.
- M. Backfill in accordance with Section 31 2323.
- N. Install bell and spigot pipe with bell end upstream.
- O. Install valves with stems upright or horizontal, not inverted. Refer to Section 22 0523.
- P. Install water piping to ASME B31.9.
- Q. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- R. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- S. Sleeve pipes passing through partitions, walls and floors.
- T. PVC Pipe shall not be installed in air plenums in accordance with ASTM E84
- U. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- V. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as indicated.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

6. Support vertical piping at every floor or per manufacturer's instructions. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 22 0548.
11. Support cast iron drainage piping at every joint.

3.04 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install globe valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of water pumps.
- G. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect water distribution system in accordance with Section 33 0110.58.
- B. Prior to starting work, verify system is complete, flushed and clean.
- C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SERVICE CONNECTIONS

- A. Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

2. Provide 18 gage, 0.0478 inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.08 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:
 - a. Pipe Size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inches to 2 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.
 - c. Pipe Size: 2-1/2 inches to 3 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 1/2 inch.
 - d. Pipe Size: 4 inches to 6 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 5/8 inch.
 - e. Pipe Size: 8 inches to 12 inches:
 - 1) Maximum hanger spacing: 14 ft.
 - 2) Hanger Rod Diameter: 7/8 inch.
 - f. Pipe Size: 14 inches and Over:
 - 1) Maximum Hanger Spacing: 20 ft.
 - 2) Hanger Rod Diameter: 1 inch.
2. Plastic Piping:
 - a. All Sizes:
 - 1) Maximum Hanger Spacing: 6 ft.
 - (a) Provide metal saddles at each hanger, min 24" in length.
 - 2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION

SECTION 22 1006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Backflow preventers.
- F. Water hammer arrestors.
- G. Mixing valves.
- H. Floor drain trap seals.

1.03 RELATED REQUIREMENTS

- A. Section 01 6000 - Product Requirements: Procedures for Owner-supplied products.
- B. Section 22 1005 - Plumbing Piping.
- C. Section 22 3000 - Plumbing Equipment.
- D. Section 22 4000 - Plumbing Fixtures.
- E. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASME A112.6.3 - Floor and Trench Drains; 2019.
- C. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2003 (Reaffirmed 2012).
- D. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2017.
- E. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2009.
- F. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2021.
- G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).
- H. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2019.
- I. NSF 61 - Drinking Water System Components - Health Effects; 2020.
- J. NSF 372 - Drinking Water System Components - Lead Content; 2020.
- K. PDI-WH 201 - Water Hammer Arresters; 2017.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

- E. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.
- F. Operation Data: Indicate frequency of treatment required for interceptors.
- G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 2. Wade Drain (Tyler Pipe): www.wadedrains.com
 - 3. MIFAB, Inc: www.mifab.com/#sle.
 - 4. Zurn Industries, Inc: www.zurn.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Floor Drain (See Schedule on Drawings):
 - 1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.
- C. Floor Sink (See Schedule on Drawings):
 - 1. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, clamp collar, half grate.

2.03 CLEANOUTS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 2. Wade Drain (Tyler Pipe): www.wadedrains.com
 - 3. MIFAB, Inc: www.mifab.com/#sle.
 - 4. Zurn Industries, Inc: www.zurn.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Cleanouts at Exterior Surfaced and Unsurfaced Areas (COTG/DCOTG):
 - 1. Line type with lacquered heavy duty cast iron body and round epoxy coated gasketed cover.
- C. Cleanouts at Interior Finished Floor Areas (FCO):
 - 1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- D. Cleanouts at Interior Finished Wall Areas (WCO):
 - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

2.04 HOSE BIBBS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 2. Woodford Manufacturing Company, www.woodfordmfg.com

3. Zurn Industries, Inc: www.zurn.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Interior Hose Bibbs:
1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

2.05 HYDRANTS

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 2. Woodford Manufacturing Company, www.woodfordmfg.com
 3. Zurn Industries, LLC: www.zurn.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Wall Hydrants:
1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, lockshield and removable key, and integral vacuum breaker.
 - a. Installation: Lockable recessed box.

2.06 BACKFLOW PREVENTERS

- A. Manufacturers:
1. Febco Company: www.febcoonline.com
 2. Watts Regulator Company: www.wattsregulator.com.
 3. Zurn Industries, Inc: www.zurn.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Reduced Pressure Backflow Preventers:
1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.07 WATER HAMMER ARRESTORS

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 2. Watts Regulator Company: www.wattsregulator.com.
 3. Zurn Industries, Inc: www.zurn.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Water Hammer Arrestors:
1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.08 MIXING VALVES

- A. Thermostatic Mixing Valves:
1. Manufacturers:
 - a. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
 - b. Powers: www.powerscontrols.com
 - c. Leonard Valve Company: www.leonardvalve.com.
 - d. Watts Water Technologies; POWERS: www.watts.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
 2. Valve: Cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
 3. Accessories:
 - a. Check valve on inlets.
 - b. Volume control shut-off valve on outlet.

- c. Stem thermometer on outlet.
- d. Strainer stop checks on inlets.

2.09 FLOOR DRAIN TRAP SEALS

- A. Manufacturers:
 - 1. Green Drains; GD4: www.greendrains.com/#sle.
 - 2. MIFAB, Inc; MI-GARD: www.mifab.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all quick closing valves.
- H. Set tops of grating frames and grates flush with finished surface.

END OF SECTION

SECTION 22 3000
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Commercial electric water heaters.
- B. Expansion Tanks.
- C. Circulating Pumps
- D. Water Pressure Booster System.
- E. Sump Pumps

1.03 RELATED REQUIREMENTS

- A. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

1.05 REFERENCE STANDARDS

- A. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less; 2019, with Errata (2020).
- B. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous; 2019.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.
- D. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.
- F. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.
- G. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.
- H. NSF 61 - Drinking Water System Components - Health Effects; 2012.
- I. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting at least one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.

2. Indicate pump type, capacity, power requirements.
 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 4. Provide electrical characteristics and connection requirements.
- C. Shop Drawings:
1. Indicate heat exchanger dimensions, size of tapings, and performance data.
 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tapings, and drains.
- D. Manufacturer's Instructions: Indicate clearances and connection requirements.
- E. Project Record Documents: Record actual locations of components.
- F. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- C. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATERS

- A. Manufacturers:
1. A.O. Smith Water Products Co: www.hotwater.com/#sle.
 2. Bradford White Corporation: www.bradfordwhite.com/#sle.
 3. Rheem Manufacturing Company: www.rheem.com/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Commercial Electric Water Heaters:
1. Type: Factory-assembled and wired, electric, vertical storage.
 2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
 3. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
 4. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.

2.02 EXPANSION TANKS (SEE PLUMBING SCHEDULE)

- A. Manufacturers:
1. Amtrol Inc: www.amtrol.com
 2. Bell & Gossett: www.bellgossett.com
 3. Taco, Inc: www.tacomfort.com

4. Substitutions: See Section 01 6000 - Product Requirements.

2.03 CIRCULATING PUMPS (SEE PLUMBING SCHEDULE)

- A. Manufacturers:
 1. Taco, Inc; www.tacocomfort.com
 2. Bell & Gossett; www.bellgossett.com
 3. Substitutions: See Section 01 6000 - Product Requirements.

2.04 PRESSURE BOOSTER SYSTEMS

- A. System: Packaged with two pumps, factory assembled, tested, and adjusted; shipped to site as integral unit; consisting of pumps, valves, and galvanized piping, with control panel mounted on fabricated steel base with structural steel framework.
- B. Controls and Instruments: Locate in NEMA 250 Type 1 general-purpose enclosure with main disconnect interlocked with door, fused circuit for each motor, magnetic starters with three overloads, control-circuit transformer with fuse protection, selector switch for each pump, low limit pressure switch, low-pressure alarm light, running lights, current-sensing devices, minimum-run timers, manual alternation, and suction and discharge pressure gauges.
- C. Lead Pump: Operate continuously with lag pump running on system demand. If lead pump fails to function, next pump in sequence to start automatically.
- D. Time-Delay Relay: Prevent lag pump short cycling on fluctuating demands.
- E. Thermal Bleed Circuit with Solenoid Valve: Prevent overheating during low demand.
- F. Low-Pressure Control: Stop pump operation if incoming water pressure drops to atmospheric.
- G. Pump Switch: Permit manual or automatic operation.
- H. Valving: Provide each pump outlet with combination pressure reducing and check valve to maintain constant system pressure. Provide gate or butterfly valves on suction and discharge of each pump. Provide check valve on each pump discharge.
- I. Time Clock for Automatic Day-Night Changeover:
 1. Day Cycle: Operate system continuously with pressure to fixtures maintained by pressure-reducing valves.
 2. Night Cycle: Operate pump intermittently on pressure switch located near pressure tank operating pump for predetermined adjustable time period.

2.05 SUMP PUMPS (SEE PLUMBING SCHEDULES)

- A. Manufacturers:
 1. Liberty Pumps; www.libertypumps.com
 2. Armstrong Fluid Technology; www.armstronfluidtechnology.com
 3. Zoeller Company; www.zoeller.com
 4. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping, gas venting, and electrical work to achieve operating system.
- C. Domestic Water Storage Tanks:
 1. Provide steel pipe support, independent of building structural framing members.
 2. Clean and flush prior to delivery to site. Seal until pipe connections are made.
- D. Pumps:
 1. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.

2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION

SECTION 22 4000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Water Closets
- B. Urinals
- C. Lavatories
- D. Sinks
- E. Mop Sinks
- F. Electric Water Coolers
- G. Showers
- H. Mop sinks.

1.03 RELATED REQUIREMENTS

- A. Section - Joint Sealers: Seal fixtures to walls and floors.
- B. Section 22 1005 - Plumbing Piping.
- C. Section 22 1006 - Plumbing Piping Specialties.
- D. Section 22 3000 - Plumbing Equipment.
- E. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. IAPMO Z124 - Plastic Plumbing Fixtures; 2017, with Errata.
- B. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014.
- C. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).
- D. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- E. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
- F. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2017, with Errata.
- G. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; 1994 (Reaffirmed 2009).
- H. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2017.
- I. ASSE 1014 - Performance Requirements for Backflow Prevention Devices for Hand-Held Showers; 2005.
- J. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- L. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- M. NSF 61 - Drinking Water System Components - Health Effects; 2020.
- N. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

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

1.07 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 FLUSH VALVE WATER CLOSETS (SEE PLUMBING SCHEDULE)

- A. Water Closets: Vitreous china, ASME A112.19.2, wall hung, siphon jet flush action, china bolt caps.
 - 1. Flush Valve: Exposed (top spud).
 - 2. Manufacturers: (See Schedule on Drawings)
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Kohler Company: www.kohler.com/#sle.
 - c. Zurn Industries, LLC: www.zurn.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
 - 1. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Delany Products: www.delanyproducts.com/#sle.
 - c. Sloan Valve Company: www.sloanvalve.com/#sle.
 - d. Zurn Industries, LLC; ZEMS Series: www.zurn.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Sensor-Operated:
 - a. Type: ASME A112.19.5; chloramine-resistant clog-resistant dual-seat diaphragm valve complete with vacuum breaker, stops and accessories.
 - b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.
 - c. Supplied Volume Capacity: 1.2 gal per flush.

- C. Seats:
 - 1. Manufacturers: (See Schedule on Drawings).
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Bemis Manufacturing Company: www.bemismfg.com/#sle.
 - c. Church Seat Company: www.churchseats.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Plastic: Solid, white finish, elongated shape, closed front, slow-closing hinged seat cover, and brass bolts with covers.
- D. Water Closet Carriers:
 - 1. Manufacturers: (See Schedule on Drawings).
 - a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - b. Zurn Industries, LLC: www.zurn.com/#sle.
 - c. Wade Drain (Tyler Pipe): www.wadedrains.com
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.03 WALL HUNG URINALS (SEE PLUMBING SCHEDULE)

- A. Wall Hung Urinal Manufacturers: (See Schedule on Drawings).
 - 1. American Standard, Inc: www.americanstandard-us.com/#sle.
 - 2. Kohler Company: www.kohler.com/#sle.
 - 3. Zurn Industries, LLC: www.zurn.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
 - 1. Manufacturers: (See Schedule on Drawings).
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Delany Products: www.delanyproducts.com/#sle.
 - c. Sloan Valve Company: www.sloanvalve.com/#sle.
 - d. Zurn Industries, LLC: www.zurn.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Sensor-Operated:
 - a. Type: ASME A112.19.5; chloramine-resistant, clog-resistant dual-seat diaphragm valve with vacuum breaker, stops and accessories.
 - b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.
 - c. Supplied Volume Capacity: 1.2 gal per flush.
- C. Carriers:
 - 1. Manufacturers: (See Schedule on Drawings).
 - a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - b. Wade Drain (Tyler Pipe): www.wadedrains.com
 - c. Zurn Industries, LLC: www.zurn.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.04 LAVATORIES (SEE PLUMBING SCHEDULE)

- A. Lavatory Manufacturers: (See Schedule on Drawings)
 - 1. American Standard, Inc: www.americanstandard-us.com/#sle.
 - 2. Kohler Company: www.kohler.com/#sle.
 - 3. Zurn Industries, LLC: www.zurn.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Wall-Hung Basin:

1. Vitreous China: ASME A112.19.2; white, rectangular basin with splash lip, front overflow, and hanger. Size as indicated on drawings with 4-inch centerset spacing.
2. Carrier:
 - a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.
 - b. Manufacturers:
 - 1) Jay R. Smith MFG. Co: www.jrsmith.com/#sle.
 - 2) Zurn Industries, LLC: www.zurn.com/#sle.
 - 3) Substitutions: See Section 01 6000 - Product Requirements.
- C. Under-Mount Basin:
 1. Vitreous China: ASME A112.19.2; white interior, rectangular shape, front overflow, seal of putty, caulking, or concealed vinyl gasket, and white exterior finish. Size as indicated on drawings.
- D. Sensor Operated Faucet: Cast brass, chrome-plated, deck mounted with sensor located on neck of spout.
 1. Power Supply:
 - a. Wired: 6 VDC, field-wired into dedicated or common power supply.
 2. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Chicago Faucet Company: www.chicagofaucets.com/#sle.
 - c. Sloan Valve Company: www.sloanvalve.com/#sle.
 - d. Zurn Industries, LLC: www.zurn.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- E. Thermostatic Mixing Valve:
 1. ASSE 1070 listed with combination stop, strainer, and check valves, and flexible stainless steel connectors.

2.05 SINKS (SEE PLUMBING SCHEDULE)

- A. Sink Manufacturers: (See Schedule on Drawings).
 1. Elkay Manufacturing: www.elkay.com
 2. Just Manufacturing: www.justmfg.com
 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Supply Faucet Manufacturers: (See Schedule on Drawings).
 1. American Standard, Inc: www.americanstandard-us.com.
 2. Kohler Company: www.kohler.com.
 3. Chicago Faucets: www.chicgofaucets.com
 4. Zurn Industries, Inc: www.zurn.com.
 5. Substitutions: See Section 01 6000 - Product Requirements.

2.06 SHOWERS (SEE PLUMBING SCHEDULE)

- A. Shower Manufacturers: (See Schedule on Drawings).
 1. American Bath Group: www.americanbathgroup.com/#sle.
 2. Comfort Designs: www.comfortdesignsbathware.com.
 3. Aquarius Bathware: www.aquariusproducts.com.
 4. Hamilton Bathware: www.hamiltonbathware.com
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Shower Valve:
 1. Comply with ASME A112.18.1.
 2. Provide two-handle, in-wall diverter valve body with integral thermostatic mixing valve to supply 1.5 gpm.
- C. Hand-Held Shower Head:
 1. ASME A112.18.1, adjustable spray hand-held shower head with swivel fitting with ASSE 1014 backflow preventer.

2. Include 60 inch minimum flexible polished stainless steel hose and in-line vacuum breaker
3. Provide 25 inch grab bar with sliding spray holder that locks at any height, allowing use of unit as either a hand-held spray or a fixed shower head.

2.07 ELECTRIC WATER COOLERS (SEE PLUMBING SCHEDULE)

- A. Electric Water Cooler Manufacturers: (See Schedule on Drawings).
 1. Elkay Manufacturing Company: www.elkay.com/#sle.
 2. Haws Corporation: www.hawesco.com/#sle.
 3. Oasis International: www.oasiscoolers.com/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Water Cooler: Electric, mechanically refrigerated; semi-recessed, ADA compliant; stainless steel top, stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
 1. Capacity: 8 gallons per hour of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
 2. Electrical: 115 V, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

2.08 MOP SINKS

- A. Manufacturers:
 1. Just Manufacturing Company: www.justmfg.com/#sle.
 2. Zurn Industries, LLC: www.zurn.com/#sle.
 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Material: Precast terrazzo composed of marble chips cast in Portland cement.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with wheel handle stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Section , color to match fixture.
- F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- G. Replace all batteries with name brand-long life batteries at the end of construction.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

- A. Clean plumbing fixtures and equipment.

3.07 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 22 6005
MEDICAL AIR, GAS, AND VACUUM SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Pipe and fittings.
- B. Valves and regulators.
- C. Piping accessories.
- D. Outlets.
- E. Medical oxygen gas system.
- F. Medical compressed air system.
- G. Medical vacuum system.
- H. Anesthesia-gas evacuation pumps.
- I. Alarm systems.

1.03 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- D. Section 22 0719 - Plumbing Piping Insulation.
- E. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.
- F. Section 31 2316 - Excavation.
- G. Section 31 2323 - Fill.

1.04 ABBREVIATIONS AND ACRONYMS

- A. CGA: Compressed Gas Association.

1.05 PRICE AND PAYMENT PROCEDURES

- A. Allowance includes purchase and delivery of bottled gases. Installation is not included in the allowance but is specified in this section and is part of the Contract Sum/Price.
- B. Allowance includes cost of testing and certifying systems in accordance with cross connection tests.

1.06 REFERENCE STANDARDS

- A. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- B. ASME B16.50 - Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings; 2018
- C. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- D. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a (Reapproved 2019).
- E. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings; 2020.
- F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- G. ASTM B32 - Standard Specification for Solder Metal; 2020.

- H. ASTM B819 - Standard Specification for Seamless Copper Tube for Medical Gas Systems; 2019.
- I. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).
- J. CGA G-7 - Compressed Air for Human Respiration; 2014.
- K. CGA V-5 - Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications); 2008 (Reaffirmed 2013).
- L. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.
- N. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.
- O. MSS SP-88 - Diaphragm Valves; 2015.
- P. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
- Q. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- R. NFPA 55 - Compressed Gases and Cryogenic Fluids Code; 2016.
- S. NFPA 99 - Health Care Facilities Code; 2018.
- T. UL (DIR) - Online Certifications Directory; Current Edition.

1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers literature and illustrations for all components indicating size, dimensions and configuration.
- C. Shop Drawings: Indicate general assembly of components, mounting and installation details, and general layout of control and alarm panels. Submit detailed medical wall assembly drawings.
- D. Samples: Submit two of each outlet.
- E. Independent Testing Agency Reports: Indicate systems are complete, zone valves installed, alarm systems functional, and pressure and cross connections tests performed. Document tests.
- F. Certificates: Certify that Products meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate systems are complete, zone valves installed, and alarm systems functional.
- H. Project Record Documents: Record actual locations of piping, valving, and outlets.
- I. Operation Data: Include installation instructions, assembly views, lubrication instructions, and assembly views.
- J. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements for additional provisions.
 - 2. Service Kits: Provide first-year service kit for each air compressor and vacuum pump.
 - 3. Extra Valves: Two of each type and size.

1.08 QUALITY ASSURANCE

- A. Select products and execute work in compliance with NFPA 99 and ICC (IPC).

- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- D. Testing Laboratory: Company specializing in performing testing of the type specified in this section, with minimum three years of documented experience.
- E. Comply with applicable codes for medical gas systems.
- F. Provide certificate of compliance from authorities having jurisdiction, indicating approval of systems.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
- H. Multi-trade Coordination: In lieu of detailed layout shop drawings, the Contractor may conduct a pre-installation and coordination meeting, with follow-up meetings to coordinate routing of mechanical, fire protection and electrical elements. Locations and conflict resolutions shall be made during these meetings. Notify Architect-Engineer of meeting times and dates. Do not install any conduit or piping until this meeting has taken place.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Accept material on site in factory containers and packing. Inspect for damage.
- B. Protect from damage and contamination by maintaining factory packaging and caps in place until installation.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Allied Healthcare Products, Inc: www.alliedhpi.com/#sle.
- B. Amico Corporation: www.amico.com/#sle.
- C. BeaconMedaes: www.beaconmedaes.com/#sle.
- D. Ohio Medical: www.ohiomedical.com
- E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PIPE AND FITTINGS

- A. Factory Preparation: Wash inside of copper pipe and copper fitting with hot solution of sodium carbonate or trisodium phosphate mixed 1 lb to 3 gal of water; rinse with water, and blow dry with oil-free dry nitrogen or compressed air.
- B. Oxygen, Compressed Air, Nitrous Oxide, Nitrogen Systems, Aboveground:
 - 1. Copper Tube: ASTM B819, Type K, H58 (drawn general purpose) temper.
 - 2. Fittings: ASME B16.50, wrought copper.
 - 3. Joints: AWS A5.8M/A5.8 Classification BCuP-3 or BCuP-4 silver braze.
- C. Oxygen, Compressed Air, Nitrous Oxide, Nitrogen Systems, Buried:
 - 1. Copper Tube: ASTM B819, Type K, H58 (drawn general purpose) temper.
 - 2. Fittings: ASME B16.50, wrought copper.
 - 3. Joints: AWS A5.8M/A5.8 Classification BCuP-3 or BCuP-4 silver braze.
- D. Vacuum and Anesthesia Gas Evacuation Systems, Aboveground:
 - 1. Copper Tube: ASTM B819, Type L, H58 (drawn, general purpose) temper.
 - 2. Fittings: ASME B16.22, wrought copper (solder-joints) or ASME B16.50, wrought copper (braze joints).
 - 3. Joints: AWS A5.8M/A5.8 Classification BCuP-3 or BCuP-4 silver braze or AWS A5.8M/A5.8, solder, Grade Sn95.

2.03 VALVES AND REGULATORS

- A. Factory Preparation for Oxygen Service: Disassemble, clean, degrease, seal, and pack for shipping.
- B. Ball Valves:
 - 1. Requirements: Comply with MSS SP-110; bronze body, three piece, double-seal ball valves with replaceable neoprene or teflon seat and stem seals, for minimum 600 psi cold working pressure, flange or union mounting, labeled for intended service.
- C. Diaphragm Valves (Oxygen, Nitrous Oxide and Nitrogen):
 - 1. MSS SP-88, brass-bodied, packless, diaphragm type with regrinding or renewable seats and disks, for minimum 300 psi working pressure.
- D. Gate Valves (Vacuum, Medical Air, and Anesthesia Gas Evacuation System):
 - 1. MSS SP-80; Class 150 bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder ends.

2.04 PIPING ACCESSORIES

- A. Hangers and Supports: MSS SP-58 with types as required.
- B. Pressure Gauges:
 - 1. ASME B40.100, white dials and black lettering with restrictor.
 - 2. Oxygen and nitrous oxide systems: Manufactured and labeled expressly for intended service; UL labeled.
 - 3. Gages selected to mid range indication for normal operating pressure for each system served.
- C. Vacuum Bottle Brackets: Stainless steel, chrome-plated metal, or aluminum with finish matching adjacent outlet.
- D. Flexible Connectors: Corrugated flexible, single ply, seamless or seam-welded tubing of stainless steel or bronze or reinforced teflon bellows or hose.
- E. Valve Cabinets:
 - 1. Extruded aluminum, flush-mounted and rigidly assembled to accommodate valves and fittings, punched or drilled sides to receive tubing, anchors to secure to wall construction.
 - 2. Cover Plates: Extruded aluminum, with replaceable plastic windows with pull ring to remove window.
 - 3. Cabinet Labels: labeled and color coded for intended service and area served.
 - 4. Valves: Pre-assemble and mount chrome plated valves and tubing extensions.
 - 5. Gauges: Provide where indicated and in operating rooms areas downstream of isolating valves.
- F. Piping Identification: Pressure sensitive adhesive tape and decals, color and labeling to comply with Section 22 0553.

2.05 OUTLETS

- A. Outlet Units:
 - 1. Before ordering medical gas outlets, the contractor must verify with the user the type of outlet connections the user has established as a standard and that it is interoperable with the outlets to be installed without any adapters needed.
 - 2. Manufacturers: (See Schedule on Drawings).
 - a. Allied Healthcare Products, Inc; _____: www.alliedmedicalllc.com/#sle.
 - b. CGA V-5, Diameter-Index Safety System (DISS) non-interchangeable connectors, automatic valves, secondary check valves (except vacuum and evacuation outlets), and capped 3/8 inch tubing stubs for supply connections, color coded and labeled for intended service.
- B. Faceplates:
 - 1. Flush Outlets: Mount in galvanized steel boxes with stainless steel faceplate with polycarbonate cover, color coded with embossed labeling.

2.06 MEDICAL COMPRESSED AIR SYSTEM

- A. Manufacturers: (See Schedule on Drawings).
- B. Duplex Air Compressor System:
 - 1. To deliver CGA G-7 compressed air.
 - 2. Oil-Less Reciprocating Piston Compressors: Equipped with check valve, inlet and outlet flexible connector, isolation valve, safety relief valve, air by-pass solenoid valve, water air separator, float trap, strainer, compound gage, solenoid valve, bypass solenoid valve and metering valve for service liquid, inlet mufflers, motor coupling with guard.
 - 3. Reciprocating 100 % Oil Free Compressors with:
 - a. Skid mount.
 - b. Flexible, single point air intake and outlet connections.
 - c. Air intake filter and silencer.
 - d. Outlet air silencer.
 - e. Terminal expansion joint air side.
 - f. Completely pre-piped oil circuit and built-in oil breather system.
 - g. Pre-mounted IP 55, VFD rated electric motors and pre-mounted starters.
 - h. Pre-mounted electrical and VFD panels and modules.
 - i. Electronic drains.
 - j. Silencing canopy.
 - k. DDC connection for starters and VFDs.
 - l. VFD and motor from same manufacturer.
 - m. Anti-condensation heater for motors.
 - n. Thermal motor winding protection.
 - o. Connection and transducer for DDC remote pressure readout.
 - p. Solenoids, gages, relief valves, traps, mufflers, strainers and all components for a complete, operation system.
 - q. Run timer (hour meter).
 - 4. Reciprocating Compressor: Cast iron housing and head, heat treated forged steel or ductile iron shaft, aluminum alloy connecting rods, automotive type pistons with rings, alloy suction and discharge valves, and oil immersed sealing surfaces. Statically and dynamically balance rotating parts. Provide reversible oil pump lubrication system to ensure adequate lubrication during starting, stopping, and normal operation.
- C. Refrigerated Air Dryer: Non-cycling hermetic type with capacity as schedule capable of drying 100 psi at 100 degrees F saturated air to 10 degrees F dew point at 100 degrees F ambient, with automatic drain trap, three valve by-pass system, motor and safety disconnect switch in NEMA 250 Type 1 general purpose enclosure, wired from compressor controller. A treatment module shall be included dual dryers, dual filtration and a CO monitor.
 - 1. Provide the following features:
 - a. Panel mounted pressure gages.
 - b. Adjustable purge regulator.
 - c. Indicator status lights, including power on and alarm.
 - d. Controlled repressurization.
 - e. Fully automatic operation.
 - f. Removable stainless steel diffuser screens.
 - g. NEMA 4X electrical enclosures.
 - h. 120v/1ph/60hz.
 - i. ASME coded and stamped.
 - j. Microprocessor controls.
 - k. Exhaust purge muffler.
 - l. Alarm package indicating failure for any and all functions.
 - m. Dry contacts for remote alarm indication.
 - n. Purge economizer.
 - o. Moisture indicator.

- p. High humidity alarm.
- q. Pre-piped filter with bypass.
- D. Desiccant Compressed Air Dryer Hankinson HHL & HHS Series
 - 1. Packaged heatless type.
 - 2. Pre-charged with fully activated alumina.
 - 3. Fully piped and wired.
 - 4. Controller.
 - a. Nema 4X enclosure.
 - b. Soft on/off switch with two power recovery mode.
 - c. Tower status LEDs.
 - d. Process valve status.
 - e. Operating mode LEDs.
 - f. Load Factored Purge Savings LEDs.
 - g. Alarm LED.
 - h. Dry contacts for alarm.
 - i. Alarm reset button.
 - j. Service reminder LEDs.
 - k. Communications port.
 - l. Moisture indicator.
 - m. Tower pressure gages.
 - n. Purge rate indicator.
 - o. Switching failure alarm.
 - p. Dew point monitor.
 - q. CO monitor.
 - 5. 1 micron particle filter.
 - 6. Automatic Energy Saving Purge Control.
 - 7. Permanently lubricated valves (not field lubricated).
 - 8. Conform to UL No. 1995.
- E. Duplex Controller: Pre-wired in NEMA 250 Type 12 enclosure with fusible disconnects, magnetic motor starters with overload protection, control circuit transformers, clock timer, automatic water and air by-pass circuits, pressure switches, hand-off automatic selector switches mounted in cabinet cover, and safety disconnect door.
- F. Receiver: _____ gallon vertical welded steel ASME receiver, prime coated with vinyl lining, with gauge, safety relief valve, and automatic tank drain.
- G. Receiver: vertical welded steel ASME receiver, prime coated with vinyl lining, with gage, safety relief valve, and automatic tank drain.
- H. Air Line Filter Regulator: Regulating assembly with line pressure adjusting knob, 2 inch diameter line pressure gauge, 1-1/4 inch pipe size connections, clear polycarbonate collection bowl with 5 micron filter unit and automatic drain.
- I. Refer to schedules on Drawings for electrical characteristics.

2.07 MEDICAL VACUUM SYSTEM

- A. Lubricated Rotary Vane Pumps:
 - 1. Skid mounted, each equipped with check valve, inlet flexible connector, water separator, strainer, compound gage, solenoid valve and metering valve for service liquid, exhaust muffler, motor coupling with guard.
 - 2. Duplex pumps, 99.9% oil-free.
 - 3. Capable of producing a maximum vacuum level of 29.1" Hg.
 - 4. NFPA 99 compliant.
 - 5. Control panel with:
 - a. Automatic staging.
 - b. Automatic staging.
 - c. Circuit breaker for each comperssor.

- d. Full voltage starters.
- e. Redundant control transformers.
- f. Visual and audible alarms with remote alarm dry contacts.
- g. Lead/lag pump operation indicator.
- h. Lighted hand-off-auto selector switch.
- i. Runtime hour meter.
- j. Connection point with transducer for vacuum line indicator connection to DDC system.
- k. Programmable logic controller.
- l. Vacuum gage.
- 6. ASME Coded and Stamped vessel for 150 PSIG..
- 7. Reservoir for up to 48 hours operation without fresh water supply.
- 8. Factory piped intake piping and connection point.
- 9. Water cooled, with stainless steel heat exchanger.
- 10. Flexible connector.
- 11. Mechanical pump seals.
- 12. Two year warranty from owner acceptance.
- 13. Electrical Characteristics: Refer to Schedules on Drawings.
- B. Electrical Controls: Pre-wired in NEMA 250 Type 12 enclosure, with fusible disconnects, magnetic motor starters, overload protection with manual reset, control circuit transformers, automatic alternators, vacuum control switches, hand-off automatic switches in cabinet cover, and safety disconnect door.
- C. Receiver: vertical welded steel ASME receiver, prime coated with vinyl lining, with gage, safety relief valve, and automatic tank drain.
- D. Motors: Continuous duty TEFC motor with 1.15 service factor.

2.08 ALARM SYSTEMS

- A. Connect to existing medical gas alarm panel in the main control room. Add and/or replace alarm components as necessary to incorporate the new medical gas systems.
- B. High-Low Pressure Alarm Panel:
 - 1. Closed circuit, self-monitoring type to monitor single gas such as oxygen, vacuum, compressed air, nitrous oxide, or nitrogen.
 - 2. Green light for system normal.
 - 3. High or low pressure warning:
 - a. Green light extinguishes.
 - b. Audible warning device sounds.
 - c. Red light energizes.
 - 4. Gauge indicates pressure or vacuum.
 - 5. Switch silences warning device.
 - 6. Test switch to test light bulbs and audible warning device.
 - 7. Provide system with internal switches, gauge, control unit, and transformer.
- C. Multi-Signal High-Low Pressure Alarm Panel:
 - 1. Closed circuit, self-monitoring type to monitor multiple gases such as oxygen, vacuum, compressed air, nitrous oxide, and nitrogen piping systems pressure or liquid level.
 - 2. Green light for systems normal.
 - 3. For abnormal condition:
 - a. Green light extinguishes.
 - b. Audible warning device sounds.
 - c. Red light energizes.
 - 4. Switch silences warning device.
 - 5. Test switch to test light bulbs and audible warning device.
 - 6. Design system such that one, two or more monitors may be connected to a single pressure switch.
 - 7. Monitor following abnormal conditions:

- a. Oxygen reserve supply in use.
 - b. Oxygen line pressure high.
 - c. Oxygen line pressure low.
 - d. Redundant Oxygen in use.
 - e. Air line pressure high.
 - f. Air line pressure low.
 - g. Air lag pump on.
 - h. Air tank water level high.
 - i. Compressor temperature high (each compressor).
 - j. Vacuum line pressure above normal.
 - k. Vacuum line pressure below normal.
 - l. Vacuum lag pump on.
8. High-Low Pressure Switch: Dual circuit with two single pole, double throw, snap action switches, tested at 180 psi with adjustable range of 4 psi, preset at 40 psi and 60 psi.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products and equipment in accordance with manufacturer's instructions.

3.02 INSTALLATION

- A. Install in accordance with NFPA 99 applying system specific piping service font and tag colors.
- B. Coordinate any shut downs with the hospital, especially the oxygen connection to the bulk source.
- C. Pre-Installation Cleaning: Disassemble positive pressure gas systems pipe, fittings, valves, and components, except those supplied cleaned and prepared for intended service, and thoroughly wash in hot solution of sodium carbonate or trisodium phosphate mixed 1 lb to 3 gal of water. After washing, rinse with water, dry and cap until installation.
- D. Braze joints in pipe and tubing. Avoid leaving excess flux inside of pipe and fittings. During brazing of pipe connections, purge interior of pipe continuously with nitrogen.
- E. Effect changes in size with reducing fittings. Make changes in direction of required turns or offsets with fittings or tubing shaped by bending tools. Make bends free of flattening, buckling or thinning of tube wall.
- F. Cut pipe and tubing accurately and install without springing or forcing.
- G. Install exposed oxygen piping in wall-mounted sheet steel raceways and junction boxes.
- H. Encase buried oxygen piping in cast-iron pipe. Provide with FM listed heat trace with fixed temperature regulation, set for 80 degrees F maximum, and terminating at junction box, mounted near main oxygen supply shut-off valve. Insulate buried oxygen lines and heat trace with insulation; see Section 22 0719.
- I. Grade piping down in direction of flow.
- J. Provide pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions. Finish flush at both ends. Extend 2 inches above finished floors. Pack space between pipe or tubing and sleeve, and calk.
- K. Identify piping with tape and decals. Provide piping identification code and schematic for installation under provisions of Section 22 0553. Install labeling on pipe at intervals of not more than 20 feet and at least once in each room and each story traversed by pipeline.
- L. Excavate and backfill pipe trenches, see Section 31 2316 and Section 31 2323. Coordinate provision of utility warning and identification tape with backfill operation. Provide above all buried lines at a depth of 8 to 12 inches below finish grade.
- M. Pipe Support; Space pipe hangers horizontally by pipe size or vertically as follows:
 - 1. 1/4 inch 5 feet.
 - 2. 3/8 inch 6 feet.
 - 3. 1/2 inch 6 feet.

4. 3/4 inch 7 feet.
 5. 1 inch 8 feet.
 6. 1-1/4 inch 9 feet.
 7. 1-1/2 inch and larger 10 feet.
 8. Vertical risers, any size, every floor 15 feet, do not exceed listed spacing.
- N. Install underground piping in trenches minimum 42 inches deep adequately protected against physical damage and corrosion or in ducts and tunnels that are not occupied by fuel oil lines and are vented.
 - O. Except where indicated or in flush wall mounted cabinets, install manual shut off valves with stem vertical and accessible for operation and maintenance.
 - P. Install strainers on inlet side of pressure reducing valves. Provide main gas valves (pressure reducing or flow control) with by-passes and isolation valves to permit maintenance without interruption of gas.
 - Q. Provide a valved by-pass around receivers.
 - R. Vibration and Noise Isolation: See Section 22 0548.
 - S. Medical Air Compressor Systems: Isolate systems including receivers, dryers, and filters until after completion and approval of purity tests for compressed air system. Tie-in at flange or union joint.
 - T. Install bulk liquid oxygen system to NFPA 55 and under supervision of manufacturer. Size liquid oxygen tank's concrete foundation and tank anchoring for 3 times fully loaded weight. Provide bulk liquid oxygen systems with shut-off valve and connection point with valve for portable emergency oxygen supply. Install bulk oxygen to inlet side of oxygen manifold.
 - U. Provide electric motor drive, equipment and associated wiring; see Section 26 0583.
 - V. Provide manual motor starters or magnetic motor controllers where required or indicated for start/stop or DDC interface.
 - W. To allow testing without disabling the applicable system, install all pressure switches with "quick disconnect" type fitting including built in check valve.

3.03 PIPING SYSTEMS CLEANING AND PRESSURE TESTING

- A. After erection of pipe and tubing but prior to installation of service outlet valves, blow systems clear of free moisture and foreign matter with nitrogen gas.
- B. Install service outlet valves, subject system to test pressure of 150 psi with nitrogen or dry compressed air. Check with soapy water. Provide 24-hour standing pressure test.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Independent testing agency to certify system is complete, zone valves installed, alarm systems functional, and tests performed. Document tests and submit.
- C. Reduce pressure in piping systems other than system under investigation to atmospheric.
- D. Test Nitrogen systems at 150 psi.
- E. Test system with dry nitrogen with test pressure in piping system at 50 psi.
- F. Check each station outlet of every piping system to determine test gas is dispensed only from outlet of system under investigation. Measure pressure with gauge attached to specific adaptor. Do not use universal adaptors.
- G. Disconnect test gas and connect proper gas to each system. Purge entire system to remove test gas. Check with analyzer suitable for gas installed.

END OF SECTION

SECTION 23 0510
BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 PROJECT MANAGEMENT

- A. Drawings are diagrammatic, all offsets, fitting, valves and accessories are not shown. Refer to all drawings in the contract documents and plan work accordingly. Coordinate with all trades and crafts.
- B. In case of interference between trades, Architect Engineer will decide which work is to take precedence regardless of work that might be installed.

1.03 CODES, ORDINANCES, INSPECTIONS, AND PERMITS

- A. Execute and inspect Work in accordance with local and state codes, laws, ordinances, rules and regulations applicable to particular class of Work.
- B. Should any part of Drawings or specifications be found to be in conflict with applicable codes or ordinances, notify the Architect Engineer, in writing, 72 hours prior to receiving of bids. After the receiving of bids, any discovery of code violations shall be promptly reported to the Architect Engineer. Any work performed knowingly in violation of codes shall be corrected without additional expense to the Owner or his representative.
- C. All plumbing work shall comply with latest local codes and the the State in which the Project is located plumbing code.
- D. Arrange with County, City, or State, if City has no ordinances covering work, for complete inspection, paying all charges pertaining thereto. Give proper authority all requisite notice relating to work under such; afford Architect Engineer and all authorized inspectors every facility for inspection and be responsible for all violations of law. Upon completion of Work, have Work inspected, if required, obtaining certificate of inspection and approval from inspecting agency and deliver such certificate to Architect Engineer. Comply with Division 01.

1.04 COORDINATION

- A. Conduct multi-trade coordination and preinstallation meetings to establish bottom elevations of all piping, ductwork and conduit before fabrication and installation. Comply with Division 01.
- B. All equipment shall be installed in accordance with the manufacturer's recommendations. It is the contractor's responsibility to follow all installation requirements and guidelines provided in the manufacture's installation manual. If there is a conflict with regards to installation, the contractor shall stop work and notify the design Architect Engineer representative.

1.05 SUBMITTALS

- A. Comply with Division 01.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for HVAC equipment, HVAC piping specialties, air distribution devices and others as may be requested.
- C. Shop Drawings: Miscellaneous steel for pipe support, duct support, pipe guides, anchors, and miscellaneous steel used for supporting any mechanical equipment.

1.06 SUBSTITUTIONS

- A. Comply with Division 01.
- B. Any proposed substitutions of equipment shall be accompanied by shop drawings showing revised equipment layouts, piping diagrams, ductwork drawings and/or wiring diagrams. Where substituted equipment furnished requires use of larger, more, or differently arranged

connections, such connections shall be installed to the complete satisfaction of Architect Engineer without additional cost to Owner.

- C. Should a substitution be accepted and subsequently proven unsatisfactory for the service intended within the warranty period, the Contractor shall replace this material or equipment with that as originally specified, or corrected as directed by Architect Engineer.

1.07 CLEAN UP

- A. Comply with Division 01.
- B. Do not allow waste material or rubbish to accumulate in or about job site.
- C. Any discoloration or other damage to parts of building, its finish or furnishings due to failure to properly clean or keep clean mechanical systems shall be repaired without cost to Owner.

1.08 EQUIPMENT START-UP AND SYSTEM COORDINATION

- A. Comply with Division 01.
- B. The Contractor shall be responsible for placing all equipment and system components into operation. Individual components shall be coordinated with other parts of Mechanical, Electrical, Plumbing and/or Fire Protection Systems to ensure that the entire project functions as designed and described by the contract documents.

1.09 CUTTING AND PATCHING

- A. Comply with Division 01.
- B. Provide all cutting and patching required to perform the mechanical work, when alteration, repair, renovation, or addition, to existing construction.

1.10 DEMOLITION

- A. Comply with Section 02 4100 - Demolition.

1.11 RECORD DOCUMENTS

- A. Comply with Division 01.

1.12 OPERATION INSTRUCTIONS

- A. Comply with Division 01.
- B. Printed instructions, installed in a suitable frame with a glass front, covering the operation and maintenance of each major item of equipment, shall be posted at locations designated by the Architect Engineer. Provide 2 bound manuals containing complete repair parts lists, and operating service and maintenance instructions for all equipment provided.

1.13 INSTRUCTION

- A. Comply with Section 01 7900 - Demonstration and Training.

1.14 FLASHINGS

- A. Refer to Division 07 for roof flashings.

1.15 ACCESS PANELS

- A. Comply with Section 08 3100 - Access Doors.
- B. Provide access panels as necessary for servicing of fire dampers, smoke dampers, valves, VAV terminals and any other equipment in concealed spaces.

1.16 PAINT EXTERIOR PIPING

- A. Comply with Section 09 90 00 - Painting and Coating.
- B. All exterior steel piping shall be painted using a metal primer coat, second coat of enamel, top coat of enamel and a finish coat of gloss.

1.17 LOCAL SITE CONDITIONS

- A. Before bidding, make complete investigation at site in order to be informed as to location of utilities and as to conditions under which work is to be performed. Utility locations shown were

obtained from surveys and/or local utility companies and are not to be assumed as being accurate.

- B. Make determination of soil conditions before bidding. These specifications and accompanying drawings in no way imply as to condition of soil to be encountered.

1.18 GUARANTY-WARRANTY

- A. This guarantee shall include capacity and integrated performance of component parts of various systems in strict accord with the true intent and purpose of these specifications. Conduct such tests as herein specified or as may be required by the Architect Engineer to demonstrate capacity and performance ability of various systems to maintain specified conditions.
- B. All materials and equipment shall be new and unused and shall carry a full year's warranty from time Owner accepts building or the date of substantial completion, whichever is earlier, regardless of start-up date of equipment, unless a longer warranty period is specified under other sections.

1.19 EQUIPMENT CONNECTIONS AND INSTALLATION

- A. Each equipment item with drain connections, shall be provided with a properly-sized drain run to the nearest floor drain or as directed.
- B. Rough-in and make final connection to all equipment requiring same, furnished under other Divisions of these specifications or by the Owner.
 - 1. Provide necessary labor and materials, including stop valves, traps, pressure-reducing valves, etc. necessary. Trap and vent drainage connections as required.
 - 2. If equipment or fixtures to be furnished by Owner and/or Owner's vendor are not delivered prior to final acceptance, services shall be capped or plugged at walls or floor as directed, ready for future connection.
- C. No equipment or fixture shall be "roughed-in" until proper rough-in drawings are in the hands of the trade doing the work.
- D. Unless another form of vibration isolation is used, all equipment shall be mounted at least on neoprene pads.

1.20 ELECTRICAL

- A. Furnish and install all electrical interlock, control and other wiring, not covered specifically under the electrical plans and specifications, for proper operation and control of all equipment specified under this Division of the specifications.
- B. Provide electrical disconnects for all mechanical equipment as per NEC.
- C. Supervise and coordinate all electrical work in connection with mechanical system.

1.21 MOTOR CONTROLLERS

- A. Furnish all motor controllers or contactors, not furnished as part of a motor control center, for proper operation of all motors.
- B. Where motor controllers or contactors are furnished as part of a motor control center, provide a schedule of every motor or equipment item furnished, its voltage requirements, type controller required, accessories required and interlocks. This schedule shall be submitted within 45 days of Notice to Proceed to Architect Engineer and supplier of motor control center for approval.
- C. Provide variable frequency drive controllers on all HVAC fan and pump motors that are three phase powered regardless if they serve a constant flow or variable flow system.
- D. Provide a motor mounted potentiometer dial on all HVAC motors that are electronic commutation (EC) motors.
- E. Provide variable speed solid state controllers on all HVAC fan motors that are single phase powered and are not electronic commutation (EC) motors.
- F. All starters and switches shall be in a proper NEMA enclosure and shall be identified with engraved laminated plastic label.

1.22 EQUIPMENT FEATURES

- A. All belt driven fans shall include an automatic belt tensioner to maintain belt tension after start-up.

1.23 EXCAVATION, TRENCHING, AND BACKFILLING

- A. All excavation, trenching and backfilling in connection with the mechanical system, to a point 5'0" outside the building, is included as part of this Division.
- B. All excavation required shall be done as part of the bid price regardless of any implied conditions on the plans or in these specifications.
- C. Excavation to have 12 inch minimum and 24 inch maximum clearance on all sides. Do not carry excavation below required level unless indicated otherwise on the drawings. Excess excavation below required level shall be backfilled at no expense to Owner with earth, sand, gravel or concrete, as directed by Architect Engineer and thoroughly compacted. Remove any unstable soil and replace with gravel, crushed stone or clean sand and thoroughly compact. Architect Engineer will determine the depth of removal of any unstable soil encountered. Grade ground adjacent to excavations to prevent water running in. Remove, by pumping or other means any water accumulated in excavation.
- D. Banks of trenches shall be vertical or as shown on the drawings. Width of trench to be 5 inches minimum, 8 inches maximum on each side of pipe bell. Bottom of trench for sewers and culverts shall be rounded so that an arc of circumference equal to 0.6 of outside diameter or pipe rests on undisturbed soil wherever practicable. Excavate bell holes accurately to size by hand. In rock, excavations shall be carried 8 inches below bottom of pipe. Use loose earth or gravel for backfill and tamp thoroughly.
- E. Bracing, sheathing and shoring shall be performed as necessary to complete and protect excavations indicated on the drawings, as required for safety, as directed by Architect Engineer, or to conform to governing laws.
- F. After piping, conduit, ducts, etc. have been installed, inspected, tested and approved by governing agency, backfill trenches with clean, stable soil free from stones. Place backfill in 4 inch layers, tamped under and around pipe and conduit to height of at least 2'0" above pipe. Tamping shall be done in such manner as not to disturb underlying work. Remainder of trenches and excavations shall be backfilled with clean, stable earth, deposited in 8 inch layers and brought up to rough grade, with each layer compacted to density of surrounding soil. Remove sheathing and shoring as backfill is placed and fill space with dry sand. Compaction tests in accordance with Division 31 may be required by the Architect Engineer, with the costs paid by the Contractor.
- G. Replace existing appurtenances removed or damaged in connection with work, and restore to original conditions, unless otherwise directed.

1.24 SEISMIC QUALIFICATION OF EQUIPMENT

- A. Provide manufacturer's certificate of compliance for the following equipment requiring seismic qualifications.
 - 1. Air handling equipment
 - 2. Air terminal units
 - 3. Boilers
 - 4. Pumps
 - 5. Heat Exchangers
 - 6. Chillers

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 23 0513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).

1.02 RELATED REQUIREMENTS

- A. Section 26 2913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.
- C. NEMA MG 1 - Motors and Generators; 2018.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Operation Data: Include instructions for safe operating procedures.
- C. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service:
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
- B. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- D. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 APPLICATIONS

2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.05 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.06 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 2913.

- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- J. Sound Power Levels: To NEMA MG 1.
- K. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

2.07 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Motor to be an electronic commutation (EC) motor specifically designed for HVAC applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors. Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and prewired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal as scheduled. Motor shall be a minimum of 85% efficient at all speeds.
- B. Applications:
 - 1. Commercial:
 - a. Roof Top Unit:
 - 1) Operating Mode: Constant speed.
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the roof top unit and/or specified sequence of operation.
 - 3) Shaft Extension: Single.
 - 4) RPM: 300 through 1200.
 - b. DX Fan Coil Unit:
 - 1) Operating Mode: Constant cfm.
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the DX fan coil unit and/or specified sequence of operation.
 - 3) Shaft Extension: Single.
 - 4) Options: Remote mount control/User-Interface.
 - 5) RPM: 300 through 1250.
 - c. Hydronic Fan Coil Unit:
 - 1) Operating Mode: Constant cfm.
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the fan coil unit and/or specified sequence of operation.
 - 3) Shaft Extension: Single.
 - 4) Options: User-interface.
 - 5) RPM: 300 through 1250.
 - d. Power Roof Ventilator (PRV):
 - 1) Operating Mode: Constant cfm.
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the PRV and/or specified sequence of operation.
 - 3) Shaft Extension: Single.
 - 4) Options: Remote mount control.
 - e. Energy Recovery Ventilator:
 - 1) Operating Mode: Constant cfm.
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the energy recovery ventilator and/or specified sequence of operation.
 - 3) Shaft Extension: Single.
 - 4) Options: Remote mount control.
 - f. Hydronic Pump:
 - 1) Operating Mode: Constant speed.

- 2) Input: Motor manufacturer to coordinate control requirements with the control board of the hydronic pump and/or specified sequence of operation.
- 3) Flange Configuration: "C".

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 23 0516

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 2 PRODUCTS

END OF SECTION

SECTION 23 0517

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 2 PRODUCTS

END OF SECTION

SECTION 23 0519
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.
- C. Static pressure gauges.
- D. Filter gauges.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

1.04 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 4-1/2 inch diameter.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Psi.

2.02 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.
- D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.03 STEM TYPE THERMOMETERS

- A. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Accuracy: 2 percent, per ASTM E77.
 - 4. Calibration: Degrees F.
- B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with

positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.

1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: 2 percent, per ASTM E77.
5. Calibration: Degrees F.

2.04 DIAL THERMOMETERS

- A. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
 1. Size: 5 inch diameter dial.
 2. Lens: Clear glass.
 3. Accuracy: 1 percent.
 4. Calibration: Degrees F.

2.05 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.06 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

2.07 STATIC PRESSURE GAUGES

- A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- D. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to 23 09 23. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
- E. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- F. Coil and conceal excess capillary on remote element instruments.
- G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- H. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

- I. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- J. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION

SECTION 23 0523
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 2 PRODUCTS

1.01 APPLICATIONS

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:

1.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
- D. Valve-End Connections:
- E. General ASME Compliance:
 - 1. Building Services Piping Valves: ASME B31.9.

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components.
- B. Retrofit piping cover system.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014 (Reapproved 2020).
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2018).
- H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- I. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2018.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- K. FM (AG) - FM Approval Guide; current edition.
- L. MFMA-4 - Metal Framing Standards Publication; 2004.
- M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.
- N. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL (DIR) - Online Certifications Directory; Current Edition.
- P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.

1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 3.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
- C. Fiberglass Channel (Strut) Framing Systems:
1. Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 2. Channel Material: Use polyester resin or vinyl ester resin.
 3. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
 4. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
- D. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
 2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch: 1/4 inch diameter.
 - c. Piping larger than 1 inch: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

- E. Thermal Insulated Pipe Supports:
 - 1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a galvanized steel jacketing.
 - 2. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- F. Pipe Supports:
 - 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - 2. Liquid Temperatures Up To 122 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
- G. Beam Clamps:
 - 1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
 - 2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
 - 3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
 - 4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
 - 5. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
 - 6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
 - 7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
 - 8. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
- H. Riser Clamps:
 - 1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 - 2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 - 3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 - 4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
 - 5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.
- I. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- J. Strut Clamps:
 - 1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
- K. Insulation Clamps:
 - 1. Two bolt-type clamps designed for installation under insulation.
 - 2. Material: Carbon steel with epoxy copper or zinc finish.
- L. Pipe Hangers:
 - 1. Hangers:
 - a. Provide hinged split ring and yoke roller hanger with plain finish.
 - b. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
 - c. Provide hanger rod and nuts of the same type and material for a given pipe run.

- d. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- M. Nonmetallic Pipe Hangers:
- N. Intermediate Pipe Guides:
 - 1. Pipe Diameter 6 inch and Smaller: Provide minimum clearance of 0.16 inch.
 - 2. Pipe Sizes 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
 - 3. Pipe Size 10 inch: 0.75 inch U-bolt.
 - 4. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
 - 5. Pipe Sizes 18 to 30 inch: 1 inch U-bolt.
 - 6. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- O. Pipe Alignment Guides: Galvanized steel.
 - 1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
 - 2. Pipe Sizes 10 inch and Larger: Roller type.
 - 3. Pipe Sizes 18 to 30 inch: 1 inch U-bolt.
- P. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- Q. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 - 1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 - 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- R. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 4. Hollow Masonry: Use toggle bolts.
 - 5. Hollow Stud Walls: Use toggle bolts.
 - 6. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood: Use wood screws.
 - 9. Plastic and lead anchors are not permitted.
 - 10. Powder-actuated fasteners are not permitted.
 - 11. Hammer-driven anchors and fasteners are not permitted.
 - 12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

2.02 RETROFIT PIPING COVER SYSTEM

- A. General Requirements:
 - 1. Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, maximum, when tested in accordance with ASTM E84 or UL 723.
- B. Materials:

1. Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors for use with CPVC, steel, and copper piping systems.
2. Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin material, paintable finish.
3. Unit Length: 7.5 feet.
4. Provide coupling fittings for joining units end to end and prefabricated inside and outside corner fittings and end caps as required.
5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect Engineer, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 23 0532

VARIABLE-FREQUENCY MOTOR CONTROLLERS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.
- B. Overcurrent protective devices for motor controllers, including overload relays.

1.02 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 2813 - Fuses.

1.03 REFERENCE STANDARDS

- A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 2013 (Corrigendum 2019).
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).
- D. NEMA ICS 7 - Standard for Industrial Control and Systems: Adjustable-Speed Drives; 2020.
- E. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems; 2014.
- F. NEMA ICS 7.2 - Application Guide for AC Adjustable Speed Drive Systems; 2015.
- G. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems; 2005.
- H. NEMA MG 1 - Motors and Generators; 2018.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- L. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
- B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
 - 1. Authorized service facilities located within 100 miles of project site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 VARIABLE-FREQUENCY MOTOR CONTROLLERS

- A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.
- B. Provide products listed, classified, and labeled as suitable for purpose intended.
- C. Controller Assemblies: Comply with NEMA ICS 7, NEMA ICS 7.1, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.
- D. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA ICS 7.2, NEMA MG 1 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:
 - 1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 1 design letter or inverter duty rating for induction motors.
 - 2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.
 - 3. Motor nameplate data.
 - 4. Requirements for speed control range, speed regulation, and braking.
 - 5. Motor suitability for bypass starting method, where applicable.
- E. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.
- F. Operating Requirements:
 - 1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.
 - 2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.
 - 3. Efficiency: Minimum of 96 percent at full speed and load.
 - 4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.
 - 5. Overload Rating:
 - a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.
 - b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.
- G. Power Conversion System: Microprocessor-based, pulse width modulation type consisting of rectifier/converter, DC bus/link, and inverter.
 - 1. Rectifier/Converter: Diode-based, 6-pulse type unless otherwise indicated.
- H. Control System:
 - 1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
 - 2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.
 - 3. Control Functions:
 - a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
 - 1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
 - 2) Vector Control: Provide selectable autotuning function.
 - b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
 - c. Selectable braking control; DC injection or flux braking.

- d. Adjustable minimum/maximum speed limits.
 - e. Adjustable pulse width modulation switching carrier frequency.
 - f. Adjustable motor slip compensation.
 - g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
- 4. Status Indications:
 - a. Motor run/stop status.
 - b. Motor forward/reverse status.
 - c. Local/remote control status.
 - d. Output voltage.
 - e. Output current.
 - f. Output frequency.
 - g. DC bus voltage.
 - h. Motor speed.
- 5. Protective Functions/Alarm Indications:
 - a. Overcurrent.
 - b. Motor overload.
 - c. Undervoltage.
 - d. Overvoltage.
 - e. Controller overtemperature.
 - f. Input/output phase loss.
 - g. Output short circuit protection.
 - h. Output ground fault protection.
- 6. Inputs:
 - a. Digital Input(s): Three.
 - b. Analog Input(s): Two.
- 7. Outputs:
- 8. Features:
 - a. Password-protected security access.
 - b. Event log.
- I. Power Conditioning/Filtering:
 - 1. Provide DC link choke or input/line reactor for each controller unless otherwise indicated or required.
 - 2. Reactor Impedance: 3 percent, unless otherwise indicated or required.
- J. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
 - 1. Disconnects: Circuit breaker or disconnect switch type.
 - a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
 - b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
 - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
 - 2. Provide door-mounted remote operator interface.
- K. Service Conditions:
 - 1. Provide controllers and associated components suitable for operation under following service conditions without derating:
 - a. Altitude: Less than 3,300 feet.
 - b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
 - 2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.
- L. Short Circuit Current Rating:

1. Provide line/input reactors where specified by manufacturer for required short circuit current rating.
- M. Conductor Terminations: Suitable for use with conductors to be installed.
- N. Enclosures:
 1. Comply with NEMA ICS 6.
 2. NEMA 250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
 3. Finish: Manufacturer's standard unless otherwise indicated.
 4. Cooling: Forced air or natural convection as determined by manufacturer.

2.02 OVERCURRENT PROTECTIVE DEVICES

2.03 DESCRIPTION

- A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
 1. Employ microprocessor-based inverter logic isolated from power circuits.
 2. Design for ability to operate controller with motor disconnected from output.
- B. Enclosures: NEMA 250, Type 1, suitable for equipment application in places regularly open to the public.

2.04 COMPONENTS

- A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
- B. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
- C. Furnish HAND-OFF-AUTOMATIC selector switch and manual speed control.
- D. Include undervoltage release.
- E. Control Power Source: Separate circuit.
- F. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.
- G. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.
- H. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
- I. Manual Bypass: Furnish contactor, motor running overload protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.
- J. Emergency Stop: Use dynamic brakes for emergency stop function.
- K. Disconnecting Means: Include integral fused disconnect switch on the line side of each controller.
- L. Wiring Terminations: Match conductor materials and sizes indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface is suitable for controller installation.
- B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

3.02 INSTALLATION

- A. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.
- B. Provide required support and attachment in accordance with Section 26 0529.

- C. Tighten accessible connections and mechanical fasteners after placing controller.
- D. Provide fuses in fusible switches; refer to Section 26 2813 for product requirements.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 4000.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.17. The insulation-resistance test on control wiring listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective controllers or associated components.

3.04 ADJUSTING

- A. Make final adjustments to installed controller to assure proper operation of load system. Obtain performance requirements from installer of driven loads.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of controllers in automatic and manual modes.

3.06 MAINTENANCE

- A. Provide service and maintenance of controllers for one year from Date of Substantial Completion.

END OF SECTION

SECTION 23 0533
HEAT TRACING FOR HVAC PIPING

PART 2 PRODUCTS

END OF SECTION

SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 DESCRIPTION

- A. Intent:
 - 1. All equipment, piping, ductwork and electrical distribution as noted on the equipment schedule or in the specification shall be mounted using 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 for the Project 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 life-safety, plumbing, mechanical and electrical building system components in place during a seismic event.
 - 4. All such systems shall be installed in strict accordance with seismic codes, component manufacturer's requirements and building construction standards. Whenever a conflict occurs between the manufacturer's requirements 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. Any variance or non-compliance with these specification requirements shall be corrected in an Architect Engineer approved manner and without additional expense to the Owner.
 - 7. Seismic restraints shall be designed in accordance with seismic design criteria as indicated on drawings and ASCE 7 chapter 13.
- B. The work in this section includes, but is not limited to the following:
 - 1. Vibration isolation for piping, ductwork and equipment.
 - 2. Equipment isolation bases.
 - 3. Flexible piping connections.
 - 4. Seismic restraints for isolated equipment.
 - 5. Seismic restraints for non-isolated equipment.
 - 6. Certification of seismic restraint designs and installation supervision.
 - 7. Certification of seismic attachment of housekeeping pads.
 - 8. All life-safety, plumbing, mechanical and electrical systems. Equipment buried underground is excluded but entry of services through the foundation wall is included.

1.03 RELATED SECTIONS

- A. Section 21 0548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
- B. Section 22 05 48 - Plumbing Vibration Isolation And Seismic Restraint.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems: Vibration isolation and seismic restraint.

1.04 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASHRAE (HVAC) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2002.

- D. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- E. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- G. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.06 CODE AND STANDARDS REQUIREMENTS

- A. Applicable codes and standards are referenced on the drawings.
- B. ASCE 7, Chapter 13.

1.07 MANUFACTURER'S RESPONSIBILITY

- 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 unisolated equipment.
 4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.08 RELATED WORK

- A. Housekeeping Pads:
 1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the supplier of restraints, if not already indicated on the drawings.
 2. Housekeeping pads shall be coordinated with the supplier of restraints and sized to provide a minimum edge distance of ten (10) 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: Provide supplementary support steel for all equipment, piping, ductwork, etc. including roof mounted equipment, as required or specified.
- C. Attachments: Provide 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

2.01 INTENT

- A. All vibration isolators and seismic restraints described in this section shall be the product of a single manufacturer.
 1. Mason Industries, www.mason-ind.com, products are the basis of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with the specification and have the approval of the Architect Engineer.
 2. Substitutions: See Section 01 6000 - Product Requirements.
 3. Submittals and certification sheets shall be in accordance with paragraph Submittals.
 4. 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 inch (3 mm) and/or horizontal permanent deformation greater than 1/4 inch (6 mm).

2.02 PRODUCT DESCRIPTIONS

- A. Vibration Isolators and Seismic Restraints:
 1. Type 1: Two layers of 3/4 inch (19 mm) thick neoprene pad consisting of 2 inches (50 mm) square waffle modules separated horizontally by a 1/16 inch (1.5 mm) gauge

- galvanized shim. Load distribution plates shall be used as required. Pads shall be equal to type Super W as manufactured by Mason Industries, Inc.
2. Type 2: Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2 inch (5 mm) 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 be UL listed for seismic restraint. Mountings shall be equal to type BR as manufactured by Mason Industries, Inc.
 3. Type 3: Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between 2 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 3 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 equal to type PB as manufactured by Mason Industries, Inc.
 4. Type 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 equal to type HG as manufactured by Mason Industries, Inc.
 5. Type 5: Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4 inch (6 mm) neoprene acoustical friction pad between the base plate and the support. All mountings shall have leveling bolts that shall be rigidly bolted to the equipment. Spring diameters shall be no less than 80% 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 equal to type SLF as manufactured by Mason Industries, Inc.
 6. Type 6: Restrained spring mountings shall have an SLF mounting as described in Type 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. Installed and operating heights are equal. A minimum clearance of 1/2 inch (12 mm) shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Restraining Bolts shall have a neoprene bushing between the bolt and the housing. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there shall be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall be UL listed for seismic restraint. Mountings shall be equal to type SLR or SLRS as manufactured by Mason Industries, Inc.
 7. Type 7: Spring mountings as in Type 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 1/4 inch (6 mm) travel in all directions before contacting the resilient snubbing collars. Mountings shall be UL listed for seismic restraint. Mountings shall be equal to type SSLFH as manufactured by Mason Industries, Inc.
 8. Type 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 inch (3 mm). Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician. Air Springs shall be equal to type MT and leveling valves equal to type LV as manufactured by Mason Industries, Inc.
 9. Type 9: Restrained air spring mountings shall have an MT air spring as described in Type 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 1/2 inch (12 mm) 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 equal to type SLR-MT as manufactured by Mason Industries, Inc.

10. Type 10: Hangers shall consist of rigid steel frames containing minimum 1-1/4 inch (32 mm) thick neoprene elements at the top and a steel spring with general characteristics as in Type 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-degree arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability. Hangers shall be equal to type 30N as manufactured by Mason Industries, Inc.
 - a. Type 10A: Hangers shall be as described in Type 10, but they shall be supplied with a combination rubber and steel rebound washer as the seismic upstop for suspended piping, ductwork, equipment and electrical cable trays. Rubber thickness shall be a minimum of 1/4 inch (6 mm). Submittals shall include a drawing of the hanger showing the installation of the rebound washer. Hangers shall be equal to type RW30N as manufactured by Mason Industries, Inc.
11. Type 11: Hangers shall be as described in Type 10, 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-degree capability. Hangers shall be equal to type PC30N as manufactured by Mason Industries, Inc.
12. Type 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. Cables shall be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables shall not be allowed to bend across sharp edges. Cable assemblies shall be UL listed for seismic restraint. At trapeze anchor locations piping shall be shackled to the trapeze. Cable assemblies shall be equal to type SCB at the ceiling and at the clevis bolt, equal to SCBH between the hanger rod nut and the clevis or equal to SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc.
13. Type 13: Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 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 preapproval OPA number from OSHPD in the state of California verifying the maximum certified load ratings. At trapeze anchor locations piping shall be shackled to the trapeze. Solid seismic brace assemblies shall be equal to type SSB, SSBS or SSRF as manufactured by Mason Industries, Inc.
14. Type 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 Preapproval OPA Number from OSHPD in the State of California. At trapeze anchor locations piping shall be shackled to the trapeze. Rod clamp assemblies shall be equal to type SRC or UC as manufactured by Mason Industries, Inc.
15. Type 15: Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing

- over the cross bolt. Clevis cross braces shall be UL listed for seismic restraint. Clevis cross brace shall be equal to type CCB as manufactured by Mason Industries, Inc.
16. Type 16: All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4 inch (6 mm) thick. Rated loadings shall not exceed 1000 psi (70.3 kg/sq-cm). A minimum air gap of 1/8 inch (3 mm) 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 be UL listed for seismic restraint. Snubber shall be equal to type Z-1225 as manufactured by Mason Industries, Inc.
 17. Type 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 3/4 inch (19 mm) thick. Rated loadings shall not exceed 1000 psi (70.3kg/sq-cm). Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch (3 mm) nor more than 1/4 inch (6 mm). Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8 inch (9 mm) 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 1/2 inch (12 mm) deflection in the x, y and z planes. Snubbers shall have an anchorage preapproval OPA number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be equal to type Z-1011 as manufactured by Mason Industries, Inc.
 18. Type 18: Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is rolled 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 ICC Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be equal to type SAS as manufactured by Mason Industries, Inc.
 19. Type 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 ICC Evaluation Service, Inc. verifying its allowable loads. Drill-in female wedge anchors shall be equal to type SAB as manufactured by Mason Industries, Inc.
 20. Type 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 inches (350 mm) provided that deflection and misalignment are limited to values that are acceptable to the . Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch (25 mm). Bases shall be equal to type WF as manufactured by Mason Industries, Inc.
 21. Type 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. Base depth shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches (150 mm). The base depth need not exceed 12 inches (300 mm) unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2 inch (12 mm) bars welded in place on 6 inches (150 mm) centers running both ways in a layer 1-1/2 inches (38 mm) 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 inch (25 mm) clearance below the base. Wooden formed bases leaving a concrete rather

- than a steel finish are not acceptable. Base shall be equal to type BMK or K as manufactured by Mason Industries, Inc.
22. Type 22: Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal or structural steel sections containing adjustable and removable steel springs that support the upper floating section. The upper frame shall provide continuous support for the equipment and shall be captive so as to resiliently resist wind and seismic forces. All directional neoprene snubber bushings shall be a minimum of 1/4 inch (6 mm) thick. Steel springs shall be laterally stable and rest on 1/4 inch (6 mm) thick neoprene acoustical pads. Hardware shall be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous flexible flashing nailed over the lower curbs waterproofing. All spring locations shall have accessibility to adjust springs. Lower curbs shall have provision for 2 inch (50 mm) of insulation. The roof curbs shall be built to seismically contain the rooftop unit. The unit shall be solidly fastened to the top floating rail, and the lower section anchored to the roof structure. Curb shall be UL listed for seismic restraint. Curb shall be equal to type SRSC or RMSS as manufactured by Mason Industries, Inc.
23. Type 23: Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Kevlar® tire cord frictioning. Any substitutions shall have equal or superior physical and chemical characteristics. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2 inches (50 mm) and larger shall have two spheres reinforced with a ductile iron external ring between spheres. Flanges shall be split ductile iron or steel with hooked or similar interlocks. Sizes 16 inches (400 mm) to 24 inches (600 mm) may be single sphere. Sizes 3/4 inch (19 mm) to 1-1/2 inches (38 mm) may have threaded two piece bolted flange assemblies, one sphere and cable retention. Connectors shall be rated at 250 psi (1.72 MPa) up to 170 degrees F (77 degrees C) with a uniform drop in allowable pressure to 215 psi (1.48 MPa) at 250 degrees F (121 degrees C) in sizes through 14 inches (350 mm). 16 inches (400 mm) through 24 inches (600 mm) single sphere minimum ratings are 180 psi (1.24 MPa) at 170 degrees F (77 degrees C) and 150 psi (1.03 MPa) at 250 degrees F (121 degrees C). Higher rated connectors may be used to accommodate service conditions. All expansion joints shall be factory tested to 150% of rated pressure for 12 minutes before shipment. Safety factors to burst and flange pullout shall be a minimum of 3:1. Concentric reducers to the above ratings may be substituted for equal ended expansion joints.
- a. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods shall be used in unanchored piping locations. If control rods are used, they shall have 1/2 inch (12 mm) thick Neoprene washer bushings large enough in diameter to take the thrust at 1000 psi (70.3 kg/sq-cm) maximum on the washer area.
- b. 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 actual blade passage frequencies on this project. All expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be equal to type SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.
24. Type 24: Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3 inches (75 mm) and larger shall be flanged. Smaller sizes shall have male nipples.
- a. Minimum lengths shall be as follows:
- 1) Flanged:
- (a) 3 inches x 14 inches (75 by 350 mm)
- (b) 4 inches x 15 inches (100 by 375 mm)
- (c) 5 inches x 19 inches (125 by 475 mm)
- (d) 6 inches x 20 inches (150 by 500 mm)
- (e) 8 inches x 22 inches (200 by 550 mm)
- (f) 10 inches x 26 inches (250 by 650 mm)

- (g) 12 inches x 28 inches (300 by 700 mm)
 - (h) 14 inches x 30 inches (350 by 750 mm)
 - (i) 16 inches x 32 inches (400 by 800 mm)
- 2) Male Nipples:
- (a) 1/2 inch x 9 inches (12 by 225 mm)
 - (b) 3/4 inch x 10 inches (19 by 250 mm)
 - (c) 1 inch x 11 inches (25 by 275 mm)
 - (d) 1-1/4 inches x 12 inches (32 by 300 mm)
 - (e) 1-1/2 inches x 13 inches (38 by 325 mm)
 - (f) 2 inches x 14 inches (50 by 350 mm)
 - (g) 2-1/2 inches x 18 inches (64 by 450 mm)
- b. 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 equal to type BSS as manufactured by Mason Industries, Inc.
25. Type 25: All-directional acoustical pipe anchor shall consist of two sizes of steel tubing separated by a minimum 1/2 inch (12 mm) 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 (35.2 kg/sq-cm) and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be equal to type ADA as manufactured by Mason Industries, Inc.
26. Type 26: Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2 inch (12 mm) 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 reinsertable to allow for selection of pipe movement. Guides shall be capable of plus or minus 1-5/8 inches (41 mm) motion, or to meet location requirements. Pipe guides shall be equal to type VSG as manufactured by Mason Industries, Inc.
27. Type 27: Split Wall Seals consist of two bolted pipe halves with minimum 3/4 inch (19 mm) 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 inch (25 mm) past either face of the wall. Where temperatures exceed 240 degrees F (115 degrees C), 10 pounds per cubic foot (160 kg/cu. m) density fiberglass may be used in lieu of the sponge. Seals shall be equal to type SWS as manufactured by Mason Industries, Inc.
28. Type 28: The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in Type 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 1/4 inch (6 mm) movement at start and stop. The assembly shall be furnished with 1 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 equal to type WBI/WBD as manufactured by Mason Industries, Inc.
29. Type 29: Housekeeping pad anchors shall consist of a ductile iron casting that is tapered and hexagonal, smaller at its base than at its top. The upper portion shall have holes for rebar to pass through. The anchor shall be continuously threaded from top to bottom for the attachment of soleplates. Housekeeping pad anchors shall be attached to the structural slab using a stud wedge anchor. Housekeeping pad anchors shall be equal to type HPA and stud wedge anchor shall be equal to type SAS both as manufactured by Mason Industries, Inc.

PART 3 EXECUTION

3.01 GENERAL

- A. All vibration isolators and seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic restraints shall 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. Do not install any equipment, piping, duct or conduit which 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 which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the Architect Engineer's attention prior to installation. Corrective work required by conflicts after installation shall be at no additional cost to the Owner.
- G. Bring to the Architect Engineer's attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work required by discrepancies after installation shall be at no additional cost to the Owner.
- H. Correct all installations which are deemed defective in workmanship and materials at no additional cost to the Owner.
- I. Overstressing of the building structure shall not occur because of overhead support of equipment. Submit loads to the structural engineer of record for approval. Generally bracing may occur from:
 - 1. Flanges of structural beams.
 - 2. Panel points in bar joist construction.
 - 3. Cast in place inserts or wedge type drill-in concrete anchors.
- J. Type 12 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- K. Type 12 cable assemblies are installed taut on non-isolated systems. Type 13 seismic solid braces may be used in place of cables on rigidly attached systems only.
- L. At locations where Type 12 or Type 13 restraints are located, the support rods shall be braced when necessary to accept compressive loads with Type 14 braces.
- M. At locations where Type 12 cable restraints are installed on support rods with spring isolators, the spring isolation hangers shall be Type 10A.
- N. At all locations where Type 12 or Type 13 restraints are attached to pipe clevis's, the clevis cross bolt shall be reinforced with Type 15 braces.
- O. Drill-in concrete anchors for ceiling and wall installation shall be Type 18, and 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 inches or specified movements exceed Type 23 capabilities.
- R. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide Type 27 wall seals.
- S. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraint shall be Type 28.

- T. Locate isolation hangers as near to the overhead support structure as possible.
- U. All fire protection piping shall be braced in accordance with NFPA 13 and 14.
- V. All mechanical equipment shall be vibration isolated and seismically restrained as per the schedules shown on the drawings.
- W. All fire protection equipment is considered life safety equipment and shall be seismically restrained using the seismic force levels calculated for life safety equipment according to the codes and standards shown on Structural Drawings.
- X. VAV boxes and fan powered equipment weighing less than 50 pounds (23 kg) and rigidly connected to the supply side of the duct system and supported with a minimum of 4 hanger rods.

3.02 VIBRATION ISOLATION OF PIPING

- A. Horizontal Pipe Isolation: The first four pipe hangers in the main lines near the mechanical equipment shall be as described in Type 11. Brace hanger rods with SRC clamps Type 14. Horizontal runs in all other locations throughout the building shall be isolated by hangers as described in Type 10 & Type 10A. Floor supported piping shall rest on isolators as described in Type 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 inch (19 mm) deflection for pipe sizes up to and including 3 inch (75 mm), 1-1/2 inch (38 mm) deflection for pipe sizes up to and including 6 inch (150 mm), and 2-1/2 inch (64 mm) deflection for pipes larger than 6 inch (150 mm). Hangers shall be located as close to the overhead structure as practical. Hanger locations that also have seismic restraints attached shall have type RW Rebound Washers to limit uplift. Where piping connects to mechanical equipment install Type 23 expansion joints or Type 24 stainless hoses as required for the service.
- B. Riser Isolation: Risers shall be suspended from Type 10A hangers or supported by Type 5 mountings, anchored with Type 25 anchors, and guided with Type 26 sliding guides. Steel springs shall be a minimum of 0.75 inch (19 mm) except in those expansion locations where additional deflection is required to limit load changes to plus or minus 25 percent of the initial load. Submittals shall 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.
- C. Seismic Restraint of Piping:
 - 1. Seismically restrain all piping listed as a, b or c below. Use Type 12 cables if isolated. Type 12 or Type 13 restraints may be used on unisolated piping.
 - a. Fuel oil piping, gas piping, medical gas piping, and compressed air piping that is 1 inch (25 mm) I.D. or larger.
 - b. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1-1/4 inch (32 mm) I.D. and larger.
 - c. All other piping 2-1/2-inch (64 mm) diameter and larger.
 - 2. Transverse piping restraints shall be at 40 feet (12 m) maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 - 3. Longitudinal restraints shall be at 80 feet (24 m) maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 - 4. 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.
 - 5. For fuel oil and all gas piping transverse restraints shall be at 20 feet (6 m) maximum and longitudinal restraints at 40 feet (12 m) maximum spacing.

6. 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 inches (600 mm) of the elbow or TEE or combined stresses are within allowable limits at longer distances.
 7. Hold down clamps shall be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
 8. Branch lines may not be used to restrain main lines.
 9. Cast iron pipe of all types, glass pipe and any other pipes joined with a four band shield and clamp assembly in areas with S_s of 0.35 or greater shall be braced as in Sections 3.02.C.2 and 3.02.C.3. For areas with S_s less than 0.35, 2 band clamps may be used with a reduced spacing of 1/2 of those listed in sections 3.02.C.2 and 3.02.C.3.
 10. Connection to the structure shall be made with a non-friction connection (i.e. no C-clamps).
 11. Hanger locations that also have seismic restraints attached shall have Type 10A RW Rebound Washers.
- D. Pipe Exclusions:
1. Gas piping less than 1 inch (25 mm) inside diameter.
 2. Piping in boiler and mechanical rooms less than 1-1/4 inch (32 mm) inside diameter.
 3. All other piping less than 2-1/2 inch (64 mm) inside diameter.
 4. Certain suspended piping:
 - a. All piping suspended by clevis hangers where the distance from the top of the pipe to the suspension point is 12 inches or less.
 - b. All trapeze supported piping where the distance from the suspension point to the trapeze member is 12-inch or less.
 - c. If any suspension location in the run fails to qualify under (a) or (b) above, the entire run shall be braced.

3.03 VIBRATION ISOLATION AND SEISMIC RESTRAINT OF DUCTWORK

- A. Vibration isolation of ductwork:
1. All discharge runs for a distance of 50 feet (15m) from the connected equipment shall be isolated from the building structure by means of Type 10 hangers or Type 5 floor isolators. Spring deflection shall be a minimum of 0.75 inch (19 mm).
 2. All duct runs having air velocity of 1000 fpm (5 m/s) or more shall be isolated from the building structure by Type 11 hangers or 5 floor supports. Spring deflection shall be a minimum of 0.75 inch (19 mm).
- B. Seismic restraint of ductwork:
1. Seismically restrain all ductwork with Type 12 or Type 13 restraints as listed below:
 - a. Restrain rectangular ducts with cross sectional area of 6 sq. ft. (0.5 sq m) or larger.
 - b. Restrain round ducts with diameters of 28 inches (700 mm) or larger.
 - c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
 2. Transverse restraints shall occur at 30 feet (9 mm) 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.
 3. Longitudinal restraints shall occur at 60 feet (18 m) 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 4 feet (1.2 m) 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.
 4. The ductwork shall 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.
 5. 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.

6. Walls, including gypsum board non bearing partitions, which have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
 7. Connection to the structure shall be made with a non-friction connection (i.e. no C-clamps)
 8. Hanger locations that also have seismic restraints attached shall have Type 10A RW Rebound Washers.
- C. Ductwork Exclusions:
1. Rectangular and square and ducts that are less than 6 square feet in cross sectional area.
 2. Oval ducts that are less than 6 square feet (0.5 sq m) in cross sectional area based on nominal size.
 3. Round duct less than 28-inch (0.71 m) diameter.
 4. Certain suspended ductwork
 - a. All trapeze supported ductwork where the distance from the suspension point to the trapeze member is 12-inches or less.
 - b. Ductwork hung with straps where the top of the duct is 12-inches or less from the suspension point and the strap has 2 #10 sheet metal screws within 2-inch of the top of the duct.
 - c. If any suspension location in the run fails to qualify under (a) or (b) above, the entire run shall be braced.

3.04 ELECTRICAL SERVICES

- A. Seismic Restraint:
1. All electrical conduit 2-1/2-inch (64 mm) in diameter and larger shall be restrained with Type 12 seismic cable restraints or Type 13 for seismic solid brace restraints.
 2. All electrical bus ducts, cable trays and ladder trays shall be restrained with Type 12, seismic cable restraints or Type 13 seismic solid brace restraints.
 3. Transverse restraints shall occur at 30 feet (9 m) intervals or both ends if the electrical run is less than the specified interval. Transverse restraints shall be installed at each electrical services turn and at each end of the electric run.
 4. Longitudinal restraints shall occur at 60 feet (18 m) intervals with at least one restraint per electric run. Transverse restraints for one electric section may also act as a longitudinal restraint for a duct for an electric section connected perpendicular to it if the restraints are installed within 4 feet (1.2 m) of the intersection of the electric run and if the restraints are sized for the larger electric run.
 5. All floor mounted transformers, motor starters, switchgears and substations shall have a resilient media between the equipment mounting hole and the anchor bolt. Anchor bolts shall be designed in accordance with seismic forces shown on Structural Drawings. Neoprene bushings shall be Type 4 and anchor bolts shall be Type 18 or Type 19.
 6. Wall mounted panels, transformers and motor starters shall be mounted with Type 3 bushings. Floor mounted panels shall be mounted on Type 4 bushings. Anchor bolts shall be Type 18 or Type 19.
 7. All generators shall be mounted on a Type 21 concrete inertia base, with Type 5 spring isolators and Type 17 seismic snubbers.
 8. Connection to the structure shall be made with a non-friction connection (i.e. no C-clamps)
- B. Exclusions:
1. All conduit less than 2-1/2 inches (64 mm) diameter suspended by individual hanger rods.
 2. Certain Suspended Conduit:
 - a. All conduits suspended by clevis hangers where the distance from the top of the conduit to the suspension point is 12 inches (300 mm) or less.
 - b. All trapeze supported conduits, bus ducts and cable trays where the distance from the suspension point to the trapeze member is 12 inches (300 mm) or less.
 - c. If any suspension location in the run fails to qualify under (a) or (b) above, the entire run shall be braced.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Ceiling tacks.

1.03 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Identification painting.

1.04 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Tags.
- C. Automatic Controls: Tags. Key to control schematic.
- D. Control Panels: Nameplates.
- E. Dampers: Ceiling tacks, where located above lay-in ceiling.
- F. Ductwork: Nameplates.
- G. Heat Transfer Equipment: Nameplates.
- H. Instrumentation: Tags.
- I. Major Control Components: Nameplates.
- J. Piping: Tags.
- K. Pumps: Nameplates.
- L. Small-sized Equipment: Tags.
- M. Tanks: Nameplates.
- N. Thermostats: Nameplates.
- O. Valves: Tags and ceiling tacks where located above lay-in ceiling.

P. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

- A. Manufacturers:
- B. Letter Color: White.
- C. Letter Height: 1/4 inch.
- D. Background Color: Black.
- E. Plastic: Comply with ASTM D709.

2.03 TAGS

- A. Manufacturers:
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
 - 6. Ductwork and Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: Semi-gloss enamel, colors conforming to ASME A13.1.

2.05 PIPE MARKERS

- A. Color: Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

2.06 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 9123 for stencil painting.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 9123.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Pipe Marker Placement. Pipe markers should be located as follows:
 - 1. At intervals of not more than 20 feet
 - 2. At least once in or above every room
 - 3. On both sides of walls or partitions penetrated by the piping
 - 4. At least once in every story height traversed by risers
 - 5. Adjacent to each valve port and flange end.
- G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- H. Use tags on piping 3/4 inch diameter and smaller.
- I. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- J. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Duct Air Leakage Testing
- C. Testing, adjustment, and balancing of hydronic and refrigerating systems.
- D. Measurement of final operating condition of HVAC systems.
- E. Commissioning activities.

1.03 RELATED REQUIREMENTS

- A. Section 01 4000 - Quality Requirements: Employment of testing agency and payment for services.
- B. Section 01 9113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- C. Section 23 0800 - Commissioning of HVAC.

1.04 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, with Errata (2017).
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect Engineer.
 - 2. Submit to the Commissioning Authority.
 - 3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 4. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect Engineer and other installers to sufficiently understand the design intent for each system.
 - 5. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - d. Final test report forms to be used.
 - e. Expected problems and solutions, etc.

- f. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Submit to the the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect Engineer and for inclusion in operating and maintenance manuals.
 - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
 - 7. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Contractor.
 - g. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. SMACNA (TAB).
 - 4. NEBB (TAB)
 - 5. Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Fire and volume dampers are in place and open.
 8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage is minimized.
 12. Hydronic systems are flushed, filled, and vented.
 13. Pumps are rotating correctly.
 14. Proper strainer baskets are clean and in place.
 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.06 DUCT AIR LEAKAGE TESTING (DALT)

- A. TAB Agency shall perform the leakage test as outlined in "Duct leakage Tests and Repairs" in Section 23 31 00 HVAC DUCTS and CASINGS for TAB agency's role and responsibilities in witnessing, recording and reporting of deficiencies.

3.07 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, at minimum air flow rate, and full heating air flow rate.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.08 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of VFD (where present), balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.09 COMMISSIONING

- A. See Sections 01 9113 - General Commissioning Requirements and 23 0800 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
 - 1. Air side systems.
 - 2. Water side systems.
- D. Witness and verify DALT per 23 3100 - HVAC Ducts and Casings.

- E. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- F. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 100 percent of the air handlers.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:
 - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading.
 - c. Temperatures: Deviation of more than one degree F.
 - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
 - 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- G. In the presence of the Commissioning Authority, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
 - 3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.10 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Boilers
 - 2. HVAC Pumps.
 - 3. Forced Air Furnaces.
 - 4. Direct Fired Furnaces.
 - 5. Air Cooled Water Chillers.
 - 6. Induced Draft Cooling Tower.
 - 7. Packaged Roof Top Heating/Cooling Units.
 - 8. Computer Room Air Conditioning Units.
 - 9. Air Coils.
 - 10. Terminal Heat Transfer Units.
 - 11. Air Handling Units.
 - 12. Air Terminal Units.

3.11 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:

1. Manufacturer.
 2. Model/Frame.
 3. HP/BHP.
 4. Phase, voltage, amperage; nameplate, actual, no load.
 5. RPM.
 6. Service factor.
 7. Starter size, rating, heater elements.
 8. Sheave Make/Size/Bore.
- B. V-Belt Drives:
1. Identification/location.
 2. Required driven RPM.
 3. Driven sheave, diameter and RPM.
 4. Belt, size and quantity.
 5. Motor sheave diameter and RPM.
 6. Center to center distance, maximum, minimum, and actual.
- C. Pumps:
1. Identification/number.
 2. Manufacturer.
 3. Size/model.
 4. Impeller.
 5. Service.
 6. Design flow rate, pressure drop, BHP.
 7. Actual flow rate, pressure drop, BHP.
 8. Discharge pressure.
 9. Suction pressure.
 10. Total operating head pressure.
 11. Shut off, discharge and suction pressures.
 12. Shut off, total head pressure.
- D. Combustion Equipment:
1. Boiler manufacturer.
 2. Model number.
 3. Serial number.
 4. Firing rate.
 5. Heat input.
 6. Ambient temperature.
 7. Heat output.
- E. Air Cooled Condensers:
1. Identification/number.
 2. Location.
 3. Manufacturer.
 4. Model number.
 5. Serial number.
 6. Entering DB air temperature, design and actual.
 7. Leaving DB air temperature, design and actual.
 8. Number of compressors.
- F. Chillers:
1. Identification/number.
 2. Manufacturer.
 3. Capacity.
 4. Model number.
 5. Serial number.
 6. Evaporator entering water temperature, design and actual.

7. Evaporator leaving water temperature, design and actual.
 8. Evaporator pressure drop, design and actual.
 9. Evaporator water flow rate, design and actual.
 10. Condenser entering water temperature, design and actual.
 11. Condenser pressure drop, design and actual.
 12. Condenser water flow rate, design and actual.
- G. Cooling Tower:
1. Tower identification/number.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Rated capacity.
 6. Entering air WB temperature, specified and actual.
 7. Leaving air WB temperature, specified and actual.
 8. Ambient air DB temperature.
 9. Condenser water entering temperature.
 10. Condenser water leaving temperature.
 11. Condenser water flow rate.
- H. Heat Exchangers:
1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Model number.
 6. Serial number.
 7. Steam pressure, design and actual.
 8. Primary water entering temperature, design and actual.
 9. Primary water leaving temperature, design and actual.
 10. Primary water flow, design and actual.
 11. Primary water pressure drop, design and actual.
 12. Secondary water leaving temperature, design and actual.
 13. Secondary water flow, design and actual.
 14. Secondary water pressure drop, design and actual.
- I. Cooling Coils:
1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Entering air DB temperature, design and actual.
 7. Entering air WB temperature, design and actual.
 8. Leaving air DB temperature, design and actual.
 9. Leaving air WB temperature, design and actual.
 10. Water flow, design and actual.
 11. Water pressure drop, design and actual.
 12. Entering water temperature, design and actual.
 13. Leaving water temperature, design and actual.
 14. Saturated suction temperature, design and actual.
 15. Air pressure drop, design and actual.
- J. Heating Coils:
1. Identification/number.
 2. Location.
 3. Service.

4. Manufacturer.
 5. Air flow, design and actual.
 6. Water flow, design and actual.
 7. Water pressure drop, design and actual.
 8. Entering water temperature, design and actual.
 9. Leaving water temperature, design and actual.
 10. Entering air temperature, design and actual.
 11. Leaving air temperature, design and actual.
 12. Air pressure drop, design and actual.
- K. Air Moving Equipment:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Arrangement/Class/Discharge.
 6. Air flow, specified and actual.
 7. Return air flow, specified and actual.
 8. Outside air flow, specified and actual.
 9. Total static pressure (total external), specified and actual.
 10. Inlet pressure.
 11. Discharge pressure.
 12. Sheave Make/Size/Bore.
 13. Number of Belts/Make/Size.
 14. Fan RPM.
- L. Return Air/Outside Air:
1. Identification/location.
 2. Design air flow.
 3. Actual air flow.
 4. Design return air flow.
 5. Actual return air flow.
 6. Design outside air flow.
 7. Actual outside air flow.
 8. Return air temperature.
 9. Outside air temperature.
 10. Required mixed air temperature.
 11. Actual mixed air temperature.
 12. Design outside/return air ratio.
 13. Actual outside/return air ratio.
- M. Exhaust Fans:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.
- N. Duct Traverses:
1. System zone/branch.
 2. Duct size.

3. Area.
 4. Design velocity.
 5. Design air flow.
 6. Test velocity.
 7. Test air flow.
 8. Duct static pressure.
 9. Air temperature.
 10. Air correction factor.
- O. Duct Leak Tests:
1. Description of ductwork under test.
 2. Duct design operating pressure.
 3. Duct design test static pressure.
 4. Duct capacity, air flow.
 5. Maximum allowable leakage duct capacity times leak factor.
 6. Test apparatus:
 - a. Blower.
 - b. Orifice, tube size.
 - c. Orifice size.
 - d. Calibrated.
 7. Test static pressure.
 8. Test orifice differential pressure.
 9. Leakage.
- P. Air Monitoring Stations:
1. Identification/location.
 2. System.
 3. Size.
 4. Area.
 5. Design velocity.
 6. Design air flow.
 7. Test velocity.
 8. Test air flow.
- Q. Flow Measuring Stations:
1. Identification/number.
 2. Location.
 3. Size.
 4. Manufacturer.
 5. Model number.
 6. Serial number.
 7. Design Flow rate.
 8. Design pressure drop.
 9. Actual/final pressure drop.
 10. Actual/final flow rate.
 11. Station calibrated setting.
- R. Terminal Unit Data:
1. Manufacturer.
 2. Type, constant, variable, single, dual duct.
 3. Identification/number.
 4. Location.
 5. Model number.
 6. Size.
 7. Minimum static pressure.
 8. Minimum design air flow.
 9. Maximum design air flow.

10. Maximum actual air flow.
11. Inlet static pressure.

END OF SECTION

SECTION 23 0713
DUCT INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Insulation jackets.

1.03 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 8400 - Firestopping.
- C. Section 09 9123 - Interior Painting: Painting insulation jackets.
- D. Section 23 0553 - Identification for HVAC Piping and Equipment.
- E. Section 23 3100 - HVAC Ducts and Casings.

1.04 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- H. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).
- I. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2008.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- K. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- L. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).
- N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 250 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- B. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure sensitive tape.
- C. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- D. Outdoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- E. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter.

2.03 GLASS FIBER, RIGID

- A. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. 'K' Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent.
 - 4. Maximum Density: 8.0 lb/cu ft.
- B. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

3. Secure with pressure sensitive tape.
- C. Vapor Barrier Tape:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- D. Indoor Vapor Barrier Finish:
 1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 JACKETS

- A. Exterior insulation jackets for outside applications shall be a multi-ply embossed UV-resistant aluminum foil/polymer laminate with a layer of rubberized asphalt specially formulated for use on insulated duct. The jacket will include a metalized polyester film coated with a high quality low temperature acrylic adhesive that allows for a peel and stick functionality.
- B. Aluminum (Indoor) Jacket: ASTM B209 (ASTM B209M).
 1. Thickness: 0.016 inch sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 2 inch laps.
 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
 6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

2.05 DUCT LINER

- A. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
 1. Fungal Resistance: No growth when tested according to ASTM G21.
 2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
 3. Service Temperature: Up to 250 degrees F.
 4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
 5. Minimum Noise Reduction Coefficients:
 - a. 1/2 inch Thickness: 0.30.
 - b. 1 inch Thickness: 0.45.
 - c. 1-1/2 inches Thickness: 0.60.
 - d. 2 inch Thickness: 0.70.
- B. Adhesive: Waterproof, fire-retardant type, ASTM C916.
- C. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that ducts have been sealed and air leak tested per Section 23 3100 - HVAC Ducts and Casings before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated ducts conveying air below ambient temperature:
 1. Provide insulation with vapor barrier jackets.
 2. Finish with tape and vapor barrier jacket.
 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated ducts conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.
 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- F. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 2. Secure insulation without vapor barrier with staples, tape, or wires.
 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- G. Duct and Plenum Liner Application:
1. Adhere insulation with adhesive for 90 percent coverage.
 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
 3. Seal and smooth joints. Seal and coat transverse joints.
 4. Seal liner surface penetrations with adhesive.
 5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES

- A. Supply Ducts: 2" Glass Fiber, Flexible
- B. Return Ducts: 2" Glass Fiber, Flexible
- C. Relief Ducts in Mechanical Rooms: 2" Glass Fiber, Flexible
- D. Ducts Exposed to Outdoors: 2" Glass Fiber, Rigid with Exterior Insulation Jacket.
- E. Supply Ducts From Fans to Vertical Ducts in Shafts (Cooling System): 2"
- F. Exhaust Ducts: Not required.

END OF SECTION

SECTION 23 0719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jackets and accessories.

1.03 REFERENCE STANDARDS

- A. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020a.
- C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.
- D. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, RIGID

- A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.

- B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. Maximum Service Temperature: 650 degrees F.
 - 2. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- G. Fibrous Glass Fabric:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Blanket: 1.0 lb/cu ft density.
 - 3. Weave: 5 by 5.
- H. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- I. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- J. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- K. Insulating Cement: ASTM C449.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 180 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETS

- A. PVC Plastic:
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive.
 - 2. Covering Adhesive Mastic: Compatible with insulation.
- B. ABS Plastic:
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F.
 - b. Maximum Service Temperature: 180 degrees F.
 - c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil.
 - e. Connections: Brush on welding adhesive.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch sheet.

2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. Glass fiber insulated pipes conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature.
 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
 1. Application: Piping 1-1/2 inches diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.
- J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.
- L. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

- A. Heating Systems:
 - 1. Heating Water Supply and Return (141 degrees F to 200 degrees F):
 - a. 1-1/4" pipe and smaller: 1-1/2" Glass Fiber, Rigid
 - b. 1-1/2" and larger: 2" Glass Fiber, Rigid
- B. Cooling Systems:
 - 1. Chilled Water (40 degrees F to 60 degrees F):
 - a. 1-1/4" pipe and smaller: 0.5" Glass Fiber, Rigid.
 - b. 1-1/2" pipe and larger: 1" Glass Fiber, Rigid.
 - 2. Refrigerant Suction: 1" Flexible Elastomeric Insulation.
 - 3. Refrigerant Hot Gas: 1" Flexible Elastomeric Insulation.

END OF SECTION

SECTION 23 0913

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Air Supply System:
- B. Control panels.
- C. Input/Output Sensors:
 - 1. Temperature sensors.
 - 2. Humidity sensors.
- D. Thermostats:
 - 1. Electric room thermostats.
 - 2. Room thermostat accessories.
 - 3. Outdoor reset thermostats.
 - 4. Immersion thermostats.
 - 5. Airstream thermostats.
 - 6. Electric low limit duct thermostats.
 - 7. Electric high limit duct thermostats.
- E. Transmitters:
 - 1. Building static pressure transmitters.

1.03 RELATED REQUIREMENTS

- A. Section 22 0519 - Meters and Gauges for Plumbing Piping: Thermometer sockets and gauge taps.
- B. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 23 0519 - Meters and Gauges for HVAC Piping: Thermometer sockets and gauge taps.
- D. Section 23 0548 - Vibration And Seismic Controls For HVAC Piping And Equipment.
- E. Section 23 0923 - Direct-Digital Control System for HVAC.
- F. Section 23 0993 - Sequence of Operations for HVAC Controls.
- G. Section 23 2113 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, and gauge taps.
- H. Section 23 2213 - Steam and Condensate Heating Piping: Installation of control valves, flow switches, temperature sensor sockets, and gauge taps.
- I. Section 23 3300 - Air Duct Accessories: Installation of automatic dampers.
- J. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.
- K. Section 26 2726 - Wiring Devices: Elevation of exposed components.

1.04 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- C. ASTM B32 - Standard Specification for Solder Metal; 2020.
- D. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- E. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- F. ASTM B819 - Standard Specification for Seamless Copper Tube for Medical Gas Systems; 2019.

- G. ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics; 2021.
- H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- I. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats; 2013.
- J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Samples: Submit two of each type of room thermostat and cover.
- E. Manufacturer's Instructions: Provide for all manufactured components.
- F. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
- G. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- H. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.07 QUALITY ASSURANCE

- A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 AIR SUPPLY SYSTEM

2.03 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- B. NEMA 250, general purpose utility enclosures with enameled finished face panel.
- C. Provide common keying for all panels.

2.04 INPUT/OUTPUT SENSORS

- A. Temperature Sensors:
 - 1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
 - 2. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F.
 - 3. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
 - 4. Temperature Sensing Device: Compatible with project DDC controllers.
 - 5. Performance Characteristics:
 - a. RTD:
 - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F minimum.
 - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F minimum.
 - 3) Chilled Water Accuracy: Plus/minus 0.50 degrees F minimum.
 - 4) All Other Accuracy: Plus/minus 0.75 degrees F minimum.
 - 5) Range: Minus 40 degrees F through 220 degrees F minimum.
 - b. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
 - 2) Range: Minus 25 degrees F through 122 degrees F minimum.
 - 3) Heat Dissipation Constant: 2.7 mW per degree C.
 - c. Temperature Transmitter:
 - 1) Accuracy: 0.10 degree F minimum or plus/minus 0.20 percent of span.
 - 2) Output: 4 to 20 mA.
 - d. Sensing Range:
 - 1) Provide limited range sensors if required to sense the range expected for a respective point.
 - 2) Use RTD type sensors for extended ranges beyond minus 30 degrees F to 230 degrees F.
 - 3) Use temperature transmitters in conjunction with RTD's when RTD's are incompatible with DDC controller direct temperature input.
 - e. Wire Resistance:
 - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
 - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
 - f. Room Sensors: Locking cover .
 - g. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
 - h. Room Security Sensors: Stainless steel cover plate with insulated back and security screws.
 - i. Room Temperature Sensors:
 - 1) Construct for surface or wall box mounting.
 - 2) Provide the following:
 - (a) Setpoint reset slide switch with an adjustable temperature range.
 - (b) Individual heating/cooling setpoint slide switches.

- (c) Momentary override request push button for activation of after-hours operation.
 - (d) Analog thermometer.
 - j. Room Temperature Sensors with Integral Digital Display:
 - 1) Provide a four button keypad with the following capabilities:
 - (a) Indication of space and outdoor temperatures.
 - (b) Display and control fan operation status.
 - (c) Manual occupancy override and indication of occupancy status.
 - (d) Controller mode status.
 - (e) Password enabled setpoint and override modes.
 - k. Temperature Averaging Elements:
 - 1) Use on duct sensors for ductwork 10 sq ft or larger.
 - 2) Use averaging elements where prone to stratification with sensor length 8 ft, or 16 ft.
 - 3) Provide for all mixed air and heating coil discharge sensors regardless of duct size.
 - l. Insertion Elements:
 - 1) Use in ducts not affected by temperature stratification or smaller than 11 sq inches.
 - 2) Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches.
- B. Humidity Sensors:
 - 1. Elements: Accurate within 5 percent full range with linear output.
 - 2. Room Sensors: With locking cover , span of 10 to 60 percent relative humidity.
 - 3. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 - 100 percent relative humidity.
 - 4. Static Pressure Sensors:
 - a. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
 - b. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
 - c. Accuracy: One percent of full scale with repeatability 0.3 percent.
 - d. Output: 0 - 5 vdc with power at 12 to 28 vdc.
 - 5. Equipment Operation Sensors:
 - a. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
 - b. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi.
 - c. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
 - 6. Digital to Pneumatic Transducers:
 - a. Convert plus or minus 12 vdc pulse width modulation outputs to 0 to 20 psi.
 - 7. Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.
 - 8. Carbon Monoxide Detectors:
 - a. Single or multichannel dual level detectors, using solid state sensors with three year minimum life. Sensor replacement shall take maximum 15 minutes. Suitable over temperature range of 23 to 130 degrees F.
 - b. Provide individual indicators and contractors for each level, initially calibrated for 50 ppm and 100 ppm.
 - c. Maximum response time to 100 ppm CO calibration gas: Two minutes.
 - 9. Carbon Dioxide Sensors:
 - a. General: Provide non-dispersive infrared (NDIR) CO2 sensors with integral transducers and linear output.
 - 1) Linear, CO2 Concentration Range Display: 0 to 2000 ppm.

- 2) Full Scale Accuracy: Plus/minus 100 ppm or plus/minus 5 percent of reading which ever is higher.
- 3) Maximum Response Time: 1 minute.
- 4) Analog Output: 0-10 VDC.
- 5) Rated Ambient Conditions:
 - (a) Air Temperature: Range of 32 to 122 degrees F.
 - (b) Relative Humidity: Range of 0 to 95 percent (non-condensing).
- b. Calibration Characteristics:
 - 1) Automatically compensating algorithm for sensor drift due to sensor degradation.
 - 2) Maximum Drift: 2 percent.
 - 3) User calibratable with a minimum calibration interval of 5 years.
- c. Construction:
 - 1) Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
 - 2) Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.

2.05 THERMOSTATS

- A. Electric Room Thermostats:
 1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
 2. Service: Cooling only.
 3. Covers: Locking with set point adjustment, with thermometer.
- B. Room Thermostat Accessories:
 1. Thermostat Covers: Brushed aluminum.
 2. Insulating Bases: For thermostats located on exterior walls.
 3. Thermostat Guards: Metal mounted on separate base.
 4. Adjusting Key: As required for device.
 5. Aspirating Boxes: Where indicated for thermostats requiring flush installation.
- C. Outdoor Reset Thermostats:
 1. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
 2. Scale range: Minus 10 to 70 degrees F.
- D. Immersion Thermostats:
 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.
- E. Airstream Thermostats:
 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
 2. Averaging service remote bulb element: 7.5 feet.
- F. Electric Low Limit Duct Thermostats:
 1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint,
 2. Bulb length: Minimum 20 feet.
 3. Provide one thermostat for every 20 sq ft of coil surface.
- G. Electric High Limit Duct Thermostats:
 1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
 2. Bulb length: Minimum 20 feet.
 3. Provide one thermostat for every 20 sq ft of coil surface.

2.06 TRANSMITTERS

- A. Building Static Pressure Transmitters:

1. One pipe, direct acting, double bell, scale range 0.01 to 6.0 inch wg positive or negative, and sensitivity of 0.0005 inch wg. Transmit electronic signal to receiver with matching scale range.
- B. Pressure Transmitters:
 1. One pipe direct acting indicating type for gas, liquid, or steam service, range suitable for system, proportional electronic output.
- C. Temperature Transmitters:
 1. One pipe, directly proportional output signal to measured variable, linearity within plus or minus 1/2 percent of range for 200 degrees F span and plus or minus 1 percent for 50 degrees F span, with 50 degrees F. temperature range, compensated bulb, averaging capillary, or rod and tube operation on 20 psig input pressure and 3 to 15 psig output.
- D. Humidity Transmitters:
 1. One pipe, directly proportioned output signal to measured variable, linearity within plus or minus 1 percent for 70 percent relative humidity span, capable of withstanding 95 percent relative humidity without loss of calibration.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- F. Ensure installation of components is complementary to installation of similar components.
- G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches above floor. Align with lighting switches and humidistats. Refer to Section 26 2726.
- C. Mount freeze protection thermostats using flanges and element holders.
- D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
- E. Provide separable sockets for liquids and flanges for air bulb elements.
- F. Provide thermostats in aspirating boxes in front entrances.
- G. Provide guards on thermostats in entrances.
- H. Provide valves with position indicators and with pilot positioners where sequenced with other controls.
- I. Provide separate steam valves for each bank of coils. Provide two valves in parallel where steam load exceeds 1500 lb per hr with 1/3 to 2/3 load capacities sequenced with smaller valve opening first.
- J. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors. _____.
- K. Provide isolation (two position) dampers of parallel blade construction.
- L. Provide pilot positioners on pneumatic damper operators sequenced with other controls.

- M. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- N. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- O. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- P. Provide conduit and electrical wiring in accordance with Section 26 0583. Electrical material and installation shall be in accordance with appropriate requirements of .

3.03 MAINTENANCE

- A. Provide service and maintenance of control system for one year from Date of Substantial Completion.
- B. Provide complete service of controls systems, including call backs, and submit written report of each service call.
- C. In addition to normal service calls, make minimum of 4 complete normal inspections of approximately 12 hours duration to inspect, calibrate, and adjust controls.

END OF SECTION

SECTION 23 0923
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. System description.
- B. Operator interface.
- C. Power supplies and line filtering.
- D. Chiller control programs.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2021).
- B. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2019h.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for each system component and software module.
- C. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
 - 3. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 4. Indicate description and sequence of operation of operating, user, and application software.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- E. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
- F. Operation and Maintenance Data:
 - 1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
 - 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

- G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- C. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer's warranty for field programmable micro-processor based units.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Web-based system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- B. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 0913.
- C. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- D. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.02 OPERATOR INTERFACE

- A. PC Based Work Station:
 - 1. Resides on high speed network with building controllers.
 - 2. Connected to server for full access to all system information.
- B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.
- C. BACnet protocol to comply with ASHRAE Std 135.
- D. Hardware:
 - 1. Desktop:
 - a. Computer(s) and display(s) to be provided by DDC controls manufacturer.
 - b. Network Connection:
 - 1) Ethernet interface card.
 - c. System Printer:
 - 1) Printer(s) to be provided by DDC controls manufacturer.
 - 2. Hand Held Device:
 - a. Provide remote system access via PDA with browser agnostic connectivity, including controller point monitor and control access to the following data:
 - 1) Alarm.
 - 2) Summary.
 - 3) Schedule.
 - 4) Trend.
 - b. Provide the capability to view in text list based format.
 - c. Minimum Functionality:
 - 1) Set point adjustment.
 - 2) Alarm acknowledgement.

3) Scheduling.

2.03 CONTROLLERS

A. Building Controllers:

1. General:
 - a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
 - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked controllers.
 - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - e. Utilize real-time clock for scheduling.
 - f. Continuously check processor status and memory circuits for abnormal operation.
 - g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - h. Communication with other network devices to be based on assigned protocol.
2. Communication:
 - a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
 - b. Perform routing when connected to a network of custom application and application specific controllers.
 - c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. Application Specific Controllers:

1. General:
 - a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
 - b. Customized for operation within the confines of equipment served.
 - c. Communication with other network devices to be based on assigned protocol.
2. Communication:
 - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:

- a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
- 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
- C. Input/Output Interface:
 - 1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
 - 2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
 - 3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
 - 4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
 - 5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
 - 6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
 - 7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
 - 8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.

- b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
 - c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
- 9. System Object Capacity:
 - a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
 - b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.04 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies:
 - 1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
 - 2. Limit connected loads to 80 percent of rated capacity.
 - 3. Match DC power supply to current output and voltage requirements.
 - 4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
 - 5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
 - 6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
 - 7. Operational Ambient Conditions: 32 to 120 degrees F.
 - 8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
 - 9. Line voltage units UL recognized and CSA approved.
- B. Power Line Filtering:
 - 1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
 - 2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.
 - c. Transverse mode noise attenuation of 65 dB or greater.
 - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 0993.
- C. The HVAC controls contractor is responsible to provide conduit and electrical wiring in accordance with Sections 26 0519 and 26 0533.13. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.
- C. Provide basic operator training for 2 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

3.03 MAINTENANCE

- A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.
- B. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.
- C. Provide complete service of systems, including call backs. Make minimum of 4 complete normal inspections of approximately 12 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

END OF SECTION

SECTION 23 0993

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

END OF SECTION

SECTION 23 2113
HYDRONIC PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, buried.
- C. Heating water and glycol piping, buried.
- D. Heating water piping, above grade.
- E. Heating water and glycol piping, above grade.
- F. Chilled water piping, buried.
- G. Chilled water piping, above grade.
- H. Condenser water piping, buried.
- I. Condenser water piping, above grade.
- J. Equipment drains and overflows.
- K. Pipe hangers and supports.
- L. Unions, flanges, mechanical couplings, and dielectric connections.
- M. Valves:
 - 1. Ball valves.
 - 2. Butterfly valves.
 - 3. Check valves.
 - 4. Gate Valves
- N. Flow controls.

1.03 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 08 3100 - Access Doors and Panels.
- C. Section 09 9123 - Interior Painting.
- D. Section 23 0548 - Vibration And Seismic Controls For HVAC Piping And Equipment.
- E. Section 23 0553 - Identification for HVAC Piping and Equipment.
- F. Section 23 0719 - HVAC Piping Insulation.
- G. Section 23 2114 - Hydronic Specialties.
- H. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.04 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- E. ASME B31.9 - Building Services Piping; 2020.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

- G. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2019a.
- H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- I. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2014 (Reapproved 2020).
- J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- K. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2019)e1.
- L. ASTM B32 - Standard Specification for Solder Metal; 2020.
- M. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- O. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- P. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.
- Q. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2004 (Reapproved 2016).
- R. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
- S. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992, with Editorial Revision (2018).
- T. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).
- U. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).
- V. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- W. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
- X. AWWA C606 - Grooved and Shouldered Joints; 2015.
- Y. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
- C. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Provide manufacturers catalogue information.
 - 3. Indicate valve data and ratings.
 - 4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

- E. Project Record Documents: Record actual locations of valves.
- F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum 3 years of experience.
- C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.
- D. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.
- E. Coupling Manufacturer:
 - 1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
 - 2. Periodic job site visits by factory-trained representative to ensure best practices in grooved joint installation.
 - 3. A distributor's representative is not considered qualified to perform the training.
- F. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
 - 1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.
 - 2. Provide a test weld for inspection by the owner and architect/engineer's representative.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.09 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 - 3. Grooved mechanical joints may be used in accessible locations only.
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect Engineer.
 - b. Use rigid joints unless otherwise indicated.
 - 4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- D. Valves: Provide valves where indicated:
1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
 2. On discharge of condenser water pumps, use spring loaded check valves.
 3. Isolate equipment using Butterfly Valves with lug end flanges or grooved mechanical couplings.
 4. For throttling, bypass, or manual flow control services, use globe or ball valves.
 5. For shut-off and to isolate parts of systems or vertical risers, use gate or ball valves.
 6. For throttling service, use plug cocks. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- E. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 HEATING WATER AND GLYCOL PIPING, BURIED

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
- B. Steel Pipe Sizes 12 inch and Greater: ASTM A53/A53M, 3/8 inch wall, black with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
 2. Joints: Welded in accordance with AWS D1.1/D1.1M.
 3. Casing: Closed glass cell insulation.

2.03 HEATING WATER AND GLYCOL PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 2. Threaded Joints: ASME B16.3, malleable iron fittings.
 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black, using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn for pipe 2 inch (50 mm) and under, using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 3. Mechanical Press Sealed Fittings: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of ASME B16.51 and IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall allow identification of an unpressed fitting during pressure testing to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.04 CHILLED WATER PIPING, BURIED

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black . Piping shall be preinsulated equal to Thermacore Ferro-Therm.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
 - 2. Joints: Welded in accordance with AWS D1.1/D1.1M.
 - 3. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.
- B. Steel Pipe Sizes 12 Inch and Over: ASTM A53/A53M, 0.375 inch wall, black . Piping shall be preinsulated equal to Thermacore.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
 - 2. Joints: Welded in accordance with AWS D1.1/D1.1M.
 - 3. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.

2.05 CHILLED WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings.
 - 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black; using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn for pipe 2 inch (50 mm) and under; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 - 2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
 - 3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 - 4. Mechanical Press Sealed Fittings: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of ASME B16.51 and IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall allow identification of an unpressed fitting during pressure testing to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.06 CONDENSER WATER PIPING, BURIED

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
 - 2. Joints: Threaded for pipe 2 inch and under; AWS D1.1/D1.1M, welded for pipe over 2 inch.

- B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
 - 2. Joints: Welded in accordance with AWS D1.1/D1.1M.

2.07 CONDENSER WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings with finish matching piping; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings with finish matching piping.
 - 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black; using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

2.08 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
 - 1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.
 - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
 - 3. Mechanical Press Sealed Fittings: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of ASME B16.51 and IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall allow identification of an unpressed fitting during pressure testing to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.09 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.
- C. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - 1. Bases: High density polypropylene.
 - 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
5. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

2.10 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe 2 Inches and Less:
- B. Flanges for Pipe 2 Inches and Greater:
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 1. Dimensions and Testing: In accordance with AWWA C606.
 2. Mechanical Couplings: Comply with ASTM F1476.
 3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 4. When pipe is field grooved, provide coupling manufacturer's grooving tools.
- D. Dielectric Connections:
 1. Waterways:
 - a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - b. Dry insulation barrier able to withstand 600 volt breakdown test.
 - c. Construct of galvanized steel with threaded end connections to match connecting piping.
 - d. Suitable for the required operating pressures and temperatures.
 2. Flanges:
 - a. Dielectric flanges with same pressure ratings as standard flanges.
 - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - c. Dry insulation barrier able to withstand 600 volt breakdown test.
 - d. Construct of galvanized steel with threaded end connections to match connecting piping.
 - e. Suitable for the required operating pressures and temperatures.

2.11 BALL VALVES

- A. Up To and Including 2 Inches:
 1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.
- B. Over 2 Inches:
 1. Ductile iron body, chrome plated stainless steel ball, teflon or Virgin TFE seat and stuffing box seals, lever handle or gear operated, flanged ends, rated to 800 psi.

2.12 GATE VALVES

- A. 2 inches and smaller: MSS SP-80, Bronze, 1035 kPa (150 psig), wedge disc, rising stem, union bonnet.
- B. 2-1/2 inches and larger: Flanged, outside screw and yoke. MSS SP-70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.

2.13 BUTTERFLY VALVES

- A. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck.
- B. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.
- C. Operator: 10 position lever handle.

2.14 SWING CHECK VALVES

- A. Up To and Including 2 Inches:

1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

2.15 SPRING LOADED CHECK VALVES

- A. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

2.16 FLOW CONTROLS

- A. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Copper tubing shall be cut with a wheeled tubing cutter or approved copper tubing cutting tool. The tubing shall be cut square to permit proper joining with the fittings.
- D. Remove scale and dirt on inside and outside before assembly.
- E. Prepare piping connections to equipment using jointing system specified.
- F. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- G. After completion, fill, clean, and treat systems. Refer to Section 23 2500 for additional requirements.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Pressure rating: install components having a pressure rating equal to or greater than the system operating pressure.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls and floors.
- G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- H. Slope piping and arrange to drain at low points.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
 2. Use flexible couplings in expansion loops.
- J. Grooved Joints:
 1. Install in accordance with the manufacturer's latest published installation instructions.
 2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
- K. Mechanical Press connections: copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

- L. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- M. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
- N. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 0719.
- O. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100.
- P. Use eccentric reducers to maintain top of pipe level.
- Q. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- R. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 9123.
- S. Install valves with stems upright or horizontal, not inverted.

3.03 SCHEDULES

- A. Hanger Spacing for Steel Piping.
 - 1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 - 8. 6 inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 - 9. 8 inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
 - 10. 10 inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
 - 11. 12 inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.
 - 12. 14 inches: Maximum span, 25 feet; minimum rod size, 1 inch.
 - 13. 16 inches: Maximum span, 27 feet; minimum rod size, 1 inch.
 - 14. 18 inches: Maximum span, 28 feet; minimum rod size, 1-1/4 inch.
 - 15. 20 inches: Maximum span, 30 feet; minimum rod size, 1-1/4 inch.

END OF SECTION

SECTION 23 2114
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Suction diffusers.
- F. Combination pump discharge valves.
- G. Pressure-temperature test plugs.
- H. Balancing valves.
- I. Combination automatic flow limiting valves.
- J. Flow meters.
- K. Relief valves.
- L. Pressure reducing valves.
- M. Glycol system.

1.03 RELATED REQUIREMENTS

- A. Section 22 1006 - Plumbing Piping Specialties: Backflow preventers.
- B. Section 23 2113 - Hydronic Piping.
- C. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.04 REFERENCE STANDARDS

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Maintenance Contract.
- F. Project Record Documents: Record actual locations of flow controls.
- G. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Extra Glycol Solution: One container, 1 gallon size.

1.07 QUALITY ASSURANCE

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

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 EXPANSION TANKS

- A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm or bladder sealed into tank, and steel support stand.
- B. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psi.
- C. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.02 AIR VENTS

- A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- B. Float Type:
 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
 2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.
- C. Washer Type:
 1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.
- D. Maximum Fluid Pressure: 150 psi.
- E. Maximum Fluid Temperature: 250 degrees F.

2.03 AIR SEPARATORS

- A. Centrifugal Air Separators/Strainers:
 1. Steel, tested and stamped in accordance with ASME BPVC-VIII-1; for 125 psi operating pressure, with integral bronze strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.
 2. Maximum Service Flow and Pressure: 16 gpm at 125 psi.

2.04 STRAINERS

- A. Size 2 inch and Under:
 1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- B. Size 2-1/2 inch to 4 inch:
 1. Provide flanged or grooved iron body for 175 psi working pressure, Y pattern with 1/16 inch, or 3/64 inch stainless steel perforated screen.
- C. Size 5 inch and Larger:
 1. Provide flanged or grooved iron body for 175 psi working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.05 SUCTION DIFFUSERS

- A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh start up screen.
- B. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.06 COMBINATION PUMP DISCHARGE VALVES

- A. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psi operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.07 PRESSURE-TEMPERATURE TEST PLUGS

- A. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.
- B. Application: Use extended length plugs to clear insulated piping.

2.08 MANUAL BALANCING VALVES

- A. Size 2 inch and Smaller:
 - 1. Provide ball style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
 - 2. Metal construction materials consist of bronze or brass.
 - 3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.
- B. Size 2.5 inch and Larger:
 - 1. Provide butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged, grooved, or weld end connections.
 - 2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
 - 3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, or NORYL.

2.09 FLOW METERS

- A. Orifice principle by-pass circuit with direct reading gauge, soldered or flanged piping connections for 125 psi working pressure, with shut off valves, and drain and vent connections.
- B. Direct reading with insert pitot tube, threaded coupling, for 150 psi working pressure, maximum 240 degrees F, 5 percent accuracy.
- C. Calibrated, plug type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer.
- D. Portable meter consisting of case containing one, 3 percent accuracy pressure gauge with 0-60 feet pressure range for 500 psi maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

2.10 RELIEF VALVES

- A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.11 PRESSURE REDUCING VALVES

- A. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 23 2113.
- B. Materials of Construction:
 - 1. Valve Body: Constructed of bronze, cast iron, brass, or iron.
 - 2. Internal Components: Construct of stainless steel or brass and engineered plastics or composition material.
- C. Connections:

1. NPT threaded: 0.50 inch, or 0.75 inch.
 2. Soldered: 0.50 inch.
- D. Provide integral check valve and strainer.
- E. Maximum Inlet Pressure: 100 psi.
- F. Maximum Fluid Temperature: 180 degrees F.
- G. Operating Pressure Range: Between 10 psi and 25 psi.

2.12 COMBINATION AUTOMATIC FLOW LIMITING VALVES

- A. Manufacturers:
1. Griswold Controls LLC: www.griswoldcontrols.com/#sle.
 2. Hays Fluid Controls: www.haysfluidcontrols.com/#sle.
 3. IMI Flow Design: www.imiflowdesign.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. General:
1. Factory set to maintain constant flow rate with +/- 10% accuracy over system pressure fluctuations; operating ranges shall fall within 2–80 PSID.
 2. Operating Pressure: Up to 3" – minimum 400 PSIG / Above 3" – minimum 200 PSIG.
 3. Temperature Range: 32°–225°F .
 4. Flow-Control Cartridge: Cartridge design shall consist of a brass, stainless steel, or elastomeric diaphragm and polyphenylsulfone orifice plate. Valve body style shall allow for flow-control cartridge change-out.
- C. Size 1/2 inch to 14 inch:
1. Provide ball style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
 2. Metal construction materials consist of bronze or brass.
 3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.
- D. Size 2-1/2 inch to 24 inch:
1. Provide butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged, grooved, or weld end connections.
 2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
 3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, NORYL, or engineered resin.

2.13 GLYCOL SYSTEM

- A. Mixing Tank: 55 gallon steel drum with fittings suitable for filling and hand pump for charging, rubber hose for connection of hand pump to system.
- B. Storage Tank: Closed type, welded steel constructed, tested and stamped in accordance with ASME BPVC-VIII-1; 100 psi rating; cleaned, prime coated, and supplied with steel support saddles. Construct with tapings for installation of accessories.
- C. Expansion Tank: Diaphragm type with vent fitting with air separator, and automatic air vent.
- D. Air Pressure Reducing Station: Pressure reducing valve with shut-off valves, strainer, check valve and needle valve bypass.
- E. Glycol Solution:
1. Inhibited ethylene glycol and water solution mixed 50 percent glycol - 50 percent water, suitable for operating temperatures from minus 40 degrees F to 250 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

- C. Provide manual air vents at system high points and as indicated.
- D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- E. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- F. Provide valved drain and hose connection on strainer blow down connection.
- G. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.
- H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.
- I. Support pump fittings with floor mounted pipe and flange supports.
- J. Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.
- K. Provide radiator balancing valves on water outlet from terminal heating units such as radiation, unit heaters, and fan coil units.
- L. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- M. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- N. Pipe relief valve outlet to nearest floor drain.
- O. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- P. Clean and flush glycol system before adding glycol solution. Refer to Section 23 2500.
- Q. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.
- R. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Set to fill at 12 psi.
- S. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Pressure system cold at 5 psi.
- T. Perform tests determining strength of glycol and water solution and submit written test results.

3.02 MAINTENANCE

- A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of glycol system for one year from date of Substantial Completion at no extra charge to Owner.
- C. Perform monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Report findings in detail in writing, including analysis and amounts of glycol or water added.
- D. Explain corrective actions to Owner's maintenance personnel in person.

END OF SECTION

SECTION 23 2123
HYDRONIC PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. In-line circulators.
- B. Vertical in-line pumps.
- C. Close-coupled pumps.
- D. Base-mounted pumps.
- E. Dual drive pumping system.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 22 0513 - Common Motor Requirements for Plumbing Equipment.
- C. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Section 23 0548 - Vibration And Seismic Controls For HVAC Piping And Equipment.
- E. Section 23 0719 - HVAC Piping Insulation.
- F. Section 23 2113 - Hydronic Piping.
- G. Section 23 2114 - Hydronic Specialties.
- H. Section 25 3500 - Integrated Automation Instrumentation and Terminal Devices for HVAC.

1.04 REFERENCE STANDARDS

- A. NEMA MG 1 - Motors and Generators; 2018.
- B. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
- D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Pump Seals: One set for each type and size of pump.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 HVAC PUMPS - GENERAL

- A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to Authority Having Jurisdiction as suitable for the purpose specified and indicated.

2.02 IN-LINE CIRCULATORS

- A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psi maximum working pressure.
- B. Casing: Cast iron, with flanged pump connections.
- C. Impeller: Non-ferrous keyed to shaft.
- D. Bearings: Oil-lubricated bronze sleeve.
- E. Shaft: Alloy steel with bronze sleeve, integral thrust collar.
- F. Seal: Mechanical seal, 225 degrees F maximum continuous operating temperature.
- G. Drive: Flexible coupling.
- H. Electrical Characteristics:
 - 1. Motor: 1750 rpm unless indicated otherwise; refer to Section 22 0513.
 - 2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.03 VERTICAL IN-LINE PUMPS

- A. Type: Vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 175 psi working pressure.
- B. Casing: Cast iron, with suction and discharge gauge port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
- D. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
- E. Seal: Mechanical seal, 225 degrees F maximum continuous operating temperature.
- F. Electrical Characteristics:
 - 1. Motor: 1750 rpm unless specified otherwise; refer to Section 22 0513.
 - 2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.04 CLOSE COUPLED PUMPS

- A. Type: Horizontal shaft, single stage, close coupled, radially split casing, for 125 psi maximum working pressure.
- B. Casing: Cast iron, with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed to motor shaft extension.
- D. Shaft: Stainless steel.
- E. Seal: Mechanical seal, 225 degrees F maximum continuous operating temperature.
- F. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 230 degrees F maximum continuous operating temperature.
- G. Electrical Characteristics:
 - 1. Motor: 1750 rpm unless specified otherwise; refer to Section 22 0513.

2.05 BASE-MOUNTED PUMPS

- A. Type: Horizontal shaft, single stage, direct connected, radially or horizontally split casing, for 125 psi maximum working pressure.
- B. Casing: Cast iron, or ductile iron with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed to shaft.
- D. Bearings: Oil lubricated roller or ball bearings.
- E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.
- F. Seal: Mechanical seal, 225 degrees F maximum continuous operating temperature.
- G. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 250 degrees F maximum continuous operating temperature.
- H. Drive: Flexible coupling with coupling guard.
- I. Baseplate: Cast iron or fabricated steel with integral drain rim.
- J. Electrical Characteristics:
 - 1. Motor: 1750 rpm unless specified otherwise; refer to Section 22 0513.
 - 2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.06 DUAL DRIVE PUMPING SYSTEM

- A. Pumping System: Horizontal split case, base-mounted pump with two motors, operating at 1750 rpm and 1150 rpm, assembled on integral base with control cabinet.
- B. Control Cabinet: NEMA OS 1, UL approved enclosure with individual circuit breakers, magnetic starters with overload protection, running lights, separate 115V fused control circuit, hands-off-automatic switches, motor failure alarm with manual reset, pre-wired.
- C. Electrical Characteristics:
 - 1. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
- C. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
- D. Provide air cock and drain connection on horizontal pump casings.
- E. Provide drains for bases and seals, piped to and discharging into floor drains.
- F. Check, align, and certify alignment of base-mounted pumps prior to start-up.
- G. Install close-coupled and base-mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03 3000.
- H. Lubricate pumps before start-up.
- I. Provide side-stream filtration system for closed loop systems. Install across pump with flow from pump discharge to pump suction from pump tapings.
- J. Controls Human-Machine Interface (HMI): HVAC operator terminal; see Section 25 3500.

END OF SECTION

SECTION 23 2300
REFRIGERANT PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Piping.
- B. Moisture and liquid indicators.
- C. Filter-driers.
- D. Solenoid valves.
- E. Expansion valves.
- F. Service Valves.

1.03 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 08 3100 - Access Doors and Panels.
- C. Section 09 9123 - Interior Painting.
- D. Section 22 0719 - Plumbing Piping Insulation.
- E. Section 23 0719 - HVAC Piping Insulation.
- F. Section 23 6313 - Air Cooled Refrigerant Condensers.
- G. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. AHRI 750 - Thermostatic Refrigerant Expansion Valves; 2007.
- B. AHRI 760 - Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; 2007.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- G. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2020.
- H. ASME B31.9 - Building Services Piping; 2020.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- J. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- L. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2020.
- M. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).
- N. ICC (IMC)-2018 - International Mechanical Code; 2018.
- O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

- P. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.
- Q. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Test Reports: Indicate results of leak test, acid test.
- F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
- G. Submit welders certification of compliance with ASME BPVC-IX.
- H. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.
- I. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Filter-Dryer Cartridges: One of each type and size.
 - 3. Refrigeration Oil Test Kits: One, each containing everything required to conduct one test.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Where indicated, use line size liquid indicators in main liquid line leaving condenser.
- D. Filter-Driers:
 - 1. Where indicated, use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
- E. Solenoid Valves:
 - 1. Where indicated, use in liquid line of single or multiple evaporator systems.

- F. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

2.02 REGULATORY REQUIREMENTS

- A. Comply with ASME B31.9 for installation of piping system.
- B. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.03 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
 - 3. Copper tube, pressure seal joint fittings for refrigerant piping: Double pressed type complying with UL 207 and ICC (IMC)-2018.
 - a. Press Tools: Manufacturer's approved jaw(s) display two circular 360 deg press bands with circular groove to either side, along with a manufacturer's witness mark embossed on the bands.
 - b. Housing: Copper.
 - c. O-Rings: HR, or compatible with specific refrigerant.
 - d. Maximum Allowable Working Pressure: In accordance with UL 207: 700 psig
 - e. Minimum Allowable Burst Pressure: In accordance with UL 207: 2100 psig
- B. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.
 - 3. Copper tube, pressure seal joint fittings for refrigerant piping: Double pressed type complying with UL 207 and ICC (IMC)-2018.
 - a. Press Tools: Manufacturer's approved jaw(s) display two circular 360 deg press bands with circular groove to either side, along with a manufacturer's witness mark embossed on the bands.
 - b. Housing: Copper.
 - c. O-Rings: HR, or compatible with specific refrigerant.
 - d. Maximum Allowable Working Pressure: In accordance with UL 207: 700 psig
 - e. Minimum Allowable Burst Pressure: In accordance with UL 207: 2100 psig
- C. Pipe Supports and Anchors:
 - 1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 5. Vertical Support: Steel riser clamp.
 - 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 7. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 - 8. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
 - 9. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

- d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
- e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

2.04 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared, solder or press ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.05 VALVES

- A. Service Valves:
 - 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared, solder or press ends, for maximum pressure of 500 psi.

2.06 FILTER-DRIERS

- A. Performance:
 - 1. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
 - 2. Design Working Pressure: 350 psi, minimum.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.
 - 1. Connections: As specified for applicable pipe type.

2.07 SOLENOID VALVES

- A. Valve: AHRI 760 I-P, pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi.
- B. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.08 EXPANSION VALVES

- A. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well.
- B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.09 ELECTRONIC EXPANSION VALVES

- A. Valve:
 - 1. Brass body with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
- B. Evaporation Control System:
 - 1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.
- C. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.10 FLEXIBLE CONNECTORS

- A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 08 3100.
- H. Flood piping system with nitrogen when brazing.
- I. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- J. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 9123.
- K. Insulate piping; refer to Section 23 0719.
- L. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- M. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- N. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- O. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- Q. Fully charge completed system with refrigerant after testing.
- R. Provide electrical connection to solenoid valves. Refer to Section 26 0583.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Test refrigeration system in accordance with ASME B31.5.
- C. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using halide torch. Test to no leakage.

3.04 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.

3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

END OF SECTION

SECTION 23 2500
HVAC WATER TREATMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. By-pass (pot) feeder.
- B. Drip feeder.
- C. Solution metering pump.
- D. Solution tanks.
- E. Agitator.
- F. Liquid level switch.
- G. Conductivity controller.
- H. Water meter.
- I. Solenoid valves.
- J. Timers.

1.03 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Owner furnished treatment equipment.
- B. Section 01 6000 - Product Requirements: Owner furnished treatment equipment.
- C. Section 23 2113 - Hydronic Piping.
- D. Section 23 2114 - Hydronic Specialties.
- E. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
- E. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
- F. Certificate: Submit certificate of compliance from Authority Having Jurisdiction indicating approval of chemicals and their proposed disposal.
- G. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- H. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Sufficient chemicals for treatment and testing during required maintenance period.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems and to public sewage systems.
- B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 BY-PASS (POT) FEEDER

- A. 1.8 gal quick opening cap for working pressure of 175 psi.

2.02 DRIP FEEDER

- A. Plastic reservoir with coil of capillary tubing with probe, weight, charging syringe, and clip.

2.03 SOLUTION METERING PUMP

- A. Positive displacement, diaphragm pump with adjustable flow rate, thermoplastic construction, continuous-duty fully enclosed electric motor and drive, and built-in relief valve.

2.04 SOLUTION TANKS

- A. 30 gallon capacity, polyethylene, self-supporting, 1 gallon graduated markings; molded fiberglass cover with recess for mounting pump, agitator, and liquid level switch.

2.05 AGITATOR

- A. Totally enclosed electric motor, cast iron clamp and motor mount, 1/2 inch diameter coated Type 316 stainless steel propeller.
- B. Electrical Characteristics:
 - 1. Cord and Plug: Provide unit with 6 foot cord and plug for connection to electric wiring system including grounding connector.

2.06 LIQUID LEVEL SWITCH

- A. Polypropylene housing with integrally mounted PVC air trap, receptacles for connection to metering pump, and low level alarm.

2.07 CONDUCTIVITY CONTROLLER

- A. Packaged monitor controller with solid state circuiting, five percent accuracy, linear dial adjustment, built-in calibration switch, on-off switch and light, control function light, output to control circuit and recorder.

2.08 WATER METER

- A. Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register, single pole, double throw dry contact switch.

2.09 SOLENOID VALVES

- A. Forged brass body globe pattern, normally open or closed as required, explosion-proof and watertight solenoid enclosure, and continuous duty coil.

2.10 TIMERS

- A. Electronic timers, infinitely adjustable over full range, 150 second and five minute range, mounted together in cabinet with hands-off-automatic switches and status lights.

2.11 SIDE-STREAM FILTRATION SYSTEM

- A. System: Flow indicator, filter housing with cartridge filter, shut-off valves, and flow control valve.

- B. Hot Water and Glycol Filter Housing: Glass reinforced nylon plastic suitable for 220 degrees F and 200 psi operating conditions.
- C. Chilled Water Filter Housing: Reinforced polypropylene plastic housing suitable for 125 degrees F and 125 psi operating conditions.
- D. Cartridges: 30 micron for start-up and 5 micron for system operation.

PART 3 EXECUTION

3.01 PREPARATION

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.
- C. Verify that electric power is available and of the correct characteristics.

3.02 CLEANING SEQUENCE

- A. Concentration:
 - 1. As recommended by manufacturer.
- B. Hot Water Heating Systems:
 - 1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
 - 2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
 - 3. Circulate for 6 hours at design temperatures, then drain.
 - 4. Refill with clean water and repeat until system cleaner is removed.
- C. Chilled Water Systems:
 - 1. Circulate for 48 hours, then drain systems as quickly as possible.
 - 2. Refill with clean water, circulate for 24 hours, then drain.
 - 3. Refill with clean water and repeat until system cleaner is removed.
- D. Steam Systems:
 - 1. Apply heat, slowly raising boiler temperature to 160 degrees F and maintain for 12 hours minimum.
 - 2. Cool, then drain as quickly as possible.
 - 3. Refill with clean water, drain, refill and check for sludge.
 - 4. Repeat until system is free of sludge.
 - 5. Apply heat to produce steam for piping system and maintain for 8 hours minimum. Bypass traps and waste condensate.
- E. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect Engineer.
- F. Flush open systems and glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.
- G. Remove, clean, and replace strainer screens.
- H. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.03 INSTALLATION

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

3.04 CONDENSER WATER SYSTEMS (COOLING TOWERS)

- A. Provide solution pumps to feed sequestering agent and corrosion inhibitor from solution tank into condenser water supply to tower. Provide agitator as required.
- B. Provide conductivity controller to sample condenser water and operate 1 inch solenoid bleed valve and solution pumps. Provide 1/4 inch solenoid valve and piping to blowdown controller sampler wired to open when condensing water pump is operating.

- C. Provide solution pump to feed diluted acid from solution tank into condenser water supply to tower.
- D. Introduce algicide to tower by intermittent slug feed.
- E. Provide water meter in make-up water line to tower, to activate solution pumps for preset time when condenser water pumps are running.
- F. Provide liquid level switch in each solution tank to deactivate solution pump and agitator and sound local alarm bell.
- G. Provide 3/4 inch water coupon rack around circulating pumps with space for 4 test specimens.

3.05 CLOSEOUT ACTIVITIES

- A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
 - 1. Provide minimum of two hours of instruction for two people.
 - 2. Have operation and maintenance data prepared and available for review during training.
 - 3. Conduct training using actual equipment after treated system has been put into full operation.

3.06 MAINTENANCE

- A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the equipment manufacturer or original installer.
- D. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Owner.
- E. Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.
- F. Provide monthly technical service visits to perform field inspections and make water analysis on-site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
- G. Provide laboratory and technical assistance services during this maintenance period.
- H. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

END OF SECTION

SECTION 23 3100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Metal ducts.
- B. Flexible ducts.
- C. Air plenums and casings
- D. Duct Leakage Tests and Repair

1.03 RELATED REQUIREMENTS

- A. Section 23 0713 - Duct Insulation: External insulation and duct liner.
- B. Section 23 3300 - Air Duct Accessories.
- C. Section 23 3600 - Air Terminal Units.
- D. Section 23 3700 - Air Outlets and Inlets.

1.04 REFERENCE STANDARDS

- A. ANSI Z9.5 - Laboratory Ventilation; 2012.
- B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASHRAE Std 126 - Method of Testing HVAC Air Ducts; 2016.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- F. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- G. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems; 2020.
- H. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals; 2019.
- I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- J. NFPA 91 - Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids; 2015.
- K. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
- L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).
- M. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.
- N. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.
- O. SMACNA (ROUND) - Round Industrial Duct Construction Standards; 2013.
- P. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- Q. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

- R. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.
- S. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.
- D. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.
- B. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.

1.07 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A standards.

1.08 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide galvanized steel duct unless otherwise indicated.
- C. Acoustical Treatment: Where indicated on the drawings, provide sound-absorbing liners and/or sectional silencers for metal-based ducts.
- D. Duct Shape and Material in accordance with Allowed Static Pressure Range:
 - 1. Round: Plus or minus 4 in-wc of galvanized steel.
 - 2. Rectangular: Plus or minus 1 in-wc of galvanized steel.
 - 3. Flat Oval: Plus 4 in-wc of galvanized steel.
- E. Duct Sealing and Leakage in accordance with Static Pressure Class:
 - 1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
 - a. Low Pressure Supply Air: 1 in-wc pressure class, galvanized steel.
 - b. Medium and High Pressure Supply Air: 3 in-wc pressure class, galvanized steel.
 - c. Outside Air Intake: 1/2 in-wc pressure class, galvanized steel.
 - d. Return and Relief Air: 1 in-wc pressure class, galvanized steel.
 - e. General Exhaust Air: 1 in-wc pressure class, galvanized steel.
 - f. Combustion Air: 1/2 in-wc pressure class, galvanized steel.
 - g. Transfer-air and Sound Boots: 1/2 in-wc pressure class.
 - 2. Low Pressure Service: Up to 2 in-wc:
 - a. Seal: Class C, apply to seal off transverse joints.
 - b. Leakage:
 - 1) Rectangular: Class 24 or 24 cfm/100 sq ft.
 - 2) Round: Class 12 or 12 cfm/100 sq ft.
 - 3. Medium and High Pressure Service: Above 3 in-wc:

- a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
 - b. Leakage:
 - 1) Rectangular: Class 6 or 6 cfm/100 sq ft.
 - 2) Round: Class 3 or 3 cfm/100 sq ft.
- F. Materials:
 - 1. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- G. Duct Fabrication Requirements:
 - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
 - 2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
 - 3. Construct tee's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
 - 4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
 - 5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
 - 6. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.02 MANUFACTURED DUCTWORK AND FITTINGS

- A. Material Requirements:
 - 1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Flat-Oval Metal Ducts:
 - 1. Flat-Oval Single Wall Duct: Machine made from a round spiral lock seam duct.
 - a. Fittings: Manufacture at least two gauges heavier metal than the duct.
 - b. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
 - 2. Flat-Oval Double Wall Insulated Duct: Machine made from round spiral lock seam duct.
 - a. Fittings: Manufacture with solid inner wall.
 - b. Inner Wall: Perforated galvanized steel.
 - c. Insulation:
 - 1) Thickness: 1 inch fiberglass.
- C. Round Metal Ducts:
 - 1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
 - 2. Round Double Wall Insulated Duct: Round spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.
 - a. Insulation:
 - 1) Thickness: 1 inch.
 - 2) Material: Fiberglass.
 - 3. Round Connection System: Interlocking duct connection system per SMACNA (DCS).
- D. Round Spiral Duct:
 - 1. Round spiral lock seam duct with galvanized steel outer wall.
- E. Connectors, Fittings, Sealants, and Miscellaneous:
 - 1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.

2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
 3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - b. VOC Content: Not more than 250 g/L, excluding water.
 - c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
 - d. For Use with Flexible Ducts: UL labeled.
 4. Gasket Tape:
 - a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
- F. Slab Duct Ventilation System: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS, with G90/Z275 coating designed for installation in cast-in-place concrete floor assemblies.

2.03 FLEXIBLE DUCTS

- A. Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form spiral helix.
 1. Insulation: R6 insulation with polyethylene vapor barrier film.
 2. Pressure Rating: 10 in-wc positive and 5 in-wc negative.
 3. Maximum Velocity: 4000 fpm.
 4. Temperature Range: Minus 20 degrees F to 250 degrees F.
- B. Flexible Air Ducts:
 1. UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound spring steel wire.
 2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 3. Pressure Rating: From 10 in-wc positive to 5 in-wc negative.
 4. Maximum Velocity: 5000 fpm.
 5. Temperature Range: Minus 20 to 210 degrees F.
- C. Flexible Air Ducts:
 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 2. Insulation: Fiberglass insulation with aluminized vapor barrier film.
 3. Pressure Rating: From 10 in-wc to 5 in-wc negative.
 4. Maximum Velocity: 5000 fpm.
 5. Temperature Range: Minus 20 to 210 degrees F.

2.04 DUCTS FOR KITCHEN EXHAUST APPLICATIONS

- A. Provide ductwork, fittings, and appurtenances per NFPA 96, SMACNA (KVS), UL 1978, and UL 2221 requirements and guidelines.
- B. Class 1 duct for air with gas and grease particle exhaust at an air velocity of 1,500 to 2,500 fpm.
- C. Where ducts are not self-draining back to equipment, provide low point drain pocket with the copper drain pipe to a sanitary sewer.
- D. Designed, fabricated, and installed to be liquid tight preventing exhaust leakage into the building.
- E. Dishwasher Exhaust Duct:
 1. Duct Size: 1 in-wc pressure class, stainless steel.
 2. Fabricate using minimum 20 gauge, 20 inch thick, single wall stainless steel with continuous external welded joints to form rectangular sections.

3. Joints to be sealed during installation with factory supplied overlapping V-bands and sealant.
- F. Kitchen Hood and Grease Exhaust Duct:
1. General:
 - a. Fabricate in accordance with ductwork manufacturer's instructions, SMACNA (DCS), SMACNA (KVS), and NFPA 96.
 - b. Liquid-tight with continuous external weld for seams and joints.
 - c. Where ducts are not self draining back to equipment, provide low point drain pocket with copper drain pipe to sanitary sewer.
 2. Round, Single-Wall, Premanufactured Grease Exhaust Duct:
 - a. UL Listed and labeled to UL 1978.
 - b. Construct of minimum 20-gauge, 0.035-inch Type 304 stainless steel.
 - c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
 - d. Minimum horizontal slope of 1/16 inch per foot per manufacturers listing to UL 1978.
 3. Single-Wall, Premanufactured Kitchen Exhaust Duct:
 - a. UL Listed and labeled to UL 1978.
 - b. Construct of 16-gauge, 0.059-inch sheet steel using continuous external welded joints in rectangular sections.
 - c. Construct of 18 gauge, 0.050 inch stainless steel using continuous external welded joints in rectangular sections.
 4. Round, Double-Wall, Premanufactured Grease Exhaust Ducts:
 - a. UL Listed and labeled to UL 1978.
 - b. Nominal 1 inch thick, body soluble fiber insulation that fills annular space between inner liner of 20-gauge, 0.035 inch Type 304 stainless steel and outer jacket of 24-gauge, 0.023-inch aluminized steel.
 - c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
 - d. Minimum horizontal slope of 1/16 inch per foot per manufacturer's listing to UL 1978.
 5. Zero Clearance, 2-Hour Fire-Rated, Round, Double-Wall, Premanufactured Grease Duct:
 - a. UL Listed and labeled to UL 1978 and UL 2221.
 - b. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
 - c. Through-penetration firestop listed to UL 1479 or ASTM E814.
 - d. Minimum horizontal slope of 1/16 inch per foot per manufacturers listing to UL 1978.
 6. Double-Wall, Premanufactured, Noncombustible Kitchen Exhaust Ducts:
 - a. Listed when tested in accordance with UL 1978 and ASTM E2336.
 - b. Construct of 18 gauge, 0.050 inch stainless steel using continuous external welded joints in rectangular sections.
 - c. Liquidtight with continuous external weld for seams and joints.
 - d. Where ducts are not self-draining back to equipment, provide low-point drain pocket with copper drain pipe to sanitary sewer.
 7. Grease Exhaust Duct Access Doors:
 - a. Listed when tested in accordance with UL 1978.
 - b. Install hinged access doors where indicated or required for access for cleaning and inspection of duct.
 - c. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.

2.05 DUCTS FOR LABORATORY AND INDUSTRIAL-GRADE APPLICATIONS

- A. Duct Class:
1. Class 1: Fumes, vapors, smoke and aerosols (spray, mists, and fog) in light concentrations at a minimum conveying velocity of 2,000 to 2,500 fpm (10 to 13 m/s).
 2. Class 5: Corrosive fumes in light concentrations at a minimum conveying velocity of 1,000 to 2,000 fpm.
- B. Sectional Shape and Material Requirements:
1. Round and Oval Metal Duct:

- a. Pressure Class: Minus 4 in-wc.
 - b. Minimum Duct Thickness: Duct Class 1 and 5; 18 gauge, 0.048 inch (1.2 mm).
 - c. Compliance: Provide ductwork, fittings, supports, hangers, and appurtenances:
 - 1) Round: SMACNA (ROUND) construction standard.
- C. Laboratory Exhaust Applications:
 - 1. Fume Hood Cabinet Exhaust:
 - a. Minimum 21 gauge, 0.034 inch thick, single wall, Type 304 stainless steel, unless noted otherwise.
 - 1) Fabricate in accordance with ductwork manufacturer's instructions, test duct system to sustain positive and negative pressures in compliance with ASHRAE Std 126.
 - b. Provide ductwork and appurtenances per NFPA 91 requirements except where NFPA 45 applications take precedence.
 - c. Coordinate duct, fittings, hangers, and accessories to comply with ANSI Z9.5.
 - d. Designed, fabricated, and installed to be liquid-tight preventing exhaust leakage into the building.
 - e. Seal joints during installation with factory supplied flanges and airtight gasketing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install in accordance with manufacturer's instructions.
- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- G. Use double nuts and lock washers on threaded rod supports.
- H. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- I. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
- J. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- K. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

3.02 DUCT LEAKAGE TESTS AND REPAIR

- A. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor directly contracted by the General Contractor and independent of the Sheet Metal Contractor.
- B. Ductwork leakage testing shall be performed for:
 - 1. The entire air distribution system, regardless of pressure classification (including all supply, return, exhaust and relief ductwork), section by section.
 - 2. Medium and High Pressure supply ductwork serving VAV systems (3 in-wc and above).
 - 3. Return ductwork serving VAV systems (all).
 - 4. Low pressure exhaust ductwork (1 in-wc and above).
 - 5. Low pressure supply and return ductwork (1 in-wc). Do not test supply ductwork downstream of terminal units.
- C. Do not test flex duct run-outs to air devices or terminal units.
- D. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual.

- E. All ductwork shall be leak tested first before enclosed in a shaft, isolated, or covered in other inaccessible areas.
- F. All tests shall be performed in the presence of the Commissioning Agent and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the Resident Engineer and identify leakage source with excessive leakage.
- G. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Commissioning Agent.
- H. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
- I. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

END OF SECTION

SECTION 23 3300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Backdraft dampers - metal.
- B. Combination fire and smoke dampers.
- C. Duct access doors.
- D. Duct test holes.
- E. Fire dampers.
- F. Flexible duct connections.
- G. Smoke dampers.
- H. Volume control dampers.

1.03 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 23 0548 - Vibration And Seismic Controls For HVAC Piping And Equipment.
- C. Section 23 3100 - HVAC Ducts and Casings.
- D. Section 23 3600 - Air Terminal Units: Pressure regulating damper assemblies.
- E. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- C. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.
- D. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
- E. NFPA 105 - Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives; 2013
- F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).
- G. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Provide instructions for fire dampers.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 BACKDRAFT DAMPERS - METAL

- A. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.02 COMBINATION FIRE AND SMOKE DAMPERS

- A. Description: Combination fire smoke dampers.
- B. Ratings:
 - 1. Fire Resistance
 - a. Dampers shall have a UL 555 fire resistance rating of 1½ hours.
 - 2. Fire Closure Temperature: Each fire damper shall be equipped with a factory installed heat responsive device (fusible link) rated to close the damper when temperature at the damper reaches:
 - a. 165 F
 - 3. Leakage:
 - a. Dampers shall have a UL555S leakage rating of Leakage Class I.(8 cfm/ft2 (0.04 m3/s/m2) at 4 in. wg (1.0 kPa)
 - 4. Differential Pressure:
 - a. Dampers shall have a UL 555S differential pressure rating of 6 in. wg
 - 5. Velocity:
 - a. Dampers shall have a minimum UL 555 velocity rating of 3000 fpm.
- C. Performance:
 - 1. Pressure drop:
 - a. The Damper manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.06 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.
- D. Combination fire smoke damper construction:
 - 1. Frame:
 - a. Damper frame shall be 16 ga. galvanized steel formed into a 5 in. x 1 in. structural hat channel. Dampers less than 17 in. high shall utilize low profile geometry and 20 ga. galvanized steel for the top and bottom frame members to maximize free area. Frame shall be 4-piece construction with 1 ½ in. (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking. No welding of damper frames shall be permitted.
 - 2. Blades:
 - a. Damper blades shall be of 14 ga. equivalent, galvanized steel with full length structural reinforcement and a double skin true airfoil shape. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening.
 - 3. Seals:
 - a. Blade Edge: Blade seals shall be extruded silicone rubber mechanically secured to the appropriate blade edges.

- b. Jamb: Flexible stainless steel compression type.
- 4. Linkage: Blade linkages shall be non-adjustable and concealed within the jamb of the damper.
- 5. Axles:
 - a. Minimum ½ inch dia. zinc plated steel.
- 6. Sleeves: Damper shall be supplied as a single assembly with a factory installed sleeve made of material matching that of the damper.
- 7. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.
- 8. Fire Closure Device:
 - a. Dampers shall be supplied with Reusable Resettable Link (RRL), an electric heat-responsive device standard on any combination fire-smoke damper that performs the same function as a fusible link and can be reset, eliminating the need to replace a fusible link.
- 9. Bearings: Axle bearings shall be stainless steel sleeve type rotating in polished extruded holes in the damper frame.
- 10. Mounting: Vertical or horizontal as indicated on the drawings
- 11. Finish:
 - a. Galvanized steel
- E. Actuators:
 - 1. Type:
 - a. Electric, 120V AC, 2-position
 - 2. Mounting Location:
 - a. External (outside of duct)
- F. Accessories:
 - 1. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.
 - a. 1½ x 1¼ inches or 2½ x 1½ inches as required.
 - 2. Breakaway Connections: Quick Connect: Universal breakaway connection that is compatible with TDC, TDF, Ductmate, Dyn-o-mate, Nexus or Ward flange systems.
- G. Quality Control:
 - 1. Factory Tests: Factory cycle damper assemblies to assure proper operation.

2.03 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.

2.04 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.05 DYNAMIC FIRE DAMPERS

- A. Description: Dynamic curtain fire dampers.
- B. Ratings:
 - 1. Fire Resistance
 - a. Dampers shall have a UL 555 fire resistance rating of 1½ hours.
 - 2. Fire Closure Temperature: Each fire damper shall be equipped with a factory installed heat responsive device (fusible link) rated to close the damper when temperature at the damper reaches:
 - a. 165 F
 - 3. Differential Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. wg.
 - 4. Velocity:
 - a. Dampers shall have a minimum UL 555 velocity rating of 4000 fpm.
- C. Dynamic Fire Damper (DFD) Construction:

1. Frame:
 - a. Galvanized steel in gauges required by manufacturer's UL listing.
 2. Blades:
 - a. Galvanized steel curtain style
 3. Sleeves:
 - a. Damper shall be supplied with a factory sleeve.
 4. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.
 5. Fire Closure Device: Damper shall be supplied with fusible link.
 6. Mounting: Vertical or horizontal as indicated on the drawings
 7. Finish:
 - a. Galvanized steel
 8. Duct Transition Connection:
 - a. Type B
 - b. Type C
 - c. Type CO
 - d. Type CR
- D. Quality Control:
- E. Factory Tests: Factory cycle damper assemblies to assure proper operation.

2.06 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 - a. Net Fabric Width: Minimum nominal 3 inches wide.
 2. Metal: 3 inches wide, 24 gage, 0.0239 inch thick galvanized steel.
- C. Maximum Installed Length: 10 inch.

2.07 SMOKE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- B. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.
- C. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.08 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Splitter Dampers:
 1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
 2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
 3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .
- C. Single Blade Dampers:
 1. Fabricate for duct sizes up to 6 by 30 inch.
 2. Blade: 24 gage, 0.0239 inch, minimum.
- D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

- E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.
- B. Examine areas to receive dampers. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization of dampers. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 3100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Dynamic Fire Dampers:
 - 1. Install dampers in accordance with manufacturer's UL Installation Instructions, labeling, and NFPA 90A at locations indicated on the drawings. Any damper installation that is not in accordance with the manufacturer's UL Installation Instructions must be approved prior to installation.
 - 2. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
 - 3. Install dampers square and free from racking.
 - 4. Do not compress or stretch the damper frame into the duct or opening.
 - 5. Attach multiple damper section assemblies together in accordance with manufacturer's instructions.
 - 6. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.
- G. Combination Fire and Smoke Dampers and Smoke Dampers:
 - 1. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
 - 2. Install dampers in accordance with manufacturer's UL Installation Instructions. Any damper installation aspect that is not in accordance with the manufacturer's UL Installation Instructions must be approved prior to installation.
 - 3. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
 - 4. Install dampers square and free from racking.

5. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
 6. Do not compress or stretch the damper frame into the duct or opening.
 7. Attach multiple damper section assemblies together in accordance with manufacturer's instructions.
- H. Demonstrate re-setting of fire dampers and combination fire and smoke dampers to Owner's representative.
 - I. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
 - J. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
 - K. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.
 - L. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
 - M. Use splitter dampers only where indicated.
 - N. Provide balancing dampers on high velocity systems where indicated. Refer to Section 23 3600 - Air Terminal Units.
 - O. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
 - P. Conduct operational testing, documentation, and training for owner's representative of all fire, smoke, and combination fire and smoke dampers as directed by NFPA 80, chapter 19 - Installation, Testing, and Maintenance of Fire Dampers and NFPA 105, chapter 6 - Installation, Testing, and Maintenance of Smoke Dampers.

END OF SECTION

SECTION 23 3423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Roof exhausters.
- B. Wall exhausters.
- C. Cabinet exhaust fans.
- D. Ceiling exhaust fans.
- E. Kitchen hood upblast roof exhausters.

1.03 RELATED REQUIREMENTS

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 0548 - Vibration And Seismic Controls For HVAC Piping And Equipment.
- C. Section 23 3300 - Air Duct Accessories: Backdraft dampers.
- D. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.
- E. Section 26 2726 - Wiring Devices: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2016.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
- I. UL 705 - Power Ventilators; Current Edition, Including All Revisions.
- J. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate installation instructions.

1.06 QUALITY ASSURANCE

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

1.07 FIELD CONDITIONS

- A. Permanent ventilators may not be used for ventilation during construction.

PART 2 PRODUCTS

2.01 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.
- B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.
- D. Fabrication: Comply with AMCA 99.
- E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- G. Enclosed Safety Switches: Comply with NEMA 250.
- H. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.02 ROOF EXHAUSTERS

- A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- B. Roof Curb: 8 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
- C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.
- D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.03 WALL EXHAUSTERS

- A. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 1/2 inch mesh, 0.062 inch thick aluminum wire bird screen.
- B. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor, and wall mounted multiple speed switch.
- C. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- D. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.04 KITCHEN HOOD UPBLAST ROOF EXHAUSTERS

- A. Direct Drive Fan:
 - 1. Fan Wheel:
 - a. Type: Non-overloading, backward inclined centrifugal.
 - b. Material: Aluminum.
 - 2. Statically and dynamically balanced.
 - 3. Motors:
 - a. Open drip-proof (ODP).
 - b. Heavy duty ball bearing type.

- c. Mount on vibration isolators or resilient cradle mounts, out of air stream.
 - d. Fully accessible for maintenance.
- 4. Housing:
 - a. Construct of heavy gage aluminum including curb cap, windband, and motor compartment.
 - b. Rigid internal support structure.
 - c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
 - d. Construct drive frame assembly of heavy gage steel, mounted on vibration isolators.
 - e. Provide breather tube for fresh air motor cooling and wiring.
- B. Shafts and Bearings:
 - 1. Fan Shaft:
 - a. Ground and polished steel with anti-corrosive coating.
 - b. First critical speed at least 25 percent over maximum cataloged operating speed.
 - 2. Bearings:
 - a. Permanently sealed or pillow block type.
 - b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
 - c. 100 percent factory tested.
- C. Drive Assembly:
 - 1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
 - 2. Belts: Static free and oil resistant.
 - 3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
 - 4. Motor pulley adjustable for final system balancing.
 - 5. Readily accessible for maintenance.
- D. Disconnect Switches:
 - 1. Factory mounted and wired.
 - 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 3. Positive electrical shutoff.
 - 4. Wired from fan motor to junction box installed within motor compartment.
- E. Roof Curb: 8 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips, insulation and curb bottom, curb bottom, ventilated double wall, factory installed nailer strip, and _____.
- F. Drain Trough: Allows for single-point drainage of water, grease, and other residues.
- G. Options/Accessories:
 - 1. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.
 - 2. Drain Connection:
 - a. Aluminum construction.
 - b. Allows single-point drainage of grease, water, or other residues.
 - 3. Finishes: Factory primed.
 - 4. Grease Trap:
 - a. Aluminum.
 - b. Includes drain connection.
 - c. Collects grease residue.
 - 5. Hinge Kit:
 - a. Aluminum hinges.
 - b. Hinges and restraint cables mounted to base (sleeve).
 - c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.
 - 6. Heat Baffle: Prevents heat from radiating into motor compartment.
 - 7. Tie-down Points: Four brackets located on windband secures fan in heavy wind applications.

8. External motor speed controllers for field mounting.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Hung Cabinet Fans:
 1. Install fans with resilient mountings and flexible electrical leads, see Section 23 0548.
 2. Install flexible connections specified in Section 23 3300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof-mounted and externally-mounted wall exhausters.
- G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.
- H. Provide backdraft dampers or motorized dampers in the wall housing or wall collar of sidewall propeller fans.

END OF SECTION

SECTION 23 3600
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Constant volume terminal units.
- B. Variable volume terminal units.
- C. Fan powered terminal units.
- D. Variable volume regulators.
- E. Integral heating coils.
- F. Integral damper motor operators.
- G. Integral controls.

1.03 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Owner furnished air terminal units (excess stock).
- B. Section 22 0513 - Common Motor Requirements for Plumbing Equipment.
- C. Section 23 0548 - Vibration And Seismic Controls For HVAC Piping And Equipment.
- D. Section 23 0923 - Direct-Digital Control System for HVAC.
- E. Section 23 0993 - Sequence of Operations for HVAC Controls.
- F. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- G. Section 23 2113 - Hydronic Piping: Connections to heating coils.
- H. Section 23 2114 - Hydronic Specialties: Connections to heating coils.
- I. Section 23 3100 - HVAC Ducts and Casings.
- J. Section 23 3300 - Air Duct Accessories.
- K. Section 23 3700 - Air Outlets and Inlets.
- L. Section 23 8200 - Convection Heating and Cooling Units: Air coils.
- M. Section 23 0913 - Instrumentation and Control Devices for HVAC: Thermostats and Actuators.
- N. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2019).
- B. ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope; 2019.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- E. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.
- F. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- G. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
 - 1. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 to 4 inch wg.
- D. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- E. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide one year manufacturer warranty for air terminal units, integral heating coils, and integral controls.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Ceiling mounted variable air volume supply air control terminals for connection to single duct, central air systems, with system powered variable volume controls,, hot water heating coils.
- B. Identify each terminal unit with clearly marked identification label and air flow indicator. Include unit nominal air flow, maximum factory set airflow, minimum factory set air flow, and coil type.

2.02 SINGLE DUCT VARIABLE VOLUME UNITS

- A. Basic Assembly:
 - 1. Casings: Minimum 22 gage galvanized steel.
 - 2. Lining: Minimum 1/2 inch thick neoprene or vinyl coated fibrous glass insulation, 1.5 lb/cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements. Face lining with mylar film.
 - 3. Plenum Air Inlets: Round stub connections for duct attachment.
 - 4. Plenum Air Outlets: S slip and drive connections.
- B. Basic Unit:
 - 1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.
 - 2. Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 2 percent of design air flow at 1 inches rated inlet static pressure.
 - 3. Mount damper operator to position damper normally open.
- C. Multi Outlet Attenuator Section: With 6 inch diameter collars, each with butterfly balancing damper with lock.

- D. Round Outlet: Discharge collar matching inlet size.
- E. Hot Water Heating Coil:
 - 1. Construction: 1/2 inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig pressure, factory installed.
 - 2. Capacity: Based on 140 degree F entering water, 110 degree F leaving water and 50 percent total air volume.
- F. DDC (Direct-Digital Controls):
 - 1. Include a factory-installed, unit-mounted, direct-digital controller.
 - 2. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
 - 3. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
 - a. Occupied and unoccupied operating mode.
 - b. Remote reset of temperature or CFM set points.
 - c. Proportional, plus integral control of room temperature.
 - d. Monitoring and adjusting with portable terminal.
 - 4. Room Sensor:
 - a. Compatible with temperature controls specified.
 - b. Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
 - 5. See Section 23 0923.
- G. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
 - 1. Air Flow Sensor.
 - a. Plastic parts are fire-resistant, complying with UL 94.
 - b. Provides accuracy within 5 percent with a 90 degree sheet metal elbow directly at the inlet of the assembly.
 - c. Control tubing is protected by grommets at the wall of the air flow sensor's housing.
 - d. Furnished with twelve total pressure sensing ports and a center averaging chamber that amplifies the sensed air flow signal.
 - e. Provide sensor with a pressure transducer to interface with a DDC system.
 - f. Provide velocity pressure sensor with a removable access section for maintenance.
 - 2. Signal accuracy: Plus/minus five percent throughout terminal operating range.
- H. Control Sequence:
 - 1. Suitable for operation with duct pressures between 0.25 and 3.0 inch wg inlet static pressure.
 - 2. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.
 - 3. See Section 23 0993.

2.03 FAN POWERED VARIABLE VOLUME UNITS

- A. Basic Assembly:
 - 1. Casings: Minimum 22 gage galvanized steel.
 - 2. Lining: Minimum 1/2 inch thick neoprene or vinyl coated fibrous glass insulation, 1.5 lb/cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements. Face lining with mylar film.
 - 3. Plenum Air Inlets: Round stub connections and S slip and drive connections for duct attachment.
 - 4. Plenum Air Outlets: S slip and drive connections.
- B. Basic Unit:
 - 1. Configuration: Air volume damper assembly and fan in series arrangement inside unit casing. Locate control components inside protective metal shroud.
 - 2. Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 2 percent of design air flow at 1 inches rated inlet static pressure.

3. Mount damper operator to position damper normally open.
- C. Automatic Damper Operator:
- D. Fan Assembly:
 1. Fan: Forward curved centrifugal type with direct drive permanent split capacitor type, thermally protected motor. Refer to Section 23 0513.
 2. Speed Control: Infinitely adjustable with electric/pneumatic and electronic controls.
 3. Isolation: Fan/motor assembly on rubber isolators.
- E. Hot Water Heating Coil:
 1. Construction: 1/2 inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig pressure, factory installed.
 2. Capacity: Based on 195 degree F entering water, 165 degree F leaving water and 50 percent total air volume.
- F. Wiring:
 1. Factory mount and wire controls. Mount electrical components in control box with removable cover. Incorporate single point electrical connection to power source.
 2. Factory mount transformer for control voltage on electric and electronic control units. Provide terminal strip in control box for field wiring of thermostat and power source.
 3. Wiring Terminations: Wire fan and controls to terminal strip. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
 4. Disconnect Switch: Factory mount fused disconnect switch in control panel.
- G. Electric Heating Coil:
 1. Listed and provided by the terminal unit manufacturer.
 2. Coil Casing: 20 gage, 0.0359 inch galvanized steel.
 3. Heating Elements: Nickel chrome, supported by ceramic insulators.
 4. Integral Control Panel: NEMA 250, Type 2 enclosure with hinged access door for access to all controls and safety devices.
 5. Furnish a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow.
 6. Provide the following additional components, mounted and/or wired within the control enclosure:
 - a. Fused or non-fused door interlocking disconnect switch.
 - b. Mercury contactors.
 - c. Fuse block.
 7. Factory wired, including all limit switches and steps of control as shown on the equipment schedule, with the SSR (solid-state relay) proportional heat control.
 8. Provide SCR (Silicon Controlled Rectifier) controller.
- H. DDC (Direct-Digital Controls):
 1. Include a factory-installed, unit-mounted, direct-digital controller.
 2. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
 3. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
 - a. Occupied and unoccupied operating mode.
 - b. Remote reset of temperature or CFM set points.
 - c. Proportional, plus integral control of room temperature.
 - d. Monitoring and adjusting with portable terminal.
 4. Room Sensor:
 - a. Compatible with temperature controls specified.
 - b. Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
 5. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
 - a. Air Flow Sensor.

- 1) Plastic parts are fire-resistant, complying with UL 94.
 - 2) Provides accuracy within 5 percent with a 90 degree sheet metal elbow directly at the inlet of the assembly.
 - 3) Control tubing is protected by grommets at the wall of the air flow sensor's housing.
 - 4) Furnished with twelve total pressure sensing ports and a center averaging chamber that amplifies the sensed air flow signal.
 - 5) Provide sensor with a pressure transducer to interface with a DDC system.
 - 6) Provide velocity pressure sensor with a removable access section for maintenance.
- b. Signal accuracy: Plus/minus five percent throughout terminal operating range.
6. Control Sequence:
- a. Suitable for operation with duct pressures between 0.25 and 3.0 inch wg inlet static pressure.
 - b. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.

2.04 MECHANICAL TYPE VARIABLE VOLUME UNITS

- A. Basic Assembly:
1. Casings: Minimum 22 gage galvanized steel; maximum casing leakage: 3 percent of design air flow at 6 inches minimum inlet static pressure..
 2. Lining: Minimum 1/2 inch thick neoprene or vinyl coated fibrous glass insulation, 1.5 lb/cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements. Face lining with mylar film.
 3. Plenum Air Inlets: Round/oval stub connections for duct attachment.
 4. Plenum Air Outlets: S slip and drive connections.
- B. Basic Unit:
1. Configuration: Air volume damper assembly and control components inside unit casing.
 2. Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 2 percent of design air flow at 1 inches rated inlet static pressure.
 3. Mount damper operator to position damper normally open.
- C. Regulator:
1. Locate: Air volume damper and automatic flow control assembly inside unit casing.
 2. Construction: Extruded aluminum or 20 gage galvanized steel components; key damper blades into shaft with nylon fitted pivot points.
 3. Automatic flow control assembly: Combine spring rates matched for each volume regulator size with machined dashpot for stable operation.
 4. Air volume control damper shall be factory calibrated assembly consisting of damper and damper shaft extension for connection to externally mounted control actuator.
 5. Internally mounted pneumatic actuator with pilot positioner: Position damper normally open.
- D. Multi Outlet Adapter Section: With 6 inch diameter collars, each with butterfly balancing damper with lock.
- E. Hot Water Heating Coil:
1. Construction: 1/2 inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig pressure, factory installed.
 2. Capacity: Based on 195 degree F entering water, 165 degree F leaving water and 50 percent total air volume.

PART 3 EXECUTION

3.01 INSTALLATION

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

- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
- E. Do not support from ductwork.
- F. Connect to ductwork in accordance with Section 23 3100.
- G. Provide minimum of 5 ft of 1 inch thick lined ductwork downstream of units.
- H. Install heating coils in accordance with Section 23 8200.
- I. Verify that electric power is available and of the correct characteristics.

3.02 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

END OF SECTION

SECTION 23 3700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.
- C. Louvers.

1.03 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2015.
- B. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (Reaffirmed 2021).
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.05 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Louvers
 - 1. Ruskin: www.ruskin.com/category/11~Louver-and-Architectural-Solutions
 - 2. Greenheck: www.greenheck.com/products/air-control/louvers
 - 3. Pottorff: www.pottorff.com
- B. Air Devices
 - 1. Titus: www.titus-hvac.com
 - 2. Price Industries: www.priceindustries.com
 - 3. Krueger-HVAC: www.krueger-hvac.com
 - 4. Tuttle and Bailey: www.tuttleandbailey.com
- C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DIFFUSERS

- A. See the Air Device Schedule on the Contract Drawings

2.03 REGISTERS / GRILLES

- A. See the Air Device Schedule on the Contract Drawings

2.04 LOUVERS

- A. Stationary Drainable Blade
 - 1. Performance
 - a. Free Area: 52.3% based on a 48 in. x 48 in. (1219 mm x 1219 mm) louver size
 - b. Free Area Velocity at Beginning Point of Water Penetration: 1027 fpm (5.2 m/s)

2. Standard Construction
 - a. Frame: Heavy gauge extruded 6063-T5 aluminum, 6 in. (152 mm) x 0.063 in. (2 mm) nominal wall thickness
 - b. Blades: Drainable design, heavy gauge extruded 6063-T5 aluminum, 0.063 in. (2 mm) nominal wall thickness, positioned 45° on approximately 6 in. (152 mm) centers
 - c. Louver: Depth 6 in. (152 mm)
 - d. Construction: Mechanically fastened
 - e. Wind Load: 25 PSF (1.2 kPa)
3. Finish:
 - a. AAMA 611 compliant Anodized Finish
4. Color: To be selected by Architect Engineer from manufacturer's standard colors range.
5. Options: Provide the following options where indicated on the Contract Drawings:
 - a. Bird Screen
 - b. Blank Off Panels

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Provide air device manufacturer's plaster or mounting frame for installation of lay-in type air devices in hard ceilings.
- D. Install diffusers to ductwork with air tight connection.
- E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 9123.

END OF SECTION

SECTION 23 4000
HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Activated carbon filters.
- B. Disposable panel filters.
- C. Extended surface high efficiency media filters.
- D. Extended surface retained media filters.
- E. High efficiency particulate air (HEPA) filters.

1.03 RELATED REQUIREMENTS

- A. Section 01 5000 - Temporary Facilities and Controls: Filters for temporary heating and ventilating.
- B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. AHRI 850 (I-P) - Performance Rating of Commercial and Industrial Air Filter Equipment; 2013.
- B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Errata (2020).
- C. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods; 2015b.
- D. UL 586 - High Efficiency, Particulate, Air Filter Units; Current Edition, Including All Revisions.
- E. UL 900 - Standard for Air Filter Units; Current Edition, Including All Revisions.

1.05 PERFORMANCE REQUIREMENTS

- A. Conform to 1 Section 7.4.
 - 1. Dust Spot Efficiency: Plus or minus 5 percent.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.

1.07 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 ACTIVATED CARBON FILTERS

- A. Assembly: Galvanized steel unit incorporating extruded aluminum tracks to accommodate filter servicing trays in deep V arrangement arranged for upstream servicing with disposable panel pre-filter.
 - 1. Nominal Size: 12 by 24 by 29 inches.
- B. Media:
 - 1. Activated Carbon Density: 34 lb/cu ft, pelletized or granular to 6 by 10 Tyler mesh screen.
 - 2. Carbon Tetrachloride Activity: Minimum 60 percent; in thin bed.

3. Trays: Nominal size 24 by 24 by 5/8 inches thick.
 4. Carbon: 1.42 cu ft per 1000 CFM nominal air flow capacity.
- C. Rating: 500 FPM face velocity, 0.45 inch WG resistance.

2.02 DISPOSABLE PANEL FILTERS

- A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
1. Nominal Size: ____ by ____ inches.
 2. Thickness: 1 inch.
- B. Performance Rating:
1. Face Velocity: 500 FPM.
 2. Initial Resistance: 0.15 inch WG.
 3. Recommended Final Resistance: 0.50 inches WG.
- C. Casing: Cardboard frame.

2.03 EXTENDED SURFACE HIGH EFFICIENCY MEDIA FILTERS

- A. Media: Pleated, water-resistant glass fiber with aluminum separators; in 16 gage, 0.0598 inch steel holding frame with corrosion resistant coating.
1. Nominal Size: 24 by 24 by 6 inches deep.
- B. Minimum Efficiency Reporting Value (MERV): 15, when tested in accordance with ASHRAE Std 52.2.
- C. Performance Rating, per ASHRAE Std 52.2:
1. MIL-STD-282 Test 0.3 Micron Dioctyl Phthalate Smoke (DOP) Efficiency: 99 percent.
 2. Initial Resistance at 150 fpm Face Velocity: 0.35 inch WG.
 3. Recommended Final Resistance: 1.5 inch WG.

2.04 EXTENDED SURFACE RETAINED MEDIA FILTERS

- A. Media: UL 900 Class 1 pleated, non-woven cotton fabric, scrim reinforced; supported by welded steel retainer; in 16 gage, 0.0598 inch steel holding frame with corrosion resistant coating.
1. Effective Media Area: 16 sq ft per 1000 CFM capacity rating.
 2. Nominal Size: 24 by 24 by 12 inches deep.
- B. Minimum Efficiency Reporting Value (MERV): 13, when tested in accordance with ASHRAE Std 52.2.
- C. Performance Rating: ASHRAE Std 52.2;
1. Percent Average Weight Arrestance: 92.
 2. Initial Resistance at 500 FPM Face Velocity: 0.20 inch WG.
 3. Recommended Final Resistance: 0.50 inch WG above initial resistance.

2.05 HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTERS

- A. Media: UL 586, pleated, water-resistant glass fiber with separators of aluminum:
1. Holding Frame: Plywood.
 2. Media to Frame Side Bond: Polyurethane foam.
 3. Face Gasket: Neoprene expanded rubber.
 4. Nominal Size: 24 by 24 by 12 inches deep.
- B. Minimum Efficiency Reporting Value (MERV): 15, when tested in accordance with ASHRAE Std 52.2.
- C. Performance Rating:
1. MIL-STD-282 Test 0.3 Micron Dioctyl Phthalate Smoke (DOP) Efficiency: 99.97 percent.
 2. Rated Air Flow Capacity at 1.0 inch WG: 1150 CFM.
 3. Recommended Final Resistance: 3.0 inch WG.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Install filter gauge static pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.
- E. Provide filter gauges on filter banks, installed with separate static pressure taps upstream and downstream of filters.

END OF SECTION

SECTION 23 5216
CONDENSING BOILERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Manufactured units.
- B. Boiler construction.
- C. Boiler trim.
- D. Fuel burning system.
- E. Factory installed controls.

1.03 RELATED REQUIREMENTS

- A. Section 23 0913 - Instrumentation and Control Devices for HVAC.
- B. Section 23 2114 - Hydronic Specialties.
- C. Section 23 2123 - Hydronic Pumps.
- D. Section 23 2500 - HVAC Water Treatment.
- E. Section 23 5100 - Breechings, Chimneys, and Stacks.
- F. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. ANSI Z21.13 - American National Standard for Gas-Fired Low Pressure Steam and Hot Water Boilers; 2017, with Errata (2018).
- C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2021.
- E. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.
- F. NFPA 31 - Standard for the Installation of Oil Burning Equipment; 2018.
- G. NFPA 54 - National Fuel Gas Code; 2018.
- H. NFPA 58 - Liquefied Petroleum Gas Code; 2020.
- I. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990 (Amended 2018).

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.

- B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.
- C. Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.
- D. Manufacturer's Factory Inspection Report: Submit boiler inspection prior to shipment.
- E. Manufacturer's Field Reports: Burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.
 - 1. Indicate compliance with specified performance and efficiency.
 - 2. Provide results of the following combustion tests:
 - a. Heat input.
 - b. Heat output.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- H. Software: Copy of software provided under this section.

1.07 QUALITY ASSURANCE

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

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide a five year warranty to include coverage for heat exchanger.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.
- B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.02 BOILER CONSTRUCTION

- A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
- B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.
- C. Required Directory Listings:
 - 1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
 - 2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.
- D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.

- E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
- F. Insulate casing with insulation material, protected and covered by heavy-gage metal jacket.
- G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic or powder coated finish.

2.03 BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Flow switch.
- C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
- D. Temperature and pressure gauge.
- E. Pressure Switches:
 - 1. High gas pressure.
 - 2. Low gas pressure.
 - 3. Air pressure.
- F. Manual reset high limit.
- G. Boiler Pump (where required by boiler design):
 - 1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
 - 2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.
 - 3. Pump time delay.

2.04 FUEL BURNING SYSTEM

- A. Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn natural gas, and maintain fuel-air ratios automatically.
 - 1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
 - 2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
 - 3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
 - 4. Combustion Air Filter: Protects fuel burning system from debris.
- B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.
- C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.
- D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe

2.05 FACTORY INSTALLED CONTROLS

- A. Option for internal or external (0-10) VDC control.
- B. Temperature Controls:
 - 1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.
 - 2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
 - 3. Low-fire start time delay relay.
- C. Electronic PI setpoint/modulation control system.
- D. Microprocessor-based, fuel/air mixing controls.

2.06 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide factory tests to check construction, controls, and operation of unit.
- C. Manufacturer to conduct boiler inspection prior to shipment; submit copy of inspection report to Architect Engineer.
- D. Non-Conforming Work: See Section 01 4000.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.
- C. Install boiler and provide connection of liquified petroleum gas service in accordance with requirements of NFPA 58 and applicable codes.
- D. Install boiler and provide connection of No. fuel oil service in accordance with requirements of NFPA 31 and applicable codes.
- E. Install boiler on concrete housekeeping base, sized minimum of 4 inches larger than boiler base in accordance with Section 03 3000.
- F. Coordinate factory installed controls with Section 23 0913.
- G. Coordinate provisions for water treatment in accordance with Section 23 2500.
- H. Pipe relief valves to nearest floor drain.
- I. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.
- J. Install primary boiler pump in accordance with Section 23 2123.
- K. Provide piping connection and accessories in accordance with Section 23 2114.
- L. Provide for connection to electrical service in accordance with Section 26 0583.
- M. Vent combustion fumes in accordance with manufacturer's recommendations. Refer to Section 23 5100.

3.02 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.
- D. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- E. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of one day of training.
 - 3. Instructor: Manufacturer's training personnel.
 - 4. Location: At manufacturer's training facility; include travel expenses for one member of Owner's staff.

END OF SECTION

SECTION 23 5233.13
FINNED WATER-TUBE BOILERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Boilers.
- B. Controls and boiler trim.
- C. Hot water connections.
- D. Fuel connection.
- E. Collector, induced draft fan, and chimney connection.
- F. Circulator.
- G. Expansion tank.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 23 2114 - Hydronic Specialties.
- C. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.04 REFERENCE STANDARDS

- A. AHRI 1500 - Performance Rating of Commercial Space Heating Boilers; 2015.
- B. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2021.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- E. NFPA 54 - National Fuel Gas Code; 2018.
- F. UL (DIR) - Online Certifications Directory; Current Edition.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.
- D. Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

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

1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable code for internal wiring of factory wired equipment.

- B. Conform to ASME BPVC-IV and BPVC-VIII-1 for boiler construction.
- C. Units: UL (DIR) listed and labeled.
- D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide a five year warranty to include coverage for heat exchangers.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Performance rating shall be in accordance with AHRI 1500.

2.02 MANUFACTURED UNITS

- A. Hot water natural draft boiler with horizontal grid, finned tube heat exchanger, gas burning system, refractory combustion chamber, controls, and boiler trim including circulator and fill system consisting of diaphragm type expansion tank, fill and check valve, and automatic air vent.

2.03 FUEL BURNING SYSTEM

- A. Induced Draft Gas Burner: Stainless steel burners for on-off firing and natural gas with adjustable combustion air supply, gas pressure regulator, diaphragm gas valves, manual shut-off, intermittent spark or glow coil ignition, thermistor flame sensing device, and automatic 100% safety gas shut-off.
- B. Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven allow gas valve to open.

2.04 TRIM

- A. ASME rated pressure relief valve set at 45 psi.
- B. Low water cut-off and inlet flow switch to automatically prevent burner operation when water falls below safe level or on low flow through boiler.

2.05 CONTROLS

- A. Operating Controls: Pre-wired, factory assembled electric control including pilot safety and thermocouple transformer, 24-volt gas valve, manual main and pilot valves, and junction box.
- B. Electronic operating temperature controller:
 1. NEMA 250 Type 1 enclosure with full cover for wall mounting.
 2. Ambient temperature range minus 30 to 150 degrees F.
 3. Adjustable reset ratio of outside air temperature change to discharge control point change 1:2 to 100:1.
 4. Integral set point adjustment 80 to 230 degrees F.
 5. Electronic primary and outdoor sensors.
- C. High limit temperature controller with automatic reset for burner to prevent boiler water temperature from exceeding safe system temperature.

2.06 CIRCULATOR

- A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in line mounting, oil lubricated, for 125 psi maximum working pressure.
 1. Casing: Cast iron.
 2. Impeller: Cadmium plated steel, keyed to shaft.

3. Bearings: Two, oil lubricated bronze sleeves.
4. Shaft: Alloy steel with copper sleeve, integral thrust collar.
5. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.
6. Drive: Flexible coupling.

2.07 DIAPHRAGM TYPE EXPANSION TANK

- A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; rated for working pressure of 125 psi, with flexible diaphragm sealed into tank, and steel legs or saddles.
- B. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psi.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.
- C. Install boiler on concrete housekeeping base, sized minimum 4 inches larger than boiler base. Refer to Section 03 3000.
- D. Provide piping connections and accessories as indicated; refer to Section 23 2114.
- E. Pipe relief valves to nearest floor drain.
- F. Install circulator and diaphragm expansion tank on boiler.
- G. Provide for connection to electrical service. Refer to Section 26 0583.

3.02 SYSTEM STARTUP

- A. Provide the services of manufacturer's field representative for starting and testing unit.

3.03 CLOSEOUT ACTIVITIES

- A. Train operating personnel in operation and maintenance of units.
- B. Provide the services of manufacturer's field representative to conduct training.

END OF SECTION

SECTION 23 5533
FUEL-FIRED UNIT HEATERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Gas fired unit heaters.

1.02 REFERENCE STANDARDS

- A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASHRAE Std 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; 2017, with Errata (2019).

PART 2 PRODUCTS

2.01 GAS FIRED UNIT HEATERS

- A. Unit Heaters: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner, controls, and accessories:
 - 1. Heating: Natural gas fired.
 - 2. Discharge Louvers: Individually adjustable horizontal and vertical louvers to match cabinet finish.
- B. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner.
- C. Supply Fan: Propeller type with direct drive, variable pitch motor pulley.
- D. Heat Exchanger: Aluminized steel welded construction.
- E. Gas Burner:
 - 1. Atmospheric type with adjustable combustion air supply.
 - 2. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
 - 3. Electronic pilot ignition, with electric spark igniter.
- F. Gas Burner Safety Controls:
 - 1. Thermocouple Sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
 - 2. Vent Safety Shutoff Sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
- G. Operating Controls:
 - 1. Room Thermostat: Cycles burner to maintain room temperature setting.
- H. Performance:
 - 1. Ratings: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Std 90.1 I-P; seasonal efficiency to ASHRAE Std 103.

END OF SECTION

SECTION 23 6313

AIR COOLED REFRIGERANT CONDENSERS

PART 2 PRODUCTS

1.01 PERFORMANCE REQUIREMENTS

END OF SECTION

SECTION 23 6416
CENTRIFUGAL WATER CHILLERS

PART 2 PRODUCTS

1.01 CENTRIFUGAL WATER CHILLER PERFORMANCE REQUIREMENTS

- A. Single-Stage, Centrifugal Chiller, CH-1:
 - 1. Refrigerant: R-454B, use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) no greater than that allowed by federal code.
 - 2. Evaporator:
 - a. Chilled Water Flow: _____ gpm .
 - b. Leaving Chilled Water Temperature: _____ degrees F.
 - c. Entering Chilled Water Temperature: _____ degrees F.
 - d. Maximum Water Pressure Drop: _____ feet water.
 - 3. Condenser Water:
 - a. Flow: _____ gpm.
 - b. Entering Chilled Water Temperature: _____ degrees F.
 - c. Leaving Chilled Water Temperature: _____ degrees F.
 - d. Maximum Water Pressure Drop: _____ feet.

END OF SECTION

SECTION 23 6423
SCROLL WATER CHILLERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Factory-assembled packaged chiller.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Condenser water connections.
- F. Electrical power connections.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete housekeeping pads.
- B. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.
- D. Section 23 0800 - Commissioning of HVAC.
- E. Section 23 0923 - Direct-Digital Control System for HVAC.
- F. Section 23 0993 - Sequence of Operations for HVAC Controls.
- G. Section 23 2113 - Hydronic Piping.
- H. Section 23 2114 - Hydronic Specialties.
- I. Section 26 0583 - Wiring Connections.

1.04 REFERENCE STANDARDS

- A. AHRI 550/590 (I-P) - Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle; 2020.
- B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.
- C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- F. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate physical size, weight and location of major pieces of equipment to be installed. Notify Architect Engineer of any major deviations from the equipment originally specified prior to ordering equipment.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

- C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- E. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories; include trouble-shooting guide.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. When required, provide certification of inspection in compliance with the requirements of Authority Having Jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written installation instructions for rigging, unloading, and transporting units.
- B. Deliver units to the job site completely assembled and charged with refrigerant and oil by manufacturer.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Provide minimum five year warranty to include coverage for materials and labor for compressor.

PART 2 PRODUCTS

2.01 CHILLER APPLICATIONS

- A. Chiller: Water-Cooled.
 - 1. Evaporator:
 - a. Water Based Fouling Factor: 0.00010 sq ft hr degrees F per Btu.
 - 2. Packaged Water-Cooled Condenser:
 - a. Water Based Fouling Factor: 0.00025 sq ft hr degrees F per Btu.

2.02 CHILLERS

- A. Chillers: Factory assemble and test chiller consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, starters, and microprocessor-based controls.
 - 1. Rating: AHRI 550/590 (I-P).
 - 2. Safety: UL 1995 and ASHRAE Std 15.
 - 3. Construction & Testing: ASME BPVC-VIII-1 as applicable for construction type.
 - 4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., testing firm acceptable to the Authority Having Jurisdiction, or _____ as suitable for the purpose specified and indicated.
 - 5. Energy Efficiency: 1.
 - 6. Enclosures:
 - a. Frame:
 - 1) Heavy-gage steel.
 - 2) Factory apply hot-dipped galvanized or air-dried paint finish.
 - b. Steel Chiller Cabinets:
 - 1) Factory apply baked on enamel or baked on powder paint finish.
 - c. Electrical Equipment: NEMA 250 or UL 1995 as applicable.

2.03 COMPRESSORS AND EVAPORATOR

- A. Compressors: Hermetic scroll type.
 - 1. Unit: Fully hermetic type with multiple, direct drive compressors with discharge and suction service valves.
 - 2. Vibration Control: Factory installed internal isolators or field installed external isolators.
 - 3. Oil Lubrication System: Initial oil charge, oil sump, heater, oil level, and sight glass.
 - 4. Capacity Reduction System: Compressor staging with control down to 12 percent of full load without the activation of hot gas by-pass.
 - 5. Motor: 3600, 3500, or _____ rpm, suction gas-cooled, with thermal, current, or _____ overload protection.
- B. Evaporator: Provide shell and tube, brazed plate, or _____ type.
 - 1. Shell and tube type.
 - a. Shell, removable heads and tube support sheets constructed of carbon steel.
 - b. Tubes: Mechanically expand and fasten, seamless, externally or internally enhanced, copper tubes into intermediate tube support sheets along the length of shell to avoid contact and relative motion between tubes.
 - c. Refrigerant Working-Side Pressure Rating: 400 psig minimum.
 - d. Water Working-Side Pressure Rating: 150 psig minimum.
 - e. Provide with flanged or grooved connections.
 - f. Insulation for all cold surfaces.
 - 1) Insulation is factory or field installed on shell, connections, and suction piping.
 - 2) 0.75 inches minimum thick, closed cell, expanded polyvinyl chloride, polyurethane, or vinyl nitrate polymer insulation with a maximum k value of 0.28.
 - g. Provide factory or field installed vents and water drain connections on evaporator or piping.
 - h. Provide factory or field installed fittings for temperature control sensors on evaporator or piping.
 - i. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F.
 - 2. Brazed plate type.
 - a. Plate Material: 316 stainless steel or _____.
 - b. Refrigerant Working-Side Pressure Rating: 430 psig minimum.
 - c. Water Working-Side Pressure Rating: 150 psig minimum.
 - d. Provide with flanged or grooved connections.
 - e. Insulation for all cold surfaces.
 - 1) Insulation is factory or field installed on evaporator, connections, and suction piping.
 - 2) 0.75 inches minimum thick, closed cell, expanded polyvinyl chloride, polyurethane, Armaflex II, or _____ insulation with a maximum k value of 0.28.
 - f. Provide factory or field installed vents and water drain connections on evaporator or piping.
 - g. Provide factory or field installed fittings for temperature control sensors on evaporator or piping.
 - h. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F.

2.04 WATER-COOLED CONDENSER

- A. Provide shell and tube or brazed plate type.
 - 1. Shell and tube type.
 - a. Shell, removable heads and tube support sheets constructed of carbon steel.
 - b. Tubes: Mechanically expand and fasten, seamless, externally or internally enhanced, copper tubes into intermediate tube support sheets along the length of shell to avoid contact and relative motion between tubes.

- c. Refrigerant Working-Side Pressure Rating: 500 psig minimum.
- d. Water Working-Side Pressure Rating: 150 psig minimum.
- e. Provide with flanged or grooved connections.
- 2. Brazed plate type.
 - a. Plate Material: 316 stainless steel or _____.
 - b. Refrigerant Working-Side Pressure Rating: 505 psig minimum.
 - c. Water Working-Side Pressure Rating: 300 psig minimum.
 - d. Provide with flanged or grooved connections.

2.05 REFRIGERATION CIRCUITS

- A. Provide multiple independent refrigeration circuit(s) with multiple or one compressor(s) per circuit.
- B. Provide liquid line shut-off valve, filter-drier, expansion valve, and refrigerant relief device for each independent circuit.

2.06 INTEGRATED MICROPROCESSOR BASED DDC CONTROLS PACKAGE

- A. Pre-wire, assemble, factory mount, and test operating and safety control system consisting of a digital display or gages, on-auto-off switch, motor starters, disconnect switches, power and control wiring. Provide controls, monitoring, programmable set-points, alarms, and BAS as defined below:
 - 1. Automatic Adjustable Operating Controls:
 - a. Temperature of chilled water leaving chiller.
 - b. Chiller system capacity control based on set-points and system load.
 - c. Compressor short-cycling prevention.
 - d. Lead/lag for multiple compressors.
 - e. Automatic reset on power source failure.
 - f. Load limiting.
 - 2. Normal Operation Monitoring and Open Cover-less Displays:
 - a. Hours of operation.
 - b. Suction and discharge refrigerant pressures.
 - c. Automatic diagnostics.
 - d. Number of starts.
 - e. On/off compressor status.
 - f. Entering and leaving chilled water temperatures.
 - g. Status of operation.
 - h. Condenser water entering and leaving temperatures.
 - i. Weekly purge cycle totalization if applicable.
 - j. Oil pressure.
 - 3. Set-Points:
 - a. Leaving chilled water temperature.
 - b. Date/time.
 - c. Leaving condenser water temperature.
 - 4. Automatic Chiller Shut-Down Safety Controls and Alarm:
 - a. Automatic Reset:
 - 1) Chilled water flow interlock.
 - 2) Voltage protection (over/under).
 - 3) Phase reversal protection.
 - b. Manual Reset:
 - 1) Evaporator low pressure.
 - 2) High motor winding temperature.
 - 3) Low chilled water temperature.
 - 4) Low chilled water flow.
 - 5) High condenser refrigerant discharge pressure.
 - 6) Motor current overload and phase loss.
 - 7) Low oil flow.

- c. Remote Alarm: Activate remote, audible bell upon safety shutdown of chiller.
- 5. Building Automation System (BAS) Communications via Shielded Cable:
 - a. Minimum Data Transmission to BAS:
 - 1) All system operating conditions.
 - 2) Capacity control information.
 - 3) Safety shutdown conditions.
 - b. Minimum Operating Commands from BAS:
 - 1) Remote unit start/stop.
 - 2) Remote condenser water reset.
 - 3) Remote chilled water reset.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.
- C. Install units on vibration isolators.
- D. Connect to electrical service.
- E. Connect to chilled water piping.
- F. Connect to condenser water piping.
- G. Arrange piping for easy dismantling to permit tube cleaning and removal.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Perform factory startup of the chiller by factory trained and authorized servicing technicians confirming equipment has been correctly installed prior to equipment becoming operational and covered under the manufacturer's warranty.
- B. Supply initial charge of refrigerant and oil if not completely factory charged.
- C. Demonstrate system operations and verify specified performance.

3.03 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.
- D. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Conduct walking tour of project.
 - 3. Briefly describe function, operation, and maintenance of each component.
- E. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's training personnel.
 - 4. Location: At project site.

3.04 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

SECTION 23 6426
ROTARY-SCREW WATER CHILLERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Factory-assembled packaged chiller.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Starters.
- F. Variable frequency drives.
- G. Electrical power connections.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete housekeeping pads.
- B. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- D. Section 23 0548 - Vibration And Seismic Controls For HVAC Piping And Equipment.
- E. Section 23 0553 - Identification for HVAC Piping and Equipment.
- F. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.
- G. Section 23 0800 - Commissioning of HVAC.
- H. Section 23 0923 - Direct-Digital Control System for HVAC.
- I. Section 23 0993 - Sequence of Operations for HVAC Controls.
- J. Section 23 2113 - Hydronic Piping.
- K. Section 23 2114 - Hydronic Specialties.
- L. Section 25 1500 - Integrated Automation Software.
- M. Section 26 0583 - Wiring Connections.

1.04 REFERENCE STANDARDS

- A. AHRI 550/590 (I-P) - Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle; 2020.
- B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.
- C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.
- E. IEEE 519 - IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems; 2014.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- G. NEMA MG 1 - Motors and Generators; 2018.
- H. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate physical size, weight and location of major pieces of equipment to be installed. Notify Architect Engineer of any major deviations from the equipment originally specified prior to ordering equipment.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- E. Manufacturer's Certificate: Certify that components furnished but not produced by manufacturer meet or exceed manufacturer's requirements.
- F. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories; include trouble-shooting guide.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. When required, provide certification of inspection in compliance with the requirements of Authority Having Jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written installation instructions for rigging, unloading, and transporting units.
- B. Deliver units to the job site completely assembled and charged with refrigerant and oil by manufacturer.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Provide minimum five year warranty to include coverage for materials only for compressor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 CHILLER APPLICATIONS

- A. Chiller CH-1: Air-Cooled.
 - 1. Evaporator:
 - a. Fouling Factor: 0.0001.
 - 2. Packaged Air-Cooled Condenser:

2.03 CHILLERS

- A. Chillers: Factory assemble and test chiller consisting of compressor(s), compressor motor(s), motor starter(s) or variable frequency drives as indicated, evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, microprocessor-based controls, readouts, and diagnostics.
 - 1. Rating: AHRI 550/590 (I-P).
 - 2. Safety: ASHRAE Std 15 and UL 1995.
 - 3. Construction & Testing: ASME BPVC-VIII-1.

4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
5. Energy Efficiency: 1.
6. Enclosures:
 - a. Chiller Structural Framing:
 - 1) Mount structural steel on welded steel base.
 - 2) Factory apply hot-dip galvanized finish.
 - b. Steel Chiller Cabinets:
 - 1) Factory apply baked on enamel finish.
 - c. Steel Control Panels:
 - 1) Factory apply baked on powder paint or applied corrosion resistant paint prior to assembly.
 - 2) Provide gasketing and weather-proofing to panels with fully opening doors containing starters or variable frequency drives, terminal blocks, through-the-door type disconnects and circuit breaker with lockable handles indicating "power-on" or "power-off".
 - 3) Provide door stays.
 - d. Electrical Equipment: NEMA 250.
7. Motors: NEMA MG 1. See Section 23 0513 for additional requirements.

2.04 COMPRESSORS AND EVAPORATOR

- A. Compressors: Rotary-screw type.
 1. Unit: Semi-hermetic type with two, direct drive compressors with multiple independent refrigeration circuit(s), internal muffler, discharge, check, suction, and _____ service valves.
 2. Oil Lubrication System: Positive pressure system, oil heater, oil separator, check valves, solenoid valves, and filtration devices.
 3. Valves: Check valves in compressor discharge.
 4. Capacity Reduction System: Load/unload valve control down to 20 percent of full load without the activation of hot gas by-pass.
 5. Motor: 3600 rpm, suction gas-cooled, hermetically sealed, squirrel cage induction with starter.
- B. Evaporator: Shell and tube type.
 1. Three pass type, with three independent refrigeration circuits.
 2. Shell, Removable Heads and Tube Support Sheets: Carbon steel.
 3. Tubes: Mechanically expand and fasten, seamless, externally or internally enhanced, copper tubes into intermediate tube support sheets along the length of shell to avoid contact and relative motion between tubes with the capability of being cleanable.
 4. Tube Size: 1.0 inches diameter.
 5. Comply with ASME BPVC-VIII-1 as applicable.
 6. Refrigerant Working-Side Pressure Rating: 200 psig.
 7. Water Working-Side Pressure Rating: 150 psig.
 8. Connections: Flanged and designed for 150 psig waterside working pressure.
- C. Insulation for All Cold Surfaces:
 1. Factory install on shell and all other cold surfaces.
 2. 0.75 inches minimum thick, closed cell, expanded polyvinyl chloride flexible foam insulation with a maximum K value of 0.28.
- D. Provide vents and water drain connections.
- E. Provide fittings for temperature control sensors.
- F. Freeze Protection: Provide evaporator heater with thermostat to protect from freezing at ambient temperatures down to minus 20 degrees F.

2.05 AIR-COOLED CONDENSER AND FANS

- A. Heat Exchanger:

1. Tubes: Round.
 2. Arrangement: Two pass.
 3. Mechanically bond aluminum fins to internally enhanced, seamless copper tubing and protect with corrosion resistant materials or coatings.
 4. Clean, dehydrate and test.
 5. Leak Test: 506 psig.
 6. Seal: Nitrogen holding charge.
- B. Coil Guards: Provide expanded metal with lint screens. Provide coil protection for shipping by enclosing entire condenser coil with heavy plastic to prevent inadvertent damage to coil during shipping or rigging.
- C. Fans and Motors:
1. Fans: Dynamically balance propeller type, direct drive fans of reinforced polymer corrosion resistant construction and equip with sealed, permanently lubricated ball bearings.
 2. Discharge Fan Guards: Coated steel wire.
 3. Discharge Direction: Vertical.
 4. Motors: Totally enclosed, high efficiency, suitable for outdoor use, three phase, permanent split capacitor, single speed with internal overload protection.

2.06 REFRIGERATION CIRCUITS

- A. Provide two independent refrigeration circuit(s) with two compressor(s) per circuit.
- B. Minimum Refrigerant Specialties per Circuit:
1. Isolation and service valves for refrigerant removal and charging.
 2. Removable-core filter driers.
 3. ASHRAE Std 15 compliant relief valves.
 4. Liquid line sight glass with moisture indicator.
 5. Refrigerant expansion valves or metering devices.
 6. Complete operating charge of both refrigerant and oil.

2.07 STARTERS AND DRIVES

- A. Starters: Design unit mounted, across-the-line starter to operate in temperatures up to 104 degrees F.
1. Provide incoming line provisions for aluminum, mechanical type incoming line lugs based on the number and cable sizes shown on drawings.
 2. Provide properly sized, double break main contacts with weld resistant silver cadmium faces and low resistance auxiliary interlocks with palladium silver contacts for interlocks that interface with control panel.
 3. Provide control power transformer with fused primary, secondary, and current transformers of the proper size, ratio and burden capacity.
 4. Provide control relays to interface with control panel.
 5. Wiring:
 - a. Type MTW copper stranded 90 degree C for power and control wiring.
 - b. 14 gage, 0.0641 inch, minimum, for control wiring.
 6. Motor Protection System Attributes:
 - a. Three phase overload protection.
 - b. Startup overload protection.
 - c. Phase imbalance, loss and reversal.
 - d. Low voltage.
 - e. Distribution fault protection.
- B. Variable Frequency Drives: Completely assemble, wire, pipe, and factory test, factory or field mounted variable frequency drive (VFD). Limit the field electrical connections for compressor motor power to the main power leads to the VFD, wiring of liquid pumps and tower fans to the control panel.
1. Characteristics:
 - a. Refrigerant cooled.

- b. Microprocessor based pulse width modulation (PWM) with input/output power devices, DC voltage rectifier, and inverter/control regulator to convert DC voltage to sinusoidal PWM waveform.
- c. Isolate low voltage control physically from main power sections.
- d. Control motor speed by integrated controls over wide range of operating conditions.
- e. Provide short circuit interrupt and withstand rating suitable for available current.
- 2. Performance:
 - a. Do not exceed IEEE-519 requirements for voltage total harmonic distortion (THD) and harmonic current total demand distortion (TDD) using VFD circuit breaker input terminals as the point of common coupling (PCC).
 - b. Full Load Efficiency: Minimum 97 percent at 100 percent VFD rated capacity.
 - c. Unity Displacement Power Factor: 0.99 minimum.
 - d. Voltage Boost Capability: Full motor voltage at reduced line voltage conditions.
 - e. Soft start, linear acceleration, and coast to stop capabilities.
 - f. Base Motor Adjustable Frequency Range: Control to 15 percent capacity at nameplate voltage.
 - g. Torque Generation: 150 percent instantaneous.
- 3. Heat Sink and Mating Flange:
 - a. Design for 185 psig waterside working pressure.
 - b. Meter to maintain temperature within acceptable limits.
- 4. Suitable Ratings:
 - a. Operation at plus or minus 10 percent nameplate voltage.
 - b. Continuous Operation at:
 - 1) 100 percent of nameplate amperes and 5 seconds at 15 percent.
 - 2) Ambient temperature range of 40 to 122 degrees F, 95 percent humidity non-condensing for altitudes up to 6000 feet.
 - c. Comply with NEMA 250 and NEMA MG 1.
- 5. User Interface for Programming and Display of the Following Parameters:
 - a. Operating, configuration and fault messages.
 - b. Hertz frequency.
 - c. VFD load, line side voltage, and current.
 - d. kW.
 - e. Input/output power devices temperature.
- 6. Electrical Service (single point power):
 - a. Input Circuit Breaker: Suitable for the available current indicated.
 - b. Provide power for chiller oil pump via factory wired standard branch circuit breaker.
 - c. Provide power for oil heater, VFD and controls via 3 KVA control power transformer and factory wired circuit breaker.
- 7. Discrete Contact Outputs (115 volt):
 - a. Circuit breaker shunt trip.
 - b. Chilled water pump.
 - c. Alarm status.
- 8. Analog Outputs: (4 to 20 mA) for head pressure reference and condenser water control valve as applicable.
- 9. Provide protection for under/over-voltage, phase loss/reversal/unbalance, ground fault, single cycle voltage loss, programmable auto restart after power loss, and motor overload/over temperature protection.

2.08 MICROPROCESSOR-BASED, PROPORTIONAL AND INTEGRAL CONTROLLER

- A. Control Components for Preventing Shutdown:
 - 1. Provide high pressure limit with indicating light for each compressor, set lower than factory pressure switch to automatically unload compressor and prevent nuisance high pressure condenser control trip.

2. Provide one protector with indicating light for each compressor, with current limit set point of 120 percent of compressor running load amperage to automatically unload compressor preventing over-current trip.
 3. Provide low refrigerant limit to automatically unload each compressor preventing a low evaporator temperature trip.
- B. Chiller Operation in Abnormal Operating Conditions:
1. Unloaded Running: Adequate chilled water production.
 2. Trip-out Limit Reached: Chiller goes off-line and manual reset is required for continued operation.
- C. Control Panel Display:
1. Evaporator pressure.
 2. Condenser refrigerant pressure.
 3. Entering and leaving evaporator water temperature.
 4. Chilled water set-point.
 5. Electrical 3 phase current limit and percent RLA setpoint.
 6. Electrical 3 phase amp draw.
 7. Chiller operating mode.
 8. Condenser refrigerant temperature.
 9. Elapsed time and number of starts counter.
 10. Chiller compressor run status relay.
 11. Minimum of 20 diagnostics with time and date stamp.
 12. Identification of the fault, date, time and operating mode at time of occurrence, type of reset required, and help message.
- D. Points for BAS Control and Monitoring:
1. Relay output energized upon detecting a fault requiring manual reset.
 2. Relay output energized whenever unit is operating in a limit mode for an extended period of time.
 3. Analog input to control leaving chilled water temperature set-point based upon a 4-20ma or 0-10 VDC signal from the building automation system.
 4. Programmable soft during pull-down period via ramped current limit or fully adjustable, temperature pull-down rate.
 5. Leaving chilled water reset based upon return water temperature.
 6. Provide RS-232 for printer interface.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.
- C. Install units on vibration isolators.
- D. Connect to electrical service.
- E. Connect to chilled water piping.
- F. Arrange piping for easy dismantling to permit tube cleaning and removal.
- G. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 1500.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Perform factory startup of the chiller by factory trained and authorized servicing technicians confirming equipment has been correctly installed prior to equipment becoming operational and covered under the manufacturer's warranty.
- B. Supply initial charge of refrigerant and oil if not completely factory charged.
- C. Demonstrate system operations and verify specified performance.

3.03 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.
- D. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Conduct walking tour of project.
 - 3. Briefly describe function, operation, and maintenance of each component.
- E. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Location: At manufacturer's training facility; include travel expenses for one member of Owner's staff.

3.04 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

SECTION 23 6513
FORCED-DRAFT COOLING TOWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cooling tower.
- B. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 22 1005 - Plumbing Piping.
- B. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 0548 - Vibration And Seismic Controls For HVAC Piping And Equipment.
- D. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.
- E. Section 23 2113 - Hydronic Piping.
- F. Section 23 2123 - Hydronic Pumps.
- G. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; 2014.
- C. ASME PTC 23 - Atmospheric Water Cooling Equipment; 2003 (Reaffirmed 2014).
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- G. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- H. CTI ATC-105 - Acceptance Test Code; 2000.
- I. CTI STD-201 OM - Operations Manual for Thermal Performance Certification of Evaporative Heat Rejection Equipment; 2017.
- J. CTI STD-201 RS - Performance Rating of Evaporative Heat Rejection Equipment; 2017.
- K. NEMA MG 1 - Motors and Generators; 2018.
- L. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
- C. Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.
- D. Manufacturer's Certificate: Certify that cooling tower performance, based on ASME PTC 23 meets or exceeds specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.
- E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

- F. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Fan Belts: One set, matched, for each unit.
 - 3. Extra Spray Nozzles: One for each cell.
 - 4. Extra Access Door Gaskets: One for each door.
 - 5. Extra Valve Seats: One for each make-up valve and control valve.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum _____ years of experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Factory assemble entire unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.
- B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide a five year warranty to include coverage for corrosion resistance of cooling tower structure labor only.

PART 2 PRODUCTS

2.01 FORCED-DRAFT COOLING TOWERS

- A. General Requirements:
 - 1. Provide units for outdoor use, factory assembled, sectional, counterflow, vertical discharge, blow-through design, with fan assemblies built into pan and casing.
 - 2. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

2.02 CONTROLS

2.03 REGULATORY REQUIREMENTS

- A. Comply with requirements of UL and applicable codes.
- B. Products Requiring Electrical Connection: Listed and classified by 1 as suitable for the purpose specified and indicated.

2.04 MANUFACTURED UNITS

- A. Provide units for outdoor use, factory assembled, sectional, counterflow, vertical discharge, blow through design, with fan assemblies built into pan and casing.

2.05 COMPONENTS

- A. Pan and Casing: Galvanized steel, 12 gage, 0.1046 inch for casing and 8 gage, 0.1644 inch for reinforcing angles and channels with access doors at both ends of tower to air plenum.
- B. Fans: Multi blade, cast aluminum, axial type, with belt drive, bearings with ABMA STD 9 or ABMA STD 11 L-10 life at 30,000 hours, with extended grease fittings.
- C. Motor: Single speed (1800/900 rpm) mounted on adjustable steel base. Refer to Section 23 0513.
- D. Belt Drive: Designed for minimum 150 percent motor nameplate power.

- E. Fan Guard: Welded steel rod and wire guard, hot dipped galvanized after fabrication.
- F. Safety: Safety railings, and ladder with safety cage from grade to fan deck.
- G. Distribution Section: Polyvinyl chloride piping header and branches with ABS plastic spray nozzles.
- H. Fill:
 - 1. Self-supporting fluted polyvinyl chloride plastic with flame spread index of 5 or less, when tested in accordance with ASTM E84.
 - 2. Fungal Resistance: No growth when tested according to ASTM G21.
- I. Drift Eliminators: Two or three pass hot dipped galvanized steel, drift loss limited to 0.7 percent of total water circulated.
- J. Float Valves: Brass or bronze balanced piston type make-up valve with plastic or copper float.
- K. Hardware: Galvanized steel nuts, bolts, washers, and nails; assembled with phenolic epoxy coated, corrosion resistant washer head fasteners.
- L. Galvanized Steel Sheet Components: Hot-dipped galvanized, ASTM A653/A653M, with G210/Z600 coating, and finished with zinc chromated aluminum paint.
- M. Steel Angles, Plates, Bars, and Shapes: Galvanized after fabrication in accordance with ASTM A123/A123M, Coating Thickness Grade 100.

2.06 PERFORMANCE REQUIREMENTS

- A. This section is based on specific selections of equipment, and these selections relate to selection of related equipment, Section 23 2123 - Hydronic Pumps and _____. In substituting equipment, ensure that performance selection criteria matches that specified or that the selection of related equipment is acceptable or is revised to suit.
- B. Capacity: See Contract Drawings for performance requirements.
- C. Disconnect Switch: Factory mount disconnect switch in control panel.
- D. Single Point Power Connection (SPPC):
 - 1. Tamper resistant NEMA 4X outdoor enclosure with:
 - a. Hinged and lockable outer door
 - b. Main disconnect and handle and control switches
 - c. Disconnect handle with lock-off capabilities
 - 2. Electrical Components:
 - a. Main circuit breaker disconnect providing true single point power connection for cooling tower controls. The SPPC panel shall provide power feeds, controls and voltages for tower controls.
 - b. User terminal points for connecting field devices including solenoids, water level probes and alarm devices.
 - c. Pilot lights.
 - d. User terminal strip.
 - e. Wiring diagram secured inside the panel door.
 - f. Built to UL and CUL standards.

2.07 ACCESSORIES

- A. Electric Immersion Heaters: In pan suitable to maintain temperature of water in pan at 42 degrees F when outside temperature is 0 degrees F and wind velocity is 15 mph; immersion thermostat and float control operate heaters on low temperature when the pan is filled.
- B. Electric Temperature Controller: In pan; with sensor to cycle fans.

PART 3 EXECUTION

3.01 INSTALLATION

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

- B. Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of one eight hour day per tower.
- C. Install tower on structural steel beams as instructed by manufacturer.
- D. Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. Refer to Section 23 2113.
- E. Connect make-up water piping with flanged or union connections to tower. Pitch to tower. Refer to Section 22 1005.
- F. Connect overflow, bleed, and drain, to Area Drain.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

3.03 SYSTEM STARTUP

- A. Start-up tower in presence of and instruct Owner's operating personnel.

END OF SECTION

SECTION 23 8124

COMPUTER ROOM AIR CONDITIONERS - FLOOR MOUNTED

PART 2 PRODUCTS

1.01 AIR CONDITIONING UNITS

- A. Description: Packaged, water cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, fans, filters, humidifier, and controls.
- B. Assembly: Up-flow air delivery, in draw-through configuration.
- C. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) no greater than that allowed by federal code
- D. Energy Efficiency:

1.02 CABINET AND FRAME

1.03 EVAPORATOR FANS AND MOTORS

1.04 COMPRESSORS

1.05 EVAPORATOR COILS

- A. Alternate row circuits, direct expansion cooling coils of seamless copper tubes expanded into aluminum fins in A-frame configuration.
- B. Mount coil assembly in stainless steel drain pan.

1.06 CONDENSERS

- A. Water Cooled: Shell and tube type to ASME BPVC-VIII-1 with liquid line stop valve and head pressure actuated water regulating valve. Terminate outside cabinet for easy external connections.

1.07 CHILLED WATER COILS

- A. Seamless copper tubes expanded into aluminum fins with three way modulated valve.

1.08 FILTERS

1.09 HUMIDIFIER

1.10 ELECTRICAL PANEL

END OF SECTION

SECTION 23 8125

COMPUTER ROOM AIR CONDITIONERS - CEILING MOUNTED

PART 2 PRODUCTS

END OF SECTION

SECTION 23 8126
SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Forced air furnaces.
- B. Air cooled condensing units.
- C. Indoor air handler (fan & coil) units for duct connection.
- D. Controls.

1.03 RELATED REQUIREMENTS

- A. Section 23 3100 - HVAC Ducts and Casings.

1.04 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.
- D. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.
- E. NEMA MG 1 - Motors and Generators; 2018.
- F. NFPA 54 - National Fuel Gas Code; 2018.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.
- I. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2019.
- J. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- F. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Filters: One for each unit.

1.06 QUALITY ASSURANCE

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

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Heating: Natural gas fired.
 - 2. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
 - 3. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B. Performance Requirements: See Drawings for additional requirements.

2.02 INDOOR UNITS FOR DUCTED SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
 - 1. Air Flow Configuration: Upflow.
 - 2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
- B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
 - 1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.
 - 2. Motor Electrical Characteristics:
- C. Air Filters: 1 inch thick urethane, washable type arranged for easy replacement.
- D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
 - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
 - 2. Manufacturers: System manufacturer.

2.03 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
 - 1. Comply with AHRI 210/240.
 - 2. Refrigerant: R-410A.
 - 3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 - 4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.
- B. Compressor: Digital scroll or variable speed to allow for full range of capacity modulation, 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
 - 1. Condenser Fans: Direct-drive propeller type.
 - 2. Condenser Fan Motor: Enclosed, 1-phase type, permanently lubricated.

- D. Coil: Air-cooled, aluminum fins bonded to copper tubes.
- E. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
 - 1. Provide thermostatic expansion valves.
- F. Operating Controls:
 - 1. Control by room thermostat to maintain room temperature setting.
 - 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.
- G. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.

2.04 GAS FURNACE COMPONENTS

- A. Heat Exchanger: Aluminized steel ceramic coated clamshell type welded construction.
- B. Burner: Atmospheric type with adjustable combustion air supply,
 - 1. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
 - 2. Electronic pilot ignition, with electric spark igniter.
 - 3. Combustion air damper with synchronous spring return damper motor.
 - 4. Non-corrosive combustion air blower with permanently lubricated motor.
- C. Burner Safety Controls:
 - 1. Thermocouple Sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
 - 2. Flame Rollout Switch: Installed on burner box and prevents operation.
 - 3. Vent Safety Shutoff Sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
 - 4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.
- D. Operating Controls:
 - 1. Cycle burner by room thermostat to maintain room temperature setting.
 - 2. Supply fan energized from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation.
- E. Flue Termination: Standard roof kit.

2.05 ACCESSORY EQUIPMENT

- A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from setpoint.
 - 3. Thermostat Display:
 - a. Actual room temperature.
 - b. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.
- C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install gas fired furnaces in accordance with NFPA 54.
- D. Provide vent connections in accordance with NFPA 211.
- E. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION

SECTION 23 8126.13
SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Forced air furnaces.
- B. Air cooled condensing units.
- C. Indoor air handler (fan & coil) units for duct connection.
- D. Controls.

1.03 RELATED REQUIREMENTS

- A. Section 23 3100 - HVAC Ducts and Casings.

1.04 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.
- D. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.
- E. NEMA MG 1 - Motors and Generators; 2018.
- F. NFPA 54 - National Fuel Gas Code; 2018.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.
- I. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2019.
- J. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- F. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Filters: One for each unit.

1.06 QUALITY ASSURANCE

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

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Heating: Natural gas fired.
 - 2. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
 - 3. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B. Performance Requirements: See Drawings for additional requirements.

2.02 INDOOR UNITS FOR DUCTED SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
 - 1. Air Flow Configuration: Upflow.
 - 2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
- B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
 - 1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.
 - 2. Motor Electrical Characteristics:
- C. Air Filters: 1 inch thick urethane, washable type arranged for easy replacement.
- D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
 - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
 - 2. Manufacturers: System manufacturer.

2.03 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
 - 1. Comply with AHRI 210/240.
 - 2. Refrigerant: R-410A.
 - 3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 - 4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.
- B. Compressor: Digital scroll or variable speed to allow for full range of capacity modulation, 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
 - 1. Condenser Fans: Direct-drive propeller type.
 - 2. Condenser Fan Motor: Enclosed, 1-phase type, permanently lubricated.

- D. Coil: Air-cooled, aluminum fins bonded to copper tubes.
- E. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
 - 1. Provide thermostatic expansion valves.
- F. Operating Controls:
 - 1. Control by room thermostat to maintain room temperature setting.
 - 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.
- G. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.

2.04 GAS FURNACE COMPONENTS

- A. Heat Exchanger: Aluminized steel ceramic coated clamshell type welded construction.
- B. Burner: Atmospheric type with adjustable combustion air supply,
 - 1. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
 - 2. Electronic pilot ignition, with electric spark igniter.
 - 3. Combustion air damper with synchronous spring return damper motor.
 - 4. Non-corrosive combustion air blower with permanently lubricated motor.
- C. Burner Safety Controls:
 - 1. Thermocouple Sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
 - 2. Flame Rollout Switch: Installed on burner box and prevents operation.
 - 3. Vent Safety Shutoff Sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
 - 4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.
- D. Operating Controls:
 - 1. Cycle burner by room thermostat to maintain room temperature setting.
 - 2. Supply fan energized from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation.
- E. Flue Termination: Standard roof kit.

2.05 ACCESSORY EQUIPMENT

- A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from setpoint.
 - 3. Thermostat Display:
 - a. Actual room temperature.
 - b. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.
- C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install gas fired furnaces in accordance with NFPA 54.
- D. Provide vent connections in accordance with NFPA 211.
- E. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION

SECTION 23 8127
LARGE CONDENSING UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Air-source heat pumps.
- B. Air cooled condensing units.
- C. Controls.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- E. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- F. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Filters: One for each unit.

1.05 QUALITY ASSURANCE

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

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Split-System Heating and Cooling Condensing Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Heating and Cooling: Air-source electric heat pump or cooling only located in outdoor unit with evaporator; low ambient control..
 - 2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

- B. Performance Requirements: See Drawings for additional requirements.

2.02 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
1. Comply with AHRI 210/240.
 2. Refrigerant: R-410A.
 3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.
- B. Compressor: Digital scroll or variable speed to allow for full range of capacity modulation, 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
1. Condenser Fans: Direct-drive propeller type.
 2. Condenser Fan Motor: Enclosed, 1-phase type, permanently lubricated.
- D. Coil: Air-cooled, aluminum fins bonded to copper tubes.
- E. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
1. Provide thermostatic expansion valves.
- F. Operating Controls:
1. Control by room thermostat to maintain room temperature setting.
 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.
- G. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.

2.03 ACCESSORY EQUIPMENT

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

END OF SECTION

SECTION 23 8128
DUCTLESS AND MINI-SPLIT SYSTEMS

PART 1 GENERAL

2.01 SECTION INCLUDES

- A. Ductless Split system - Cooling Only
- B. Ductless Split System - Heat Pump

2.02 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Conductor and cable applications.
- B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections and installation and wiring of thermostats and other control components.

2.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
- B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment; 2015, with Addendum.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.
- D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

2.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

2.05 QUALITY ASSURANCE

- A. The system components shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with Air-conditioning, Heating and Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.
- D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to product and manufacturing quality and environmental management and protection set by the International Standard Organization (ISO).
- E. A dry air holding charge shall be provided in the indoor section.

- F. Installer Qualifications: Company specializing in performing the work of this section 3 and approved by manufacturer.

2.06 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and carefully handled according to the manufacturer's recommendations.

2.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. The units shall have a manufacturer's parts and defects warranty for a period five (5) years from date of installation. The compressor shall have an extended warranty of seven (7) years from date of installation.
- C. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty will not include labor.

PART 2 PRODUCTS

3.01 DUCTLESS SPLIT SYSTEM CONDENSING UNIT - COOLING ONLY

- A. System Description
 - 1. The ductless split air conditioning system shall consist of a slim silhouette horizontal discharge outdoor unit which shall be of an inverter driven compressor design matched with a slim silhouette, compact, wall mounted indoor fan coil section with wired remote controller.
- B. Outdoor Unit
 - 1. General:
 - a. The outdoor units shall be specifically designed to work with the matched indoor units. The outdoor units must have a thermally fused powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
 - b. Outdoor unit shall have a sound rating no higher than 55 dB(A).
 - c. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.
 - d. The outdoor unit shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.
 - e. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.
 - f. Four-legged outdoor unit mounting systems shall be provided by manufacturer. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.
 - 2. Unit Cabinet:
 - a. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.
 - b. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
 - 3. Fan:
 - a. The unit shall be furnished with a direct drive propeller type fan.
 - b. The outdoor unit fan motor shall be a direct current (DC) motor and have permanently lubricated bearings.

- c. The fan motor shall be mounted for quiet operation.
- d. The fan shall be provided with a raised guard to prevent contact with moving parts.
- e. The outdoor unit shall have horizontal discharge airflow.
- 4. Refrigerant and Refrigerant Piping
 - a. R410A refrigerant shall be required for systems.
 - b. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
 - c. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the equipment manufacturer and installed in accordance with manufacturer recommendations.
 - d. All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
 - e. Refrigerant line sizing shall be in accordance with manufacturer specifications.
- 5. Coil:
 - a. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
 - b. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.
 - c. The coil shall be protected with an integral metal guard.
 - d. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.
 - e. Outdoor unit shall be pre-charged with sufficient R-410a refrigerant for up to twenty five (25) feet of refrigerant piping for capacities up to 15,000 BTU/h, and up to thirty three (33) feet of refrigerant piping for capacities 18,000 BTU/h and above.
 - f. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.
 - g. All refrigerant connections between outdoor and indoor units shall be flare type.
- 6. Compressor:
 - a. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type manufactured by Mitsubishi Electric Corporation.
 - b. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.
 - c. The compressor will be equipped with internal thermal overload protection.
 - d. The outdoor unit must have the ability to operate over the full capacity range with a maximum height difference of 40 feet and refrigerant tubing length of 65 feet for capacities up to 15,000 BTU/h and a maximum height difference of 50 feet and refrigerant tubing length of 100 feet for capacities 18,000 BTU/h and above between indoor and outdoor units.
 - e. There shall be no need for line size changes. Filters, sight glasses, and traps shall not be used, and no additional refrigerant oil shall be required.
 - f. The compressor shall be mounted so as to avoid the transmission of vibration.
- 7. Operating Temperature Range:

- a. Indoor cooling maximum db / wb: 95° F db / 71° F wb
- b. Indoor cooling minimum db / wb: 67° F db / 57° F wb
- c. Outdoor cooling maximum db: 115° F db
- d. Outdoor cooling minimum db: 14° F
- 8. Electrical:
 - a. The outdoor unit electrical power supply shall be 208/230 volts, 1-phase, 60 hertz.
 - b. The unit shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts.
 - c. The outdoor unit shall be controlled by microprocessors located in the indoor unit and outdoor unit. A 12 to 24 volt DC data stream shall communicate between the units providing all necessary information for full function control.
- 9. Controls:
 - a. The control system shall consist of a minimum of one microprocessor on each indoor unit and one in the outdoor unit, communicating via data over power transmission. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired or wireless controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via a connector and a 12 VDC output.
 - b. A three (3) conductor 14 gauge AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. If code requires a disconnect mounted near the indoor unit, a 3-Pole disconnect shall be used; all three conductors must be interrupted. Install conductors in conduit per Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
 - c. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

C. Indoor Unit: See Paragraph INDOOR UNIT - WALL-MOUNTED FAN COIL below.

3.02 DUCTLESS SPLIT SYSTEM HEAT PUMP CONDENSING UNIT

- A. System Description
 - 1. The ductless split heat pump system shall consist of a slim silhouette horizontal discharge outdoor unit which shall be of an inverter driven compressor design matched with a slim silhouette, compact, wall mounted indoor fan coil section with wired remote controller.
- B. Outdoor Unit
 - 1. General:
 - a. The outdoor units shall be specifically designed to work with the matched indoor units. The outdoor units must have a thermally fused powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
 - b. Outdoor unit shall have a sound rating no higher than 55 dB(A).
 - c. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.
 - d. The outdoor unit shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.
 - e. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.
 - f. Four-legged outdoor unit mounting systems shall be provided by manufacturer. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat

- finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.
2. Unit Cabinet:
 - a. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.
 - b. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
 3. Fan:
 - a. The unit shall be furnished with a direct drive propeller type fan.
 - b. The outdoor unit fan motor shall be a direct current (DC) motor and have permanently lubricated bearings.
 - c. The fan motor shall be mounted for quiet operation.
 - d. The fan shall be provided with a raised guard to prevent contact with moving parts.
 - e. The outdoor unit shall have horizontal discharge airflow.
 4. Refrigerant and Refrigerant Piping
 - a. R410A refrigerant shall be required for systems.
 - b. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
 - c. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the equipment manufacturer and installed in accordance with manufacturer recommendations.
 - d. All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
 - e. Refrigerant line sizing shall be in accordance with manufacturer specifications.
 5. Coil:
 - a. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
 - b. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.
 - c. The coil shall be protected with an integral metal guard.
 - d. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.
 - e. Outdoor unit shall be pre-charged with sufficient R-410a refrigerant for up to twenty five (25) feet of refrigerant piping for capacities up to 15,000 BTU/h, and up to thirty three (33) feet of refrigerant piping for capacities 18,000 BTU/h and above.
 - f. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.
 - g. All refrigerant connections between outdoor and indoor units shall be flare type.

6. Compressor:
 - a. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type manufactured by Mitsubishi Electric Corporation.
 - b. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.
 - c. The compressor will be equipped with internal thermal overload protection.
 - d. The outdoor unit must have the ability to operate over the full capacity range with a maximum height difference of 40 feet and refrigerant tubing length of 65 feet for capacities up to 15,000 BTU/h and a maximum height difference of 50 feet and refrigerant tubing length of 100 feet for capacities 18,000 BTU/h and above between indoor and outdoor units.
 - e. There shall be no need for line size changes. Filters, sight glasses, and traps shall not be used, and no additional refrigerant oil shall be required.
 - f. The compressor shall be mounted so as to avoid the transmission of vibration.
7. Operating Temperature Range:
 - a. Indoor cooling maximum db / wb: 95° F db / 71° F wb
 - b. Indoor cooling minimum db / wb: 67° F db / 57° F wb
 - c. Outdoor cooling maximum db: 115° F db
 - d. Outdoor cooling minimum db: 14° F
 - e. Indoor heating maximum db / wb: 80° F db / 67° F wb
 - f. Indoor heating minimum db / wb: 70° F db / 60° F wb
 - g. Outdoor heating maximum db / wb: 75° F db / 65° F wb
 - h. Outdoor heating minimum db: -12° F db / -13° F wb
8. Electrical:
 - a. The outdoor unit electrical power supply shall be 208/230 volts, 1-phase, 60 hertz.
 - b. The unit shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts.
 - c. The outdoor unit shall be controlled by microprocessors located in the indoor unit and outdoor unit. A 12 to 24 volt DC data stream shall communicate between the units providing all necessary information for full function control.
9. Controls:
 - a. The control system shall consist of a minimum of one microprocessor on each indoor unit and one in the outdoor unit, communicating via data over power transmission. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired or wireless controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via a connector and a 12 VDC output.
 - b. A three (3) conductor 14 gauge AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. If code requires a disconnect mounted near the indoor unit, a 3-Pole disconnect shall be used; all three conductors must be interrupted. Install conductors in conduit per Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
 - c. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

C. Indoor Unit: See Paragraph INDOOR UNIT - WALL-MOUNTED FAN COIL below.

3.03 INDOOR UNIT - WALL MOUNTED

- A. General:
 1. The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function,

3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

- B. Unit Cabinet:
 - 1. All casings, regardless of model size, shall have the same white finish
 - 2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.
 - 3. There shall be a separate back plate which secures the unit firmly to the wall.
- C. Fan:
 - 1. The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.
 - 2. An integral, motorized, multi-position, horizontal air sweep vane shall provide for uniform air distribution, up and down. Vane shall have 5 selectable positions plus AUTO (Controls position based upon mode, microprocessor shall automatically determine the vane angle to provide the optimum room temperature distribution) and SWING (Continuously moves up and down). In OFF mode the horizontal vane shall return to the closed position.
 - 3. A motorized adjustable vertical guide vane shall be provided with the ability to change the airflow from side to side (left to right). Vane shall be positioned by a stepper motor driven by the indoor unit control microprocessor. Vane shall have 5 selectable positions and SWING (Continuously moves left and right).
 - 4. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of six (6) speed settings, Quiet, Low, Med, High, Super High and Auto (2 ton unit does not have Quiet setting).
- D. Filter:
 - 1. Return air shall be filtered by means of two (2) easily removable, washable filters, and electrostatic filters.
- E. Coil:
 - 1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - 2. The tubing shall have inner grooves for high efficiency heat exchange.
 - 3. All tube joints shall be brazed with silver alloy.
 - 4. The coils shall be pressure tested at the factory.
 - 5. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.
- F. Electrical:
 - 1. The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.
 - 2. The system shall be equipped with a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground. Install conductors in conduit per Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
 - 3. The indoor unit shall not have any supplemental electrical heat elements.
- G. Controls:
 - 1. The unit shall include an IR receiver for wireless remote control flexibility
 - 2. The unit shall ship with a wired controller for wall mounting.
 - 3. (Heat Pump System) Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

3.04 INDOOR UNIT - ONE-WAY CEILING-RECESSED CASSETTE

- A. General:
 - 1. The one-way cassette indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a

self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

B. Unit Cabinet:

1. The cabinet shall be a compact 43-3/8" wide x 14-3/16" deep so it will fit within a two joints with a standard 16" separation.
2. The cabinet panel shall have an interior pocket to hold a wireless interface for kumo cloud app.
3. One-way grille shall be fixed to bottom of cabinet.
4. The grille shall allow the unit to be serviceable from the bottom, without the need for an access panel.

C. Fan:

1. The indoor fan shall be an assembly with one line-flow fan direct driven by a single motor with permanently lubricated bearings.
2. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (5) speed settings, Quiet, Low, Med, High and Auto.
3. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
4. The vanes shall be capable of swinging left and right for uniform air distribution.

D. Filter:

1. Return air shall be filtered by means of a long-life washable permanent filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
2. The coils shall be pressure tested at the factory.
3. The unit shall be provided with an integral condensate lift mechanism able to raise drain water 19.6 inches above the condensate pan.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be equipped with a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground. Install conductors in conduit per Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
3. The indoor unit shall not have any supplemental electrical heat elements.

G. Controls:

1. The unit shall include an IR receiver for wireless remote control flexibility
2. The unit shall ship with a wired controller for wall mounting.
3. (Heat Pump Systems) Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
4. Control board shall include contacts for control of external heat source. External heat may be energized as second stage when the space temperature is 1.8°F from set point.
5. A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur the control shuts down the indoor unit before an overflow can occur.

3.05 INDOOR UNIT - FOUR-WAY CEILING GRID-RECESSED CASSETTE

A. General:

1. The indoor unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.
- B. Unit Cabinet:
1. The cabinet shall be a compact 22-7/16" wide x 22-7/16" deep so it will fit within a standard 24" square suspended ceiling grid.
 2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
 3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
- C. Fan:
1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
 2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
 3. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of three (3) speed settings, Low, Mid, and High.
 4. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
 5. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
 6. Grille shall include a factory installed sensor to work in conjunction with indoor unit control sequence to prevent unnecessary cooling or heating in unoccupied areas of the zone without decreasing comfort levels. Sensor must detect occupancy (not simply motion) and location of occupants by measuring size and temperature of objects within a 39' detecting diameter (based on 8.8ft mounting height) with 1,856 or more measuring points.
- D. Filter:
1. Return air shall be filtered by means of a long-life washable filter.
- E. Coil:
1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
 2. The coils shall be pressure tested at the factory.
 3. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4" inches above the condensate pan.
- F. Electrical:
1. The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.
 2. The system shall be equipped with a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground. Install conductors in conduit per Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
 3. The indoor unit shall not have any supplemental electrical heat elements.
- G. Controls:
1. The unit shall include an IR receiver for wireless remote control flexibility
 2. The unit shall ship with a wired controller for wall mounting.
 3. (Heat Pump Systems) Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

4. Control board shall include contacts for control of external heat source. External heat may be energized as second stage when the space temperature is 1.8°F from set point.
5. A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur the control shuts down the indoor unit before an overflow can occur.

3.06 INDOOR UNIT - FOUR-WAY CEILING-RECESSED CASSETTE

A. General:

1. The ceiling-recessed indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

B. Unit Cabinet:

1. The cabinet panel shall have provisions for a field installed filtered outside air intake.
2. Branch ducting shall be allowed from cabinet.
3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
4. The grille vane angles shall be individually adjustable from a wired remote controller to customize the airflow pattern for the conditioned space
5. The grille shall allow the unit to be serviceable from the bottom, without the need for an access panel.

C. Fan:

1. The indoor fan shall be an assembly with a statically and dynamically balanced turbo fan direct driven by a single motor with permanently lubricated bearings.
2. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
3. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
4. The indoor unit fan logic must include multiple setting that can be changed to provide optimum airflow based on ceiling height and number of outlets used.
5. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
6. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.
7. Grille shall include a factory-installed sensor to work in conjunction with indoor unit control sequence to prevent unnecessary cooling or heating in unoccupied areas of the zone without decreasing comfort levels. Sensor must detect occupancy (not simply motion) and location of occupants by measuring size & temperature of objects within a 39' detecting diameter (based on 8.8ft mounting height) with 1,856 or more measuring points.

D. Filter:

1. Return air shall be filtered by means of a long-life washable filter

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
2. The coils shall be pressure tested at the factory.
3. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.

F. Electrical:

1. The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.
 2. The system shall be equipped with a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground. Install conductors in conduit per Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
 3. The indoor unit shall not have any supplemental electrical heat elements.
- G. Controls:
1. The unit shall include an IR receiver for wireless remote control flexibility
 2. The unit shall ship with a wired controller for wall mounting.
 3. (Heat Pump System) Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
 4. Control board shall include contacts for control of external heat source. External heat may be energized as second stage when the space temperature is 1.8°F from set point.
 5. A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur the control shuts down the indoor unit before an overflow can occur.

3.07 VERTICAL/HORIZONTAL DUCTED (MULTI-POSITION AIR HANDLER)

- A. General:
1. The multi-position indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in air handling spaces in accordance with Section 18.2 of UL 1995 4th Edition, be tested in accordance with ANSI/ASHRAE 193 and have less than 2% air leakage at maximum airflow setting.
- B. Unit Cabinet:
1. The cabinet shall include a fixed bottom return, a fixed vertical discharge supply and be pre-painted, pre-insulated, 22 gauge galvanized steel or utilize black ZAM steel.
- C. Fan:
1. The indoor unit fan shall be an assembly with a single, statically and dynamically balanced direct drive fan with a high efficiency DC motor with permanently lubricated bearings.
 2. The fan shall have 3-speeds with the capability to operate between 0.3-0.8 In.WG selectable.
- D. Filter:
1. The unit shall have a 1" filter rack with a reusable filter.
- E. Coil:
1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
 2. The coils shall be pressure tested at the factory.
- F. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
 2. The indoor unit shall be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground. Install conductors in conduit per Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
 3. The indoor unit shall have the option to be powered independently from the outdoor unit.
- G. Controls:
1. Control board shall include contacts for control of no less than two stages of external heat. The first stage of external heat may be energized when the space temperature is 2.7°F

from set point for between 10-25 minutes (user adjustable). The second stage of external heat may be energized when the first stage has been active for no less than 5 minutes and the space temperature has not risen by more than 0.9°F.

2. The unit shall include an IR receiver for wireless remote control flexibility
3. The unit shall ship with a wired controller for wall mounting.
4. (Heat Pump System) Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
5. Control board shall include contacts for control of external heat source. External heat may be energized as second stage when the space temperature is 1.8°F from set point.
6. A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur the control shuts down the indoor unit before an overflow can occur.

PART 3 EXECUTION

4.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.

4.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A.
- C. Insulate liquid and suction refrigerant lines per the manufacturer's installation instructions.
- D. Provide a U.V. resistant, paintable lineset cover kit to cover exterior refrigerant linesets.

END OF SECTION

SECTION 23 8129
VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Variable refrigerant volume HVAC system includes:
 - 1. Outdoor/condensing unit(s).
 - 2. Indoor/evaporator units.
 - 3. Branch selector units.
 - 4. Refrigerant piping.
 - 5. Control panels.
 - 6. Control wiring.
- B. Basis of Design Equipment List is in Section 23 8130.

1.03 RELATED REQUIREMENTS

- A. Section 23 2300 - Refrigerant Piping: Additional requirements for refrigerant piping system.
- B. Section 23 8130 - Basis of Design VRV Equipment.
- C. Section 26 0583 - Wiring Connections: Power connections to equipment.
 - 1. Provide separate power connections for each unit of equipment.

1.04 PRICE AND PAYMENT PROCEDURES

- A. Alternates: See Section 01 2300 - Alternates, for product alternatives affecting this section.
- B. Alternates: Owner requests a bid Alternate for a system designed and manufactured by a manufacturer other than that listed as the Basis of Design.
 - 1. Alternate systems will be considered only under the terms described for Substitutions in the article MANUFACTURERS in PART 2 of this section.
 - 2. Contractor shall include with Contractor's bid the amount to be deducted from the bid amount if the alternate is accepted by the Owner.

1.05 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.
- 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. ITS (DIR) - Directory of Listed Products; current edition.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Pre-Bid Submittals: For proposed substitute systems/products, as defined in PART 2, and alternate systems/products, as defined above, proposer shall submit all data described in this article, under the terms given for substitutions stated in PART 2.
- C. Design Data:

1. Refrigerant piping design shall be provided by the manufacturer. Design shall include piping layout with all pipe routing, sizes and piping appertenances based on the manufacturer's specific product requirements.
- D. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings indicated in the Contract Documents:
1. Outdoor/Central Units:
 - a. Refrigerant Type and Size of Charge.
 - b. Cooling Capacity: Btu/h.
 - c. Heating Capacity: Btu/h.
 - d. Cooling Input Power: Btu/h.
 - e. Heating Input Power: Btu/h.
 - f. Operating Temperature Range, Cooling and Heating.
 - g. Air Flow: Cubic feet per minute.
 - h. Fan Curves.
 - i. External Static Pressure (ESP): Inches WG.
 - j. Sound Pressure Level: dB(A).
 - k. Electrical Data:
 - 1) Maximum Circuit Amps (MCA).
 - 2) Maximum Fuse Amps (MFA).
 - 3) Maximum Starting Current (MSC).
 - 4) Full Load Amps (FLA).
 - 5) Total Over Current Amps (TOCA).
 - 6) Fan Motor: HP.
 - l. Weight and Dimensions.
 - m. Maximum number of indoor units that can be served.
 - n. Maximum refrigerant piping run from outdoor/condenser unit to indoor/evaporator unit.
 - o. Maximum height difference between outdoor/condenser unit to indoor/evaporator unit, both above and below.
 - p. Control Options.
 2. Indoor/Evaporator Units:
 - a. Cooling Capacity: Btu/h.
 - b. Heating Capacity: Btu/h.
 - c. Cooling Input Power: Btu/h.
 - d. Heating Input Power: Btu/h.
 - e. Air Flow: Cubic feet per minute.
 - f. Fan Curves.
 - g. External Static Pressure (ESP): Inches WG.
 - h. Sound Pressure level: dB(A).
 - i. Electrical Data:
 - 1) Maximum Circuit Amps (MCA).
 - 2) Maximum Fuse Amps (MFA).
 - 3) Maximum Starting Current (MSC).
 - 4) Full Load Amps (FLA).
 - 5) Total Over Current Amps (TOCA).
 - 6) Fan Motor: HP.
 - j. Maximum Lift of Built-in Condensate Pump.
 - k. Weight and Dimensions.
 - l. Control Options.
 3. Control Panels: Complete description of options, control points, zones/groups.
- E. Operating and Maintenance Data:
1. Manufacturer's complete standard instructions for each unit of equipment and control panel.

2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
 3. Identification of replaceable parts and local source of supply.
- F. Project Record Documents: Record the following:
1. As-installed routing of refrigerant piping and condensate piping.
 2. Locations of access panels.
 3. Locations of control panels.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.
 2. Company that provides system design software to installers.
- B. Installer Qualifications: Trained and approved by manufacturer of equipment.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Compressors: Provide manufacturer's warranty for six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced at the discretion of Daikin AC (Americas), Inc. according to Daikin's terms and conditions. All warranty service work shall be preformed by a Daikin factory trained service professional.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Systems designed and manufactured by other manufacturers will be considered by Owner under the terms described for substitutions with the following exceptions:
1. Substitution requests will be considered only if required submittal data is complete; see article SUBMITTALS above.
 2. Contractor (not equipment supplier) shall certify that the use of the substitute system and equipment will not require changes to other work or re-design by Architect Engineer.
 3. Contractor or HVAC subcontractor shall certify that the substitute system will achieve the performance specified.
 4. Do not assume substitution has been accepted until formal written notice has been issued by Architect Engineer.

2.02 HVAC SYSTEM DESIGN

- A. System Operation: Heating and cooling, simultaneously.
1. Zoning: Provide capability for temperature control for each individual indoor/evaporator unit independently of all other units.
 2. Zoning: Provide heating/cooling selection for each individual indoor/evaporator unit independently of all other units.
 3. Provide a complete functional system that achieves the specified performance based on the specified design conditions and that is designed and constructed according to the equipment manufacturer's requirements.
 4. Conditioned spaces are indicated on drawings.
 5. Outdoor/Condenser unit locations are indicated on drawings.
 6. Indoor/Evaporator unit locations are indicated on drawings.
 7. Branch selector unit locations are indicated on drawings and locations are approximate. The exact location to be determined by the system manufacturer. Final

- installed locations to be in strict accordance with the system manufacturer's recommendations.
8. Required equipment unit capacities are indicated on drawings.
 9. Refrigerant pipe routing is shown on the drawings, routing is approximate, and line sizes are not shown. The exact routing and pipe sizes required shall be determined by the system manufacturer. Final installed piping system shall be in strict accordance with the system manufacturer's recommendations. Any field deviations from the shop drawings shall be prior-approved by the system manufacturer
 10. Connect equipment to condensate piping provided by others; condensate piping is indicated on drawings.
- B. Cooling Mode Interior Performance:
1. Daytime Setpoint: 68 degrees F, plus or minus 2 degrees F.
 2. Setpoint Range: 57 degrees F to 77 degrees F.
 3. Night Setback: 78 degrees F.
 4. Interior Relative Humidity: 20 percent, maximum.
- C. Heating Mode Interior Performance:
1. Daytime Setpoint: 68 degrees F, plus or minus 2 degrees F.
 2. Setpoint Range: 59 degrees F to 80 degrees F.
 3. Night Setback: 60 degrees F.
 4. Interior Relative Humidity: 10 percent, minimum.
- D. Operating Temperature Ranges:
1. Simultaneous Heating and Cooling Operating Range: minus 4 degrees F to 60 degrees F dry bulb.
 2. Cooling Mode Operating Range: minus 4 degrees F to 110 degrees F dry bulb.
 3. Heating Mode Operating Range: 0 degrees F to 77 degrees F dry bulb; minus 4 degrees F to 60 degrees F wet bulb; without low ambient controls or auxiliary heat source.
- E. Refrigerant Piping Lengths: Provide equipment capable of serving system with following piping lengths without any oil traps:
1. Minimum Piping Length from Outdoor/Central Unit(s) to Furthest Terminal Unit: 540 feet, actual; 620 feet, equivalent.
 2. Total Combined Liquid Line Length: 3280 feet, minimum.
 3. Minimum Piping Length Between Indoor Units: 49 feet.
- F. Control Wiring Lengths:
1. Between Outdoor/Condenser Unit and Indoor/Evaporator Unit: 6,665 feet, minimum.
 2. Between Outdoor/Condenser Unit and Central Controller: 3,330 feet, minimum.
 3. Between Indoor/Evaporator Unit and Remote Controller: 1,665 feet.
- G. Controls: Provide the following control interfaces:
1. For Each Indoor/Evaporator Unit: One wall-mounted wired "local" controller, with temperature sensor; locate where indicated.
 2. Remote, multizone on/off control panels sufficient to control all units; locate where indicated.
 3. One central remote control panel for entire system; locate where indicated.
 4. One time clock control panel for entire system; locate where indicated.
 5. LonWorks gateways sufficient to connect all units to building automation system by others; include wiring to gateways.
 6. The building automation system by the VRV manufacturer is not specified in this section. Consult the manufacturer for details.
 7. Building automation system by HVAC system manufacturer; provide one user stations located where indicated.
- H. Local Controllers: Wall-mounted, wired, containing temperature sensor.

- I. Remote Temperature Sensors: In addition to temperature sensors integral with indoor/evaporator units, provide wall-mounted, wired remote temperature sensors located in the same room for the following:
 - 1. In-ceiling mounted units.
 - 2. On-ceiling mounted units.
 - 3. Wall mounted units mounted up high.
 - 4. Air handling units.
 - 5. Concealed console units.
 - 6. Exception: Where a local controller with temperature sensor is provided for the particular unit and is located in the same space.

2.03 EQUIPMENT

- A. All Units: Factory assembled, wired, and piped and factory tested for function and safety.
 - 1. Refrigerant: R-410A.
 - 2. Performance Certification: AHRI Certified; www.ahrinet.org.
 - 3. Safety Certification: Tested to UL 1995 by UL or Intertek-ETL, listed in ITS (DIR), and bearing the certification label.
 - 4. Provide outdoor/condensing units capable of serving indoor unit capacity up to 200 percent of the capacity of the outdoor/condensing unit.
 - 5. Provide units capable of serving the zones indicated.
 - 6. Thermal Performance: Provide heating and cooling capacity as indicated, based on the following nominal operating conditions:
 - a. Cooling: Indoor air temperature of 80 degrees F dry bulb, 67 degrees F wet bulb; outdoor air temperature of 95 degrees F dry bulb; and 25 feet
 - b. Heating: Outdoor air temperature of 47 degrees F dry bulb, 43 degrees F wet bulb; indoor air temperature of 70 degrees F dry bulb; and 25 feet
 - 7. Energy Efficiency: Report EER and COP based on tests conducted at "full load" in accordance with AHRI 210/240 or alternate test method approved by U.S. Department of Energy.
 - 8. Outdoor Units: Units and their supports designed and installed to resist wind pressures defined in ASCE 7.
- B. Electrical Characteristics:
 - 1. Power - Branch Selector Units: 208 to 230 Volts, single phase, 60 Hz.
 - 2. Power - Indoor Units: 208 to 230 Volts, single phase, 60 Hz.
 - 3. 208-230 Voltage Range: 187 to 253 volts.
 - 4. Control: 16 volts DC.
- C. System Controls:
 - 1. Include self diagnostic, auto-check functions to detect malfunctions and display the type and location.
- D. Remote Centralized Control Panel:
- E. Remote On/Off Control Panel:
- F. Time Clock Panel:
- G. Unit Controls: As required to perform input functions necessary to operate system; provided by manufacturer of units.
 - 1. Provide interfaces to remote control and building automation systems as specified.
 - 2. Outside air capability.
- H. Wiring:
 - 1. Control Wiring: 18 AWG, 2-conductor, non-shielded, non-polarized, stranded cable.
 - 2. Control Wiring Configuration: Daisy chain.
- I. Refrigerant Piping:

1. Provide three-pipe refrigerant system, including high/low pressure dedicated hot gas, liquid and suction lines; two-pipe systems utilizing lower temperature mixed liquid/gas refrigerant to perform heat recovery are not permitted due to reduced heating capabilities.
2. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.
3. Insulate each refrigerant line individually between the condensing and indoor units.
4. Isolation valves:

2.04 OUTDOOR/CONDENSING UNITS

- A. Outdoor/Condensing Units: Air-cooled DX refrigeration units, designed specifically for use with indoor/evaporator units; factory assembled and wired with all necessary electronic and refrigerant controls; modular design for ganging multiple units.
 1. Refrigeration Circuit: Scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
 2. Refrigerant: Factory charged.
 3. Variable Volume Control: Modulate compressor capacity automatically to maintain constant suction and condensing pressures while varying refrigerant volume to suit heating/cooling loads.
 4. Capable of being installed with wiring and piping to the left, right, rear or bottom.
 5. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle (cooling mode) oil return or defrost is not permitted, due to potential reduction in space temperature.
 6. Sound Pressure Level: As specified, measured at 3 feet from front of unit; provide night setback sound control as a standard feature; three selectable sound level steps of 55 dB, 50 dB, and 45 dB, maximum.
 7. Power Failure Mode: Automatically restart operation after power failure without loss of programmed settings.
 8. Provide refrigerant auto-charging feature and refrigerant charge check function.
 9. Safety Devices: High pressure sensor and switch, low pressure sensor/switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
 10. Provide refrigerant sub-cooling to ensure the liquid refrigerant does not flash when supplying to us indoor units.
 11. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.
 12. Controls: Provide contacts for electrical demand shedding.
- B. Unit Cabinet: Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
 1. Designed to allow side-by-side installation with minimum spacing.
- C. Fans: One or more direct-drive propeller type, vertical discharge, with multiple speed operation via DC (digitally commutating) inverter.
 1. Provide minimum of 2 fans for each condensing unit.
 2. External Static Pressure: Factory set at 0.12 in WG, minimum.
 3. Indoor Mounted Air-Cooled Units: External static pressure field set at 0.32 in WG, minimum; provide for mounting of field-installed ducts.
 4. Fan Airflow: As indicated for specific equipment.
 5. Fan Motors: Factory installed; permanently lubricated bearings; inherent protection; fan guard; output as indicated for specific equipment.
- D. Condenser Coils: Copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.

- E. Compressors: Scroll type, hermetically sealed, variable speed inverter-driven and fixed speed in combination to suit total capacity; minimum of one variable speed, inverter driven compressor per condenser unit; minimum of two compressors per condenser unit; capable of controlling capacity within range of 6 percent to 100 percent of total capacity.
1. Variable Speed Control: Capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure; high/low pressures calculated by samplings of evaporator and condenser temperatures every 20 seconds, with compressor capacity adjusted to eliminate deviation from target value by changing inverter frequency or on/off setting of fixed speed compressors.
 2. Multiple Condenser Modules: Balance total operation hours of compressors by means of duty cycling function, providing for sequential starting of each module at each start/stop cycle, completion of oil return, and completion of defrost, or every 8 hours.
 3. Failure Mode: In the event of compressor failure, operate remaining compressor(s) at proportionally reduced capacity; provide microprocessor and associated controls specifically designed to address this condition.
 4. Inverter Driven Compressors: PVM inverter driven, highly efficient reluctance DC (digitally commutating), hermetically sealed scroll "G2-type" with maximum speed of 7,980 rpm.
 5. Provide each compressor with crankcase heater, high pressure safety switch, and internal thermal overload protector.
 6. Provide oil separators and intelligent oil management system.
 7. Provide spring mounted vibration isolators.

2.05 BRANCH SELECTOR UNITS

- A. Branch Selector Units: Concealed boxes designed specifically for this type of system to control heating/cooling mode selection of downstream units; consisting of electronic expansion valves, subcooling heat exchanger, refrigerant control piping and electronics to facilitate communications between unit and main processor and between branch unit and indoor/evaporator units.
1. Control direction of refrigerant flow using electronic expansion valves; use of solenoid valves for changeover and pressure equalization is not permitted due to refrigerant noise.
 2. Provide one electronic expansion valve for each downstream unit served, except multiple indoor/evaporator units may be connected, provided balancing joints are used in downstream piping and total capacity is within capacity range of the branch selector.
 3. When branch unit is simultaneously heating and cooling, energize subcooling heat exchanger.
 4. Casing: Galvanized steel sheet; with flame and heat resistant foamed polyethylene sound and thermal insulation.
 5. Refrigerant Connections: Braze type.

2.06 INDOOR/EVAPORATOR UNITS

- A. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
1. Refrigerant: Refrigerant circuits factory-charged with dehydrated air, for field charging.
 2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.
 3. Dehumidification Function: In conjunction with wall-mounted wired remote controller.
 4. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
 - a. Provide thermistor on liquid and gas lines.
 5. Fans: Direct-drive, with statically and dynamically balanced impellers; high and low speeds unless otherwise indicated; motor thermally protected.
 6. Return Air Filter: Washable long-life net filter with mildew proof resin, unless otherwise indicated.
 7. Condensate Drainage: Built-in condensate drain pan with PVC drain connection.

- a. Units With Built-In Condensate Pumps: Provide condensate safety shutoff and alarm.
- 8. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.
- B. Recessed Ceiling Units - 3 FT by 3 FT: Four-way airflow cassette with central return air grille, for installation in a fixed ceiling.
 - 1. Face Size: 33 inches square, nominal.
 - 2. Cabinet Height: Maximum of 10 inches above face of ceiling.
 - 3. Exposed Housing: White, impact resistant, with washable decoration panel.
 - 4. Supply Airflow Adjustment:
 - a. Via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees.
 - b. Field-modifiable to 3-way and 2-way airflow.
 - c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
 - 5. Return Air Filter: Manufacturer's standard.
 - 6. Minimum Capacity: As indicated on drawings.
 - 7. Sound Pressure Range: Between 28 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.
 - 8. Fan: Direct-drive turbo type, with motor output range of 0.06 to 0.12 HP.
 - 9. Condensate Pump: Built-in, with lift of 21 inches, minimum.
 - 10. Provide side-mounted supply air branch duct connection.
 - 11. Provide side-mounted fresh air intake duct connection.
- C. Recessed Ceiling Units - 2 FT by 2 FT: Four-way airflow cassette with central return air grille, sized for installation in standard 24 by 24 inch lay-in ceiling grid.
 - 1. Cabinet Height: Maximum of 12 inches above face of ceiling.
 - 2. Exposed Housing: White, impact resistant, with washable decoration panel.
 - 3. Maintenance Access: All electrical components accessible through decoration panel.
 - 4. Supply Airflow Adjustment:
 - a. Via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees.
 - b. Field-modifiable to 3-way and 2-way airflow.
 - c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
 - 5. Sound Pressure: Measured at low speed at 5 feet below unit.
 - 6. Fan: Direct-drive turbo type.
 - 7. Condensate Pump: Built-in, with lift of 21 inches, minimum.
 - 8. Provide side-mounted supply air branch duct connection.
 - 9. Provide side-mounted fresh air intake duct connection.
- D. Concealed-In-Ceiling Units: Ducted horizontal discharge and return; galvanized steel cabinet.
 - 1. Return Air Filter: Manufacturer's standard.
 - 2. Sound Pressure: Measured at low speed at 5 feet below unit.
 - 3. Provide external static pressure switch adjustable for high efficiency filter operation
 - 4. Condensate Pump: Built-in, with lift of 9 inches, minimum.
 - 5. Switch box accessible from side or bottom.
- E. Ceiling Surface-Mounted Units: White, finished casing, with removable front grille; foamed polystyrene and polyethylene sound insulation, and mounting brackets; mildew-proof polystyrene drain pan.
 - 1. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaulting to same angle as previous operation.
 - 2. Sound Pressure Range: Measured at low speed at 3.3 feet below and away from unit.
 - 3. Fan: Two-speed, direct-drive cross-flow type.

- F. Wall Surface-Mounted Units: Finished white casing, with removable front grille; foamed polystyrene and polyethylene sound insulation; wall mounting plate; polystyrene condensate drain pan.
 - 1. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaulting to same angle as previous operation.
 - 2. Sound Pressure Range: Measured at low speed at 3.3 feet below and away from unit.
 - 3. Condensate Pump: Built-in, concealed.
 - 4. Condensate Drain Connection: Back, with piping concealed in wall.
 - 5. Fan: Direct-drive cross-flow type.
- G. Exposed Console Units: Top discharge grille, bottom return air; finished casing, sound-insulated with fiberglass urethane foam; auto-swing louver that closes automatically when unit stops.
 - 1. Floor Mounting: Refrigerant and condensate lines directed downward.
 - 2. Wall Mounting: Side (horizontal) refrigerant and condensate connections; manufacturer-supplied wall mounting template.
 - 3. Maintenance Access Required: Not more than 3/4 inch in rear, 4 inch on each side.
 - 4. Sound Pressure Range: Measured at high speed at 5 feet away and 5 feet above floor.
 - 5. Fan: Sirocco type.
- H. Concealed Console Units: Top discharge grille, bottom return air; unfinished casing, sound-insulated with fiberglass urethane foam; auto-swing louver that closes automatically when unit stops.
 - 1. Floor Mounting: Refrigerant and condensate lines directed downward.
 - 2. Wall Mounting: Side (horizontal) refrigerant and condensate connections; manufacturer-supplied wall mounting template.
 - 3. Maintenance Access Required: Not more than 3/4 inch in rear, 4 inch on each side.
 - 4. Sound Pressure Level: Measured at high speed measured at 5 feet away and 5 feet above floor.
 - 5. Fan: Sirocco type.
- I. Air Handling Units: Factory-painted heavy gage steel casing insulated with sound absorbing foil faced insulation.
 - 1. Vertical Configuration: Top discharge air and bottom return air; floor mounted.
 - 2. Horizontal Right Configuration: Horizontal discharge air and horizontal return air.
 - 3. Secondary condensate drain pan; field installed.
 - 4. Fan: Direct-drive ECM type fan with automatic airflow adjustment.
 - 5. Provide air filter.
 - 6. External insulation; field installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.
- B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.
- C. Notify Architect Engineer if conditions for installation are unsatisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install refrigerant piping in accordance with equipment manufacturer's instructions.
- C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).
- D. Coordinate with installers of systems and equipment connecting to this system.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide manufacturer's field representative to inspect installation prior to startup.

3.04 SYSTEM STARTUP

- A. Provide manufacturer's field representative to perform system startup.
- B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.
- C. Adjust equipment for proper operation within manufacturer's published tolerances.

3.05 CLEANING

- A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.
- D. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- E. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's training personnel.
 - 4. Location: At project site.

3.07 PROTECTION

- A. Protect installed components from subsequent construction operations.
- B. Replace exposed components broken or otherwise damaged beyond repair.

3.08 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION

SECTION 23 8200
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Unit heaters.
- B. Cabinet unit heaters.
- C. Fan-coil units.
- D. Electric unit heaters.
- E. Electric cabinet unit heaters.
- F. Blower-coil units.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 0719 - HVAC Piping Insulation.
- D. Section 23 0913 - Instrumentation and Control Devices for HVAC.
- E. Section 23 2113 - Hydronic Piping.
- F. Section 23 2114 - Hydronic Specialties.
- G. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.03 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. AHRI 350 - Sound Performance Rating of Non-Ducted Indoor Air-Conditioning and Heat Pump Equipment; 2015.
- C. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addendum (2011).
- D. AHRI 440 - Performance Rating of Room Fan-Coils; 2008.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
 - 2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
 - 3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

4. Submit the following for blower-coil units indicating:
 - a. Overall dimensions including installation, operation, and service clearances.
 - b. Lift points, recommendations, and center of gravity.
 - c. Unit shipping, installation, and operating weights including dimensions.
 - d. Fan curves with specified operating point clearly plotted.
 - e. Safety and start-up instructions.
- D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- E. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Extra Filters: One set of each type and size.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 SEE SECTION 01 6000 FOR ADDITIONAL REQUIREMENTS.

2.02 HYDRONIC UNIT HEATERS

- A. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- B. Perform factory run test under normal operating conditions, water, and steam flow rates.
- C. Casing: Minimum 18 gage, 0.0478 inch thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 18 gage, 0.0478 inch thick sheet steel top and bottom plates for vertical projection models.
- D. Finish: Factory applied baked primer coat.
- E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- F. Air Outlet: Adjustable pattern diffuser on vertical projection models and two way louvers on horizontal projection models.

2.03 HYDRONIC CABINET UNIT HEATERS

- A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
- B. Coils:
 1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
- C. Cabinet: Minimum 16 gage, 0.0598 inch thick sheet steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.
- D. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.

- E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- F. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- G. Filter: Easily removed, 1 inch thick glass fiber throw-away type, located to filter air before coil.

2.04 FAN-COIL UNITS

- A. Performance Data and Safety Requirements:
 - 1. Unit capacities certified in accordance with AHRI 440.
 - 2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
 - 3. Insulation to comply with NFPA 90A requirements for flame spread and smoke generation.
 - 4. Equipment wiring to comply with requirements of NFPA 70.
- B. Required Directory Listings: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
- C. Coils:
 - 1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
 - 2. Water Coil: Suitable for working temperatures not less than 200 degrees F.
 - 3. Provide drain pan under cooling coil easily removable for cleaning.
- D. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.
- E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- F. Motor: Electronically Commutated (EC) Motor.
- G. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.

2.05 ELECTRIC UNIT HEATERS

- A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
- B. Assembly: Suitable for mounting from ceiling or structure above with built-in controls, thermal safety cut-out, and electric terminal box.
- C. Acceptable Heating Element Assemblies:
 - 1. Horizontal Projection Units:
 - a. Copper clad steel sheath element with continuously brazed steel fins formed to allow side draw through air flow.
 - 2. Vertical Projection Units:
 - a. Copper clad steel sheath element with continuously brazed steel fins formed to allow side draw through air flow.
- D. Housing:
 - 1. Suitable for ceiling or wall mounting using provided hanging hardware. The heater manufacturer's minimum mounting height shall be followed.
 - 2. Horizontal Projection Units:
 - a. Construction materials to consist of heavy gage steel with galvanized, polyester powder coat, or high gloss baked enamel finish.
 - b. Provide with threaded holes for threaded rod suspension.
 - c. Provisions for access to internal components for maintenance, adjustments, and repair.
 - 3. Vertical Projection Units:
 - a. Construction materials to consist of heavy gage steel with polyester powder coat or high gloss baked enamel.

- b. Provide with mounting support brackets or provisions for mounting from ceiling or structure above.
 - c. Provisions for access to internal components for maintenance, adjustments, and repair.
- E. Air Inlets and Outlets:
 - 1. Inlets: Provide stamped louvers or protective grilles with fan blade guard.
 - 2. Outlets: Provide directional louvers.
- F. Fan: Factory balanced, direct drive, axial type with fan guard.
- G. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.
- H. Controls:

2.06 BLOWER-COIL UNITS

- A. Performance Data and Safety Requirements:
 - 1. Coils rated and tested in accordance with AHRI 410.
 - 2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
 - 3. Comply with NFPA 90A for unit construction, including filters and related equipment, for protection of life and property from fire, smoke, and gases resulting from conditions having manifestations similar to fire.
- B. Unit Casing:
 - 1. Fabricate from heavy gage galvanized steel sheet.
 - 2. Insulate inside walls with 1 inch thick, fiberglass insulation for thermal and acoustical control.
 - 3. Provide access panels allowing servicing of coils, drain pan, fan, motor, and drive.
 - 4. Provide knockouts or hanger rod holes at all four corners for suspended units.
- C. Air Coils:
 - 1. Aluminum fins mechanically expanded or bonded to copper tubes having standard sweat connections.
 - a. Water: Manual, automatic or self-venting, designed to a working pressure and temperature of not less than 250 psig and 200 degrees F.
- D. Fans:
 - 1. Double width double inlet (DWDI) forward curved centrifugal blower type.
 - 2. Mounted directly to the motor shaft.
 - 3. Dynamically balanced.
- E. Drain Pan: Cleanable, one-piece construction of polymer or stainless steel; with drain connection and sloped for positive drainage.
- F. Filters: Fully accessible, flat filter rack with throw-away filters.
- G. Motors: Single speed with sleeve or ball bearings, 1750 rpm, wired to unit junction box, and mounted on a resilient motor base.
- H. Motor: Electronically Commutated (EC) Motor.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

- A. Provide housekeeping pads for blower-coil units under provisions of Section 03 3000.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Do not damage equipment or finishes.
- D. Unit Heaters:
 - 1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
 - 2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- E. Cabinet Unit Heaters:
 - 1. Install as indicated.
 - 2. Coordinate to ensure correct recess size for recessed units.
- F. Fan-Coil Units:
 - 1. Install as indicated.
 - 2. Coordinate to ensure correct recess size for recessed units.
- G. Units with Hydronic Coils:
 - 1. Provide with shut-off valve on supply piping and tamper-proof, balancing valve with memory stop on return piping.
 - 2. If not easily accessible, extend air vent to exterior surface of cabinet for ease of servicing.
 - 3. Provide float operated automatic air vents with stop valve for cabinet unit heaters, fan coil units, and unit heaters.
- H. Units with Cooling Coils: Connect drain pan to condensate drain.
- I. Units with Electric Heating Elements:
 - 1. Install as indicated including electrical devices furnished by manufacturer but not factory installed.
 - 2. Install wiring in accordance with the manufacturer's wiring diagram submittal and Section 26 0583.
- J. Blower-Coil Units:
 - 1. Verify all surfaces and openings at unit location can suitably accommodate unit(s).
 - 2. Install in accordance with manufacturer's recommendations.
 - 3. Provide manual shut-off valve on hydronic supply side of coil and balancing valve with memory stop on return side.
 - 4. General piping installation requirements are specified in other Sections and drawings indicate general arrangement of piping, fittings, and specialties.
 - 5. Connect hydronic, condensate drain, and overflow drain piping to unit.
 - 6. Connect hydronic, condensate drain, and overflow drain piping to unit.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

3.05 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. After construction and painting is completed, clean exposed surfaces of units.
- C. Vacuum clean coils and inside of units.
- D. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.
- E. Install new filters.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

3.07 PROTECTION

- A. Provide finished cabinet units with protective covers during the balance of construction.

END OF SECTION

SECTION 23 8313
RADIANT-HEATING CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Heating cable.
- B. Temperature controllers for heating cable and mat.

1.03 PERFORMANCE REQUIREMENTS

- A. Pipe Trace Heating: Freeze protection with outside temperature at 0 degrees F.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for heating cable and control components.
- C. Shop Drawings: Indicate heating cable layout, locations of terminations, thermostats, and branch circuit connections.
- D. Manufacturer's Installation Instructions: Indicate installation instructions.
- E. Operation Data: Include description of operating controls.
- F. Maintenance Data: Include repair methods and parts list of components.

1.05 QUALITY ASSURANCE

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

1.06 COORDINATION

- A. Coordinate installation of heating cable with installation of piping and piping insulation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chromalox, Inc.: www.chromalox.com/#sle.
- B. Easyheat: www.easyheat.com/#sle.
- C. Thermon Manufacturing Company: www.thermon.com/#sle.
- D. Tyco.: www.tycothermal.com
- E. Raychem: www.raychem.com.
- F. Substitutions: See Section 01 6000 - Product Requirements.

2.02 HEATING CABLE

- A. Heating Cable: The heating cable shall consist of two (2) 16 AGW Nickel-coated-copper bus wires embedded in a radiation cross-linked polymer capable of regulating its power output in response to temperature changes all along its length with a self-regulating index of no less than 90 percent between 50 degrees F and 140 degrees F. The heating cable shall be covered with a radiation cross-linked modified polyolefin dielectric jacket (2,000 psi minimum) which in turn shall be covered with a tinned copper braid (3.0 ohms/1,000' maximum electrical resistance) and an outer modified polyolefin jacket. Voltage shall be 120, 208, 220, 240, or 277.
- B. The heat tracing controller shall be UL listed and capable of operating from 120 to 277 volts without modification. The controller shall be fully rated to 30A at ambient temperatures up to 140 degrees F. Unit shall have 30mA ground fault trip with separate setting for ground fault alarm. Enclosure shall be NEMA 4X with control and monitor adjustment keys available without exposure of internals to the environment. Unit shall have front panel keystroke lockout feature

to prevent unauthorized programming changes. The microprocessor controller shall supply a common solid-state switch for 120 to 277 volt remote alarm programmable for open or closed on alarm. The controller shall cycle the heat tracing (settable from 0.5-24 hours) regularly to confirm proper system operation. Unit shall have individual local alarm lights for the following:

1. Low Temperature, high temperature, low current, ground fault, and sensor failure.
 2. Unit shall include, "Power On" and "Heater On" indication lights.
- C. All power, splice, and tee connections must be made up using re-entrerable, NEMA 4X, 6P, quick-connect components, requiring no stripping of the core insulator. No heat shrink components will be allowed in making these connections.

2.03 ACCESSORIES

- A. Thermostats:
1. Manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping are ready to receive work.
- B. Verify field measurements are as shown on shop drawings.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts conditions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Bending Radius: Six times cable diameter, minimum.
- C. Avoid pinching and making sharp bends in cable.
- D. Prevent damage by sharp rocks, metal, or other objects during installation.
- E. Do not install heating cable across expansion or construction joints.
- F. Do not cross heating cable over itself.
- G. The heating cable shall be installed under the pipe's thermal insulation without spiraling and with sufficient heat output to maintain the pipe temperature of no less than 40 degrees F. when outside ambient is -20 degrees F. and the average wind speed is 15 MPH.
- H. After cable installation and before and after installation of thermal pipe insulation, the heating cable shall be tested using a 2,500 volt meter. Minimum electrical insulation resistance shall be 20 megaohms regardless of circuit length. Both bus wires and braid shall be tested to verify the connection of all splices and tees. All material shall be installed in accordance with the manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

- A. Test continuity of heating cable.
- B. Measure insulation resistance to manufacturer's recommended values. Use test instruments in accordance with manufacturer's instructions.
- C. Perform tests on completed cable installation. For cables embedded in concrete, perform tests immediately before and after concrete placement.
- D. Measure voltage and current at each unit.

3.04 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of heating cable controls.

END OF SECTION

SECTION 26 0010
ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

- A. Work covered by this specification shall include furnishing all labor, materials, equipment and services required to construct and install the complete electrical system shown on accompanying plans and specified herein, and make final connections to all equipment.
- B. This work shall include: The general layout of the complete electrical system; arrangement of feeders, circuits, outlets, switches, controls, panelboards, transformers, service equipment, fixtures, and other work. No rough-in or connection, etc. for mechanical equipment shall be done until coordination is completed with Division 23.

1.03 RELATED WORK

- A. The Contractor shall be familiar with any work specified elsewhere in these specifications. Perform this work as specified herein.

1.04 LOCAL CONDITIONS

- A. Unless otherwise required or specified under another section of these specifications, cutting and patching will be performed by the Contractor. Division 26 shall furnish sketches showing locations and sizes of all openings, chases, etc. required for the installation of work.
- B. Division 26 shall furnish and locate sleeves and inserts required before floors and walls are built or he shall be responsible for the cost of cutting and patching required where such sleeves and inserts are not installed or where incorrectly located. Division 26 shall do all drilling required for installation of the hangers.
- C. No cutting shall be permitted to any of the structural members without the written permission of the Architect Engineer.
- D. Where openings are cut to permit installation of work, or cut to repair or remodel, any defects that may appear up to expiration of guarantee, patching shall be done by the trade whose work is disturbed, but shall be paid for by the Division cutting openings or causing the damage.
- E. Roof curbs for electrical openings shall be provided and flashed by the Contractor. Division 26 shall advise the Contractor as to size, location and details of curbs required.
- F. The Contractor shall furnish all foundations and supports required for electrical equipment. Division 26 shall furnish an approved layout of bases and supports to the Contractor.
- G. In general, all floor-mounted equipment shall be installed on raised concrete bases. Concrete bases shall be not less than 6 inches high unless otherwise noted, and shall be poured in forms built of new dressed lumber. Foundation corners shall be neatly chamfered by means of sheet metal or triangular wood strips nailed to the form. Foundation bolts shall be placed in forms when concrete is poured; bolts shall be correctly located by means of templates. Allow 1 inch below equipment bases for alignment and grouting. After grouting, the forms will be removed and the surface of the foundations shall be hand-rubbed with carborundum.
- H. Division 26 shall give full cooperation to other trades, furnishing, in writing, to the Architect Engineer, any information necessary to permit work of all trades to be installed satisfactorily and with the least possible interference or delay.
- I. Where work of this Division will be installed close to work of other trades, or where there is evidence that the work will interfere with work of other trades, the Division 26 shall assist in working out space conditions to make satisfactory adjustment. If the Contractor installs work before coordinating with other trades, he shall make necessary changes in his work to correct the condition without extra charge.

- J. Keep work area clean at all times. Daily remove all scraps and debris from work area.

1.05 PERMITS AND INSPECTIONS

- A. Give all necessary notices; obtain all permits, and pay all governmental taxes, fees and other costs in connection with work; file all necessary plans; prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain required certificates of inspection for his work and deliver same to the Architect Engineer before request for acceptance and final payment of work.
- B. Contractor shall include in the work, without extra cost to the Owner, all labor, materials, services, apparatus, drawings, etc. in order to comply with all laws, ordinances, rules and regulations, whether or not shown on the drawings and/or in the specifications.

1.06 CODES AND STANDARDS

- A. The following specifications and standards, of issues listed below, but referred to thereafter by basic designation only, form part of these specifications:
 - 1. National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Amendments and Supplements.
 - 2. National Electrical Safety Code.
 - 3. National Fire Protection Association's Recommended Practices.
 - 4. Local, City and State Codes and Ordinances.
 - 5. Underwriters Laboratories, Inc.
 - 6. Illuminating Engineering Society.
 - 7. Institute of Electrical and Electronic Engineers.
 - 8. Insulated Cable Engineers Association.
 - 9. National Electrical Manufacturers Association.
 - 10. American National Standards Institute.
 - 11. American Society for Testing Materials.
 - 12. State Fire Prevention Code.
 - 13. Occupational Health Safety Act.
 - 14. National Electrical Contractor Standards..
- B. The latest specifications and standards available shall be used for the above.

1.07 REVIEW OF MATERIALS

- A. It is the intent of these specifications to establish quality standards of materials and equipment installed. Therefore, specific items are identified by manufacturer, trade name or catalog designation.
- B. Should the Contractor propose to furnish material and equipment other than that specified, he shall submit a written request for any or all substitutions to the Architect Engineer. Such request shall be alternatives to the original bid, and shall be submitted complete with descriptive (manufacturer, brand name, catalog number, etc.), and technical data for all items. The Contractor shall submit written answers to the following questions for each substitution request:
 - 1. Is the substitution of equal, greater or less quality than the design requirements?
 - 2. If of less quality, what is the difference in value?
 - 3. If of equal or better quality, what are the advantages to the Owner in accepting the substitution at no change in contract price?
- C. Where such substitutions alter the design or space requirements indicated on the drawings, the Contractor shall include all items of cost for the revised design and include cost of all applicable trades involved.
- D. Acceptance or rejection of the proposed substitutions shall be subject to the approval of the Architect Engineer. If requested by the Architect Engineer, the Contractor shall submit for inspection samples of both the specified and proposed substitute items.
- E. In all cases where substitutions are permitted, the Contractor shall bear any extra cost of evaluating the equality of the material and the equipment to be installed.

- F. The Contractor shall submit to the Architect Engineer detailed dimensioned shop drawings covering all items of electrical equipment. No equipment should be put into manufacture or ordered until these shop drawings or brochures have been approved by the Architect Engineer.
- G. The Contractor shall submit 5 physical copies or electronic copies of the shop drawings to the Architect Engineer for comment or correction.
- H. In the event resubmittal is required, the Contractor shall revise the shop drawings as directed by the Architect Engineer. The Contractor shall then resubmit 5 physical copies or electronic copies of the corrected shop drawings to the Architect Engineer for final approval.
- I. As soon as practicable and within 30 days after award of contract, and before beginning fabrication of material or installation of equipment, the Contractor shall submit a complete schedule of materials, equipment, apparatus and appurtenances proposed for installation and/or use in this project to the Architect Engineer for approval.
- J. This schedule shall be in the form of a bill of materials and shall include manufacturer's names, catalog numbers, diagrams and other descriptive data as required for approval. Submittal procedure shall be the same as specified above.
- K. Upon completion of the project, this Contractor shall prepare and deliver to the Architect Engineer one set of red-lined "RECORD SET" prints, showing actual installed locations of all electrical conduits, ducts and cables outside and inside of the buildings, including the location of all underground junction boxes, pull boxes, handholes and manholes. Make all necessary field measurements during the installation of the electrical work.

1.08 DEVIATIONS

- A. The Drawings, which constitute an integral part of the contract, shall indicate the general layout of the complete electrical systems; arrangement of feeders, circuits, outlets, switches, controls, panelboards, transformers, unit substations, service equipment, fixtures and other work.
- B. Field verification of scale dimensions on the drawings is directed since actual locations, distances and levels will be governed by actual field conditions.
- C. The Contractor shall check architectural, structural, plumbing, heating and ventilating to avert possible installation conflicts. Should drastic changes from original drawings be necessary to resolve such conflicts, the Contractor shall notify the Architect Engineer and secure written approval and agreement on necessary adjustments before the installation is started.
- D. The drawings may be superseded by later revised or detailed drawings or specification addenda prepared by the Architect Engineer, and the Contractor shall conform to all reasonable changes without extra cost to the Owner. All items not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary to make a complete working installation, shall be included.

1.09 SITE UTILITIES

- A. Locations and elevations of various utilities, included within the scope of this work, have been obtained from city and utility maps and/or other substantially reliable sources, and are offered separately from contract documents as a general guide only without guarantee as to accuracy. The Contractor shall examine the site and verify to his own satisfaction the locations and elevations of all utilities and shall adequately inform himself of their relations to the work before entering into contract.
- B. Voltage that appears on the drawings and elsewhere in these specifications has been obtained from the serving utility company. Before ordering equipment and starting the job, the Contractor shall verify the voltage with the utility company. If voltage differs from that noted on the drawings and in the specifications, the Architect Engineer shall be notified at once. If the Architect Engineer is not notified before equipment is ordered or construction is started, the Contractor shall provide an acceptable and operable system at no additional cost to the Owner.
- C. Exterior utilities shall include all conduit and appurtenances outside of the building or as shown on the plans. Unless otherwise noted, utilities shall include complete tie-in with utility lines at no extra cost to the Owner. The Contractor shall pay all costs required by utility company

pertaining to construction and tie-in. Deposits required for permanent service shall be paid by the Owner.

1.10 ELECTRICAL LICENSE REQUIREMENT

- A. No person shall perform electrical work on the contract without possessing an Arkansas State Master or Journeyman License from the Arkansas State Electrical Examiners Board. All electrical work and apprentice electricians shall be supervised by a Master or Journeyman Electrician on a one to one ratio.
- B. All electricians shall have a copy of their license with them and shall be required to show it to an appropriate inspector upon request.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Each item of equipment furnished under these specifications is to be essentially the standard product of the manufacturer; however, component parts of equipment need not be products of one manufacturer.
- B. All material and equipment shall be new and of the best quality normally used in good commercial practice, being products of reputable manufacture. Each major component shall bear a name plate stating name and address of the manufacturer and catalog number or designation. All materials shall be of the manufacturer's latest design standard, and bear Underwriters Laboratories, Inc. label and the manufacturer's trade mark.
- C. Where items of equipment and/or apparatus come under the following general headings; all of the equipment shall be from the same manufacturer:
 - 1. Busways, circuit breakers, load centers, metering equipment, panelboards, safety switches, starters, substations, switchboards and switchgear.

PART 3 - EXECUTION

3.01 GENERAL

- A. All electrical construction work shall be installed under the direction of a competent supervisor who will be at the job site at all times when electrical installations are being made.
- B. Installing Contractor will be held responsible for damage to other work resulting from negligence of his workmen. Such repairs shall be performed by the trade originally accomplishing the work but at the expense of Division 26.
- C. The Contractor shall utilize only competent and skillful workmen in handling and installing equipment specified.
- D. Installation shall be carried out in such a manner that the many components will function as a complete workable system including any accessories required to accomplish such installation. Equipment shall be left properly adjusted and in satisfactory working order. Work is to be executed in conformity with best acceptable standard practices with the equipment being installed to allow for maximum accessibility and best appearance. Installation shall be such that future installations and expansions can be made with a minimum of expenditure.
- E. Where possible, work must be scheduled for accomplishment during periods acceptable to the Owner, but when such scheduling is not feasible, work shall be executed at night or over weekends. No additional compensation will be allowed for overtime.
- F. Apparatus which is too large to permit access through stairways, doorways or shafts shall be brought to the job site by the Contractor involved and put in place before the closing of the structure.
- G. Division 26 shall be responsible for the protection of electrical apparatus from damage and the elements. This shall include the erection of temporary shelters, cribbing, and the covering of apparatus in uncompleted areas of buildings with tarpaulins. Failure to comply with the foregoing by the Contractor to the satisfaction of the Architect Engineer will be sufficient cause for rejection of the piece of apparatus in question.

- H. Chases, recesses, and other openings required for the location of conduits or equipment in new construction shall be provided by the Contractor. Division 26 shall advise the Contractor of the size and locations, and furnish all necessary drawings required for his work in sufficient time to allow for provision of chase.
- I. After installation is complete, and at such time as the Architect Engineer may direct, the Contractor shall conduct an operating test for approval. Equipment shall be demonstrated to operate in accordance with the requirements of this specification. Test shall be performed in the presence of the Architect Engineer or authorized representative. Division 26 shall furnish instruments and personnel required for the test and Owner will furnish necessary electrical power.
- J. The Contractor shall furnish a written certificate guaranteeing materials, equipment and labor furnished to be free of defects for a period of 1 year; except where otherwise indicated, from and after the date of final acceptance of the work by the Owner, and further agrees that if defects appear within stipulated guaranty period same shall be replaced or made good without charge.

3.02 SEISMIC QUALIFICTION OF EQUIPMENT

- A. Provide manufacturer's certificate of compliance for the following equipment requiring seismic qualification in accordance with ASCE-7.
 - 1. Transformers
 - 2. Panel Boards
 - 3. Circuit Breakers
 - 4. Motor Starters
 - 5. Switch Boards
 - 6. Light Fixtures

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Heat shrink tubing.
- F. Wire pulling lubricant.
- G. Cable ties.

1.03 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.04 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
- I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- N. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Most Recent Edition, Including All Revisions.
- O. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

- P. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- Q. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- S. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Field Quality Control Test Reports.
- D. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - 1) Maximum Length: 6 feet.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- H. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- I. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- J. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
 - 2. Control Circuits: 14 AWG.
- K. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- L. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 - 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - c. Equipment Ground, All Systems: Green.
 - d. Travelers for 3-Way and 4-Way Switching: Pink.
 - e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
 - f. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 - 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. General Cable Technologies Corporation: www.generalcable.com/#sle.
 - d. Service Wire Co: www.servicewire.com/#sle.
 - e. Southwire Company: www.southwire.com/#sle.
 - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
 - 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.04 METAL-CLAD CABLE

- A. Manufacturers:
 - 1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 - 2. Encore Wire Corporation: www.encorewire.com/#sle.
 - 3. Service Wire Co: www.servicewire.com/#sle.
 - 4. Southwire Company: www.southwire.com/#sle.
 - 5. _____.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Grounding: Full-size integral equipment grounding conductor.
- G. Armor: Steel, interlocked tape.

2.05 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 0526.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
 7. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.06 ACCESSORIES

- A. Electrical Tape:
1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
 7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Wire Pulling Lubricant:
1. Manufacturers:
 - a. 3M: www.3m.com/#sle.

- b. American Polywater Corporation: www.polywater.com/#sle.
 - c. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Listed and labeled as complying with UL 267.
 - 3. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 4. Suitable for use at installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

- A. Circuiting Requirements:
 - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 - 2. When circuit destination is indicated without specific routing, determine exact routing required.
 - 3. Arrange circuiting to minimize splices.
 - 4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
 - 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 - 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 - 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
 - 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install metal-clad cable (Type MC) in accordance with NECA 120.
- E. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- F. Exposed Cable Installation (only where specifically permitted):
 - 1. Route cables parallel or perpendicular to building structural members and surfaces.
 - 2. Protect cables from physical damage.

- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
 - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
 - 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- I. Terminate cables using suitable fittings.
 - 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- J. Install conductors with a minimum of 12 inches of slack at each outlet.
- K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- N. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
 - 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 - 3. Wet Locations: Use heat shrink tubing.
- P. Insulate ends of spare conductors using vinyl insulating electrical tape.

- Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- R. Identify conductors and cables in accordance with Section 26 0553.
- S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
 - 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Ground plate electrodes.
- G. Ground access wells.

1.03 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
 - 1. Includes oxide inhibiting compound.
- B. Section 26 0536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.04 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2017.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Field quality control test reports.
- E. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- E. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Ring:
 - a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.
 - b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.
 - c. Provide connection from ground ring conductor to:
 - 1) Perimeter columns of metal building frame.
 - 2) Ground rod electrodes located as indicated.
6. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground access well for each electrode.
7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
- F. Service-Supplied System Grounding:
 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- G. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
 1. Provide grounding electrode system for each separate building or structure.
 2. Provide equipment grounding conductor routed with supply conductors.
 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

H. Separately Derived System Grounding:

1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
 - c. Generators, when neutral is switched in the transfer switch.
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

I. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

- J. Communications Systems Grounding and Bonding:
 - 1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
 - 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- K. Cable Tray Systems: Also comply with Section 26 0536.
- L. Pole-Mounted Luminaires: Also comply with Section 26 5600.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
 - 2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.
- C. Connectors for Grounding and Bonding:
 - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - a. Exceptions:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.
 - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.
 - 4. Manufacturers - Mechanical and Compression Connectors:
 - a. allG Fabrication: www.allgfab.com/#sle.
 - b. Burndy LLC: www.burndy.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
 - 5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- D. Ground Bars:
 - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 - 2. Size: As indicated.

3. Holes for Connections: As indicated or as required for connections to be made.
4. Manufacturers:
 - a. allG Fabrication: www.allgfab.com/#sle.
 - b. Harger Lightning & Grounding: www.harger.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- E. Ground Rod Electrodes:
 1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
 4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
 5. Manufacturers:
 - a. allG Fabrication: www.allgfab.com/#sle.
 - b. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- F. Ground Plate Electrodes:
 1. Material: Copper.
 2. Size: 24 by 24 by 1/4 inches, unless otherwise indicated.
 3. Manufacturers:
 - a. allG Fabrication: www.allgfab.com/#sle.
 - b. Harger Lightning & Grounding: www.harger.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- G. Ground Access Wells:
 1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
 2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
 - a. Round Wells: Not less than 8 inches in diameter.
 - b. Rectangular Wells: Not less than 12 by 12 inches.
 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
 4. Cover: Factory-identified by permanent means with word "GROUND".
 5. Manufacturers:
 - a. allG Fabrication: www.allgfab.com/#sle.
 - b. Harger Lightning & Grounding: www.harger.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- H. Oxide Inhibiting Compound: Comply with Section 26 0519.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).

- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
- D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.
- E. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- F. Identify grounding and bonding system components in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- D. Section 26 0536 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.
- E. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- F. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- G. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.04 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Architect Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 3000.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- E. Installer's qualification statement.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications for Field Welding: See Section 05 5000.
- B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of 4. Include consideration for vibration, equipment operation, and shock loads where applicable.
 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Materials for Metal Fabricated Supports: See Section 05 5000.
- C. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
1. Manufacturers:
 - a. Substitutions: See Section 01 6000 - Product Requirements.
- E. Metal Channel/Strut Framing Systems:
1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 2. Comply with MFMA-4.
 3. Channel/Strut Used as Raceway, Where Indicated: Listed and labeled as complying with UL 5B.
 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 6. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.
- F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2-inch diameter.
 - b. Busway Supports: 1/2-inch diameter.
 - c. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
 - d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
 - e. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
 - f. Outlet Boxes: 1/4-inch diameter.
 - g. Luminaires: 1/4-inch diameter.
- G. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- H. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 4. Hollow Masonry: Use toggle bolts.
 5. Hollow Stud Walls: Use toggle bolts.
 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 7. Sheet Metal: Use sheet metal screws.
 8. Wood: Use wood screws.
 9. Plastic and lead anchors are not permitted.
 10. Powder-actuated fasteners are not permitted.
 11. Hammer-driven anchors and fasteners are not permitted.
 12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.

- d. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
- 13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Architect Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect Engineer, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Equipment Support and Attachment:
 - 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 - 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized concrete pad 3 inches in height; see Section 03 3000.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Conduit Support and Attachment: See Section 26 0533.13 for additional requirements.
- J. Cable Tray Support and Attachment: See Section 26 0536 for additional requirements.
- K. Box Support and Attachment: See Section 26 0533.16 for additional requirements.
- L. Interior Luminaire Support and Attachment: See Section 26 5100 for additional requirements.
- M. Exterior Luminaire Support and Attachment: See Section 26 5600 for additional requirements.
- N. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- O. Secure fasteners in accordance with manufacturer's recommended torque settings.
- P. Remove temporary supports.
- Q. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.

- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 0533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Stainless steel rigid metal conduit (RMC).
- C. Galvanized steel intermediate metal conduit (IMC).
- D. PVC-coated galvanized steel rigid metal conduit (RMC).
- E. Flexible metal conduit (FMC).
- F. Liquidtight flexible metal conduit (LFMC).
- G. Galvanized steel electrical metallic tubing (EMT).
- H. Rigid polyvinyl chloride (PVC) conduit.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 8400 - Firestopping.
- C. Section 220548 - Vibration Isolation and Seismic Control (For Seismic Bracing of Conduit, Equipment and Boxes)
- D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- E. Section 26 0529 - Hangers and Supports for Electrical Systems.
- F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.04 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2018.
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- M. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- N. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.

- O. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- P. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- Q. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- R. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- S. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- T. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
- U. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
 - 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
 - 5. Notify Architect Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Shop Drawings:
 - 1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
 - 2. Include proposed locations of roof penetrations and proposed methods for sealing.
- D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

1.07 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- B. Multi-trade Coordination: In lieu of detailed shop drawings, the Contractor may conduct a pre-installation and coordination meeting, with follow-up meetings to coordinate routing of mechanical, fire protection and electrical elements. Locations and conflict resolutions shall be made during these meetings. Notify Architect-Engineer of meeting times and dates. Do not install any conduit until this meeting has taken place.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use galvanized steel rigid metal conduit (RMC), PVC-coated galvanized steel rigid metal conduit (RMC), or rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
 - 3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit (RMC), PVC-coated galvanized steel rigid metal conduit (RMC), or rigid PVC conduit.
 - 4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC) where emerging from underground.
 - 5. Where rigid polyvinyl (PVC) conduit is provided, use galvanized steel rigid metal conduit (RMC) elbows or PVC-coated galvanized steel rigid metal conduit (RMC) elbows for bends.
 - 6. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use PVC-coated galvanized steel rigid metal conduit..
- D. Embedded Within Concrete:
 - 1. Within Slab on Grade: Not permitted.
 - 2. Within Slab Above Ground: Not permitted.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC) or PVC-coated galvanized steel rigid metal conduit (RMC).
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC).
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
 - b. Where exposed below 20 feet in warehouse areas.
- K. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
- L. Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
- M. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit (RMC).

- N. Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC) or PVC-coated galvanized steel rigid metal conduit (RMC).
- O. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 - 1. Maximum Length: 6 feet.
- P. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 3. Maximum Length: 6 feet unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
- Q. Panelboard feeders: Use galvanized steel rigid metal conduit.

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
 - 1. Where permitted, existing conduits to be reused may be used as sole equipment grounding conductor only when continuity of conduit pathway, including associated boxes and fittings, is verified; see Section 26 0526.
- C. Electrical Service Conduits: See Section 26 2100 for additional requirements.
- D. Fittings for Grounding and Bonding: See Section 26 0526 for additional requirements.
- E. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- F. Provide products listed, classified, and labeled as suitable for purpose intended.
- G. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4-inch trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch trade size.
 - 3. Control Circuits: 1/2-inch trade size.
 - 4. Flexible Connections to Luminaires: 1/2-inch trade size.
 - 5. Underground, Interior: 1-inch trade size.
 - 6. Underground, Exterior: 1-inch trade size.
- H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 4. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.

- e. Substitutions: See Section 01 6000 - Product Requirements.
- 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
- 3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
- 4. Material: Use steel or malleable iron.
 - a. Where not subject to severe corrosive influence, stainless steel fittings may be used.
 - b. Do not use die cast zinc fittings.
- 5. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
 - 3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 - 4. Material: Use steel or malleable iron.
 - a. Where not subject to severe corrosive influence, stainless steel fittings may be used.
 - b. Do not use die cast zinc fittings.
 - 5. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.
 - 6. More than Five Feet from Foundation Wall:
 - a. In Dirt: Use rigid steel conduit.
 - b. Under Road: Use rigid steel conduit.
 - 7. In or Under Slab on Grade: Use Schedule 40 PVC.
- D. Slab Penetrations:
 - 1. Vertical penetrations: Use rigid steel conduit.
 - 2. Elbows: Use rigid steel conduit.
- E. Motor and other moving equipment connections:
 - 1. Dry locations: Flexible steel conduit.
 - 2. Damp locations: Liquid-tight flexible steel conduit.

2.05 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. ABB; Ocal: www.electrification.us.abb.com/#sle.
 - 2. Calbond, a division of Atkore International www.calbond.com/#sle
 - 3. Allied Tube & Conduit: www.alliedtube.com.
 - 4. Robroy Industries: www.robroy.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.
- D. Interior Coating: Urethane, minimum thickness of 2 mil, 0.002 inch.
- E. PVC-Coated Boxes and Fittings:
 - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 - 2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
 - 3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 - 4. Material: Use steel or malleable iron.
 - 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.
 - 6. Interior Coating: Urethane, minimum thickness of 2 mil, 0.002 inch.
- F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.06 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com.
 - 2. Flex Tubes: www.flex-tubes.com
 - 3. Electri-Flex Company: www.electriflex.com.
 - 4. International Metal Hose: www.metalhose.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.07 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com.
 - 2. Electri-Flex Company: www.electriflex.com.
 - 3. International Metal Hose: www.metalhose.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.08 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 1. Allied Tube & Conduit: www.alliedeg.com.
 2. Nucor Tubular Products: www.nucortubular/#sle.
 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 4. Wheatland Tube Company: www.wheatland.com.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 4. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.
 5. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.

2.09 NONMETALLIC CONDUIT

- A. Manufacturers:
 1. ABB; Carlon: www.carlon.com/#sle.
 2. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 3. Cantex Inc: www.cantexinc.com/#sle.
 4. Heritage Plastics, a division of Atkore International: www.heritageplastics.com/#sle.
 5. JM Eagle: www.jmeagle.com/#sle.
 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 1. Manufacturer: Same as manufacturer of conduit to be connected.
 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

- D. Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.
- E. Sealing Systems for Concrete Penetrations:
 - 1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
 - 2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
- F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
 - 1. Products:
 - a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
 - b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- G. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
 - 1. Products:
 - a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- H. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - 1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- I. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.
 - 1. Products:
 - a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- J. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for casing and conduit/duct arrangement to be installed.
 - 1. Products:
 - a. Advance Products & Systems, LLC; Bore Spacers: www.apsonline.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install intermediate metal conduit (IMC) in accordance with NECA 101.

- E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.
- F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- G. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - 5. Unless otherwise approved, do not route exposed conduits:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
 - 6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 7. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 - 9. Arrange conduit to provide no more than 150 feet between pull points.
 - 10. Route conduits above water and drain piping where possible.
 - 11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 - 13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 - 14. Group parallel conduits in same area on common rack.
- H. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 - 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 - 5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 - 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 - 7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
 - 8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
 - 9. Use of spring steel conduit clips for support of conduits is not permitted.
 - 10. Use of wire for support of conduits is not permitted.

11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.
- I. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
 7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
 8. Secure joints and connections to provide mechanical strength and electrical continuity.
- J. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
 8. Provide metal escutcheon plates for conduit penetrations exposed to public view.
 9. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 8400.
- K. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 18 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
 2. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 26 0553.
- L. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Maximum Conduit Size: 1-inch trade size unless otherwise approved.
 2. Secure conduits to prevent floating or movement during pouring of concrete.
- M. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches on all sides unless otherwise indicated; see Section 03 3000.
- N. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.

3. Where conduits are subject to earth movement by settlement or frost.
- O. Conduit Sealing:
 1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - a. Where conduits enter building from outside.
 - b. Where service conduits enter building from underground distribution system.
 - c. Where conduits enter building from underground.
 - d. Where conduits may transport moisture to contact live parts.
 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
 - c. Where conduits penetrate coolers or freezers.
 3. Where conduits cross boundaries of hazardous/classified locations, provide identified/listed sealing fittings or conduit mechanical seals as approved by authorities having jurisdiction; locate as indicated or in accordance with NFPA 70.
- P. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- Q. Provide grounding and bonding; see Section 26 0526.
- R. Identify conduits; see Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 0533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.03 RELATED REQUIREMENTS

- A. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0533.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- D. Section 26 2726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.
- E. Section 230548 - Heating, Ventilation and Air-Conditioning (HVAC) Vibration Isolation And Seismic Restraint.

1.04 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- F. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (R2020).
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- C. Project Record Documents: Record actual locations for pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

1.07 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 (NEC).

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use nonmetallic boxes where exposed rigid PVC conduit is used.
 4. Use suitable concrete type boxes where flush-mounted in concrete.
 5. Use suitable masonry type boxes where flush-mounted in masonry walls.
 6. Use raised covers suitable for the type of wall construction and device configuration where required.
 7. Use shallow boxes where required by the type of wall construction.
 8. Do not use "through-wall" boxes designed for access from both sides of wall.

9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
11. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
12. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
13. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
14. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
15. Wall Plates: Comply with Section 26 2726.
16. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com.
 - c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com.
 - d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 4. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
 5. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
 - c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

- D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- G. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Locate boxes so that wall plates do not cross masonry joints.
 - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
 - 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
 - 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
 - 11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- H. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 - 4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- I. Install boxes plumb and level.
- J. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

- 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- K. Install boxes as required to preserve insulation integrity.
- L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- N. Close unused box openings.
- O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- P. Provide grounding and bonding in accordance with Section 26 0526.
- Q. Do not mount boxes back-to-back.

3.03 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0533.23
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Surface raceway systems.
- B. Wireways.
- C. Wall duct.

1.03 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0533.13 - Conduit for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 2726 - Wiring Devices: Receptacles.

1.04 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. UL 5 - Surface Metal Raceways and Fittings; Current Edition, Including All Revisions.
- E. UL 5A - Nonmetallic Surface Raceways and Fittings; Current Edition, Including All Revisions.
- F. UL 111 - Outline of Investigation for Multioutlet Assemblies; Current Edition, Including All Revisions.
- G. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate rough-in locations of outlet boxes provided under Section 26 0533.16 and conduit provided under Section 26 0533.13 as required for installation of raceways provided under this section.
 - 3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
 - 4. Wall Duct: Coordinate the work with other trades to provide walls suitable for installation of flush-mounted wall duct where indicated.
 - 5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install raceways until final surface finishes and painting are complete.
 - 2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
 - 1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 RACEWAY REQUIREMENTS

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.02 SURFACE RACEWAY SYSTEMS

- A. Manufacturers:
 - 1. MonoSystems, Inc: www.monosystems.com/#sle.
 - 2. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Surface Metal Raceways: Listed and labeled as complying with UL 5.
- C. Surface Nonmetallic Raceways: Listed and labeled as complying with UL 5A.
- D. Multioutlet Assemblies: Listed and labeled as complying with UL 111.

2.03 WIREWAYS

- A. Manufacturers:
 - 1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - 2. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
 - 3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.
- C. Wireway Type, Unless Otherwise Indicated:
 - 1. Indoor Clean, Dry Locations: NEMA 250, Type 1, painted steel with screw-cover.
- D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.
- E. Minimum Wireway Size: 2.5 by 2.5 inches unless otherwise indicated.
- F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.04 WALL DUCT

- A. Manufacturers:
 - 1. Dennis Filges Company, Inc: www.filgesco.com/#sle.
 - 2. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 - 3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Metal raceways specifically designed for enclosure of wiring to X-ray machines and similar medical equipment; listed and labeled as complying with UL 870.
- C. Material: Steel, unless otherwise indicated.
- D. Mounting Provisions: Suitable for surface- or flush-mounting as indicated.
- E. Size: As indicated on the drawings.

2.05 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Factory test each production unit for pre-wired surface raceway systems to verify proper wiring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.
- C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install raceways plumb and level.
- D. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.
- E. Secure and support raceways in accordance with Section 26 0529 at intervals complying with NFPA 70 and manufacturer's requirements.
- F. Close unused raceway openings.
- G. Provide grounding and bonding in accordance with Section 26 0526.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect raceways for damage and defects.
- C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.
- D. Correct wiring deficiencies and replace damaged or defective raceways.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 PROTECTION

- A. Protect installed raceways from subsequent construction operations.

END OF SECTION

SECTION 26 0548

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Seismic control requirements.
 - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Seismic restraint systems.

1.02 RELATED REQUIREMENTS

- A. Section 01 4533 - Code-Required Special Inspections and Procedures.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- D. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.03 DEFINITIONS

- A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., conduit, cable tray).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. ASHRAE (HVAC) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2020.
- E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).
- I. MFMA-4 - Metal Framing Standards Publication; 2004.
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
 2. Seismic Controls: Include seismic load capacities.

1.07 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 1. Select vibration isolators to provide required static deflection.
 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
- D. Equipment Isolation:
 1. Transformers:
 - a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
 - b. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.
- E. Conduit Isolation:
 1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.

2.02 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.
- B. Seismic Design Criteria: As indicated on drawings.

- C. Component Importance Factor (Ip): Electrical components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.
- D. Seismic Qualification of Equipment:
 - 1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
 - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 - 3. Notify Architect Engineer and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Seismic Restraints:
 - 1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 - 2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) Electrical components where either of the following apply:
 - (a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - b. Conduit, Cable Tray, and Raceway Exemptions, All Seismic Design Categories:
 - 1) Raceways with component importance factor (Ip) of 1.0 where flexible connections are provided between cable tray or raceway and associated components, where cable tray or raceway is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
 - (b) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.
 - (c) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
 - (d) Hanger supported conduits, cable trays, or raceways with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.
 - 2) Conduits less than 2-1/2 inch trade size.
 - c. Lighting Exemptions, All Seismic Design Categories:
 - 1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the structure or other nonstructural components.
 - 2) Lay-in luminaires weighing less than 56 pounds secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.

3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. ASHRAE (HVACA).
 - b. FEMA 413.
 - c. FEMA E-74.
 - d. SMACNA (SRM).
 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
 5. Seismic Restraint Systems:
 - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
 - c. Use only one restraint system type for a given electrical component or distributed system (e.g., conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
 - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
 - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
 - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
 - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
 - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
 - i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
- F. Seismic Attachments:
1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
 2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
 3. Do not use power-actuated fasteners.
 4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
 5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- G. Seismic Interactions:
1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.

2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
- H. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., conduit, cable tray); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.

2.03 SEISMIC RESTRAINT SYSTEMS

- A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- B. Cable Restraints:
1. Comply with ASCE 19.
 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 4. Use protective thimbles for cable loops where potential for cable damage exists.
- C. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect Engineer in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
 2. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
 3. Verification of required clearances between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.

- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Secure fasteners according to manufacturer's recommended torque settings.
- E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Vibration Isolation Systems:
 - 1. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 - 2. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 - 3. Adjust isolators to be free of isolation short circuits during normal operation.
 - 4. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- G. Seismic Controls:
 - 1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
 - 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
 - 3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
 - 4. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
 - 5. Concrete Housekeeping Pads:
 - a. Size in accordance with seismic design to meet anchor requirements.
 - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
 - 6. Seismic Restraint Systems:
 - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - b. Install restraints within permissible angles in accordance with seismic design.
 - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
 - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
 - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
 - 1. Verify isolator static deflections.
 - 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Seismic Controls:
 - 1. Verify snubbing element air gaps.
- E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Conduit and raceway markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.
- H. Instruction signs.

1.03 RELATED REQUIREMENTS

- A. Section 09 9113 - Exterior Painting.
- B. Section 09 9123 - Interior Painting.
- C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.
- E. Section 27 1000 - Structured Cabling: Identification for communications cabling and devices.

1.04 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011 (Reaffirmed 2017).
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011 (Reaffirmed 2017).
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions and graphic features of identification products.

- D. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of the National Electrical Code - NFPA 70 (NEC).

1.08 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use identification nameplate to identify main overcurrent protective device.
 - 5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - c. Transformers:
 - 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify load(s) served. Include location when not within sight of equipment.
 - d. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
 - 3. Emergency System Equipment:

- a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
 - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
 4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
 5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
 6. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
 7. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
 8. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
 9. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
 10. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
 11. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
 - a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 9123 and 09 9113.
 12. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70, including but not limited to the following.
 - a. Service equipment.
 - b. Industrial control panels.
 - c. Motor control centers.
 - d. Elevator control panels.
 - e. Industrial machinery.
 13. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.
 14. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
 15. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 16. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 17. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
5. Use underground warning tape to identify direct buried cables.
- C. Identification for Boxes:
 1. Use voltage markers to identify highest voltage present.
 2. Use voltage markers or color coded boxes to identify systems other than normal power system.
 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
- D. Identification for Devices:
 1. Identification for Communications Devices: Comply with Section 27 1000.
 2. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
 3. Factory Pre-Marked Wallplates: Comply with Section 26 2726.
 4. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
 5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
 1. Manufacturers:
 - a. Brady Corporation: www.bradyid.com/#sle.
 - b. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
 1. Minimum Size: 1 inch by 2.5 inches.
 2. Legend:
 - a. System designation where applicable:

- 1) Emergency Power System: Identify with text "EMERGENCY".
 - 2) Fire Alarm System: Identify with text "FIRE ALARM".
 - b. Equipment designation or other approved description.
 - c. Other information as indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height:
 - a. System Designation: 1 inch.
 - b. Equipment Designation: 1/2 inch.
 - c. Other Information: 1/4 inch.
 5. Color:
 - a. Normal Power System: White text on black background.
 - b. Emergency Power System: White text on red background.
 - c. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/4 inch.
 5. Color: Black text on white background unless otherwise indicated.
 - a. Exceptions:
 - 1) Provide white text on red background for general information or operational instructions for emergency systems.
 - 2) Provide white text on red background for general information or operational instructions for fire alarm systems.
- E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Designation indicated and device zone or address.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Red text on white background.
- G. Nameplate Inscription:
1. Nameplates must adequately describe the function or use of the particular equipment to which it is attached. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. Example: "Panel A, 277/480 v, 3-phase, 4-wire".
 2. The name of the machine on the motor nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and PB station nameplates for that machine.
 3. Use 1-7/8 inch letters for identifying signs on enclosures containing high voltage equipment. Signs shall read "DANGER - HIGH VOLTAGE".
 4. Warning signs (items 3 & 4 above) to be of standard manufacture, fabricated of 18 ga. steel, or heavier, with a porcelain enamel finish. Letters shall be red on white background.

2.03 WIRE AND CABLE MARKERS

- A. Manufacturers:

1. Brady Corporation: www.bradyid.com/#sle.
 2. HellermannTyton: www.hellermannntyton.com/#sle.
 3. Panduit Corp: www.panduit.com/#sle.
 4. Seton Identification Products: www.seton.com/aec.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

- A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.
 3. Seton Identification Products: www.seton.com/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- D. Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
 2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
 2. Markers for System Identification:
 - a. Emergency Power System: Text "EMERGENCY".
- F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.
 3. Seton Identification Products: www.seton.com/#sle.
 4. The C. H. Hanson Co.: www.chhanson.com
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.
- C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- D. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- E. Legend: Type of service, continuously repeated over full length of tape.

- F. Color:
 - 1. Tape for Buried Power Lines: Black text on red background.
 - 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 FLOOR MARKING TAPE

- A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

2.07 WARNING SIGNS AND LABELS

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.brimar.com/#sle.
 - 2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- C. Warning Signs:
 - 1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
 - 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
 - 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- D. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - a. Do not use labels designed to be completed using handwritten text.
 - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 - 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Boxes: Outside face of cover.
 - 8. Conductors and Cables: Legible from the point of access.
 - 9. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.
- C. Install wire, cable and underground markers per manufacturers' instructions.
- D. Install conduit, raceway and instructions signs parallel to lines and surrounding surfaces. Install instruction signs in a clearly visible location, straight and square to surroundings.

END OF SECTION

SECTION 26 0573
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Short-circuit study.
- B. Arc flash and shock risk assessment.
 - 1. Includes arc flash hazard warning labels.

1.02 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.
- B. Section 26 2413 - Switchboards.
- C. Section 26 2416 - Panelboards.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011 (Reaffirmed 2017).
- B. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).
- C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).
- D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
- E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.
- F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).
- G. NEMA MG 1 - Motors and Generators; 2018.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 2. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Submit study reports prior to or concurrent with product submittals.
 - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect Engineer.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Study preparer's qualifications.
- C. Study reports, stamped or sealed and signed by study preparer.

- D. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
 - 1. Identify modifications made in accordance with studies that:
 - a. Can be made at no additional cost to Owner.
 - b. As submitted will involve a change to the contract sum.
- E. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- F. Site-specific arc flash hazard warning labels.
- G. Field quality control reports.
- H. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- I. Project Record Documents: Revise studies as required to reflect as-built conditions.
 - 1. Include hard copies with operation and maintenance data submittals.
 - 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.06 POWER SYSTEM STUDIES

- A. Scope of Studies:
 - 1. Perform analysis of new electrical distribution system as indicated on drawings.
 - 2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
 - 3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
- B. General Study Requirements:
 - 1. Comply with NFPA 70.
 - 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
 - 1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
 - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
 - 1) Obtain up-to-date information from Utility Company.
 - b. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
 - c. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - d. Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - e. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
 - f. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

- D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
 2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
 - a. Maximum utility fault currents.
 - b. Maximum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
 3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
 3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
 - a. Maximum and minimum utility fault currents.
 - b. Maximum and minimum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- F. Study Reports:
1. General Requirements:
 - a. Identify date of study and study preparer.
 - b. Identify study methodology and software product(s) used.
 - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
 - d. Identify base used for per unit values.
 - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
 - f. Include conclusions and recommendations.
 2. Short-Circuit Study:
 - a. For each scenario, identify at each bus location:
 - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
 - 2) Fault point X/R ratio.
 - 3) Associated equipment short circuit current ratings.
 - b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
 3. Arc Flash and Shock Risk Assessment:
 - a. For the worst case for each scenario, identify at each bus location:
 - 1) Calculated incident energy and associated working distance.
 - 2) Calculated arc flash boundary.
 - 3) Bolted fault current.
 - 4) Arcing fault current.
 - 5) Clearing time.
 - 6) Arc gap distance.
 - b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

1.07 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
 - 1. Materials: Comply with Section 26 0553.
 - 2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
 - a. Include the following information:
 - 1) Arc flash boundary.
 - 2) Available incident energy and corresponding working distance.
 - 3) Nominal system voltage.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Adjust equipment and protective devices for compliance with studies and recommended settings.
- D. Notify Architect Engineer of any conflicts with or deviations from studies. Obtain direction before proceeding.

3.02 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

END OF SECTION

SECTION 26 0583
WIRING CONNECTIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Electrical connections to equipment.

1.03 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 0533.13 - Conduit for Electrical Systems.
- C. Section 26 0533.16 - Boxes for Electrical Systems.
- D. Section 26 2726 - Wiring Devices.

1.04 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

1.07 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 (NEC).
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Division 23 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 2726.
- D. Flexible Conduit: As specified in Section 26 0533.13.

- E. Wire and Cable: As specified in Section 26 0519.
- F. Boxes: As specified in Section 26 0533.16.

2.02 EQUIPMENT CONNECTIONS

- A. Coordinate Requirements with Division 23 (15):
 - 1. Electrical Connection: Flexible conduit.
 - 2. Provide field-installed disconnect switch where required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 0923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Occupancy sensors.
- B. Outdoor photo controls.

1.03 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0533.16 - Boxes for Electrical Systems.
- C. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

1.04 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices; 2020.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- F. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
 - 3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
 - 4. Notify Architect Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
- D. Field Quality Control Reports.

- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Include detailed information on device programming and setup.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.09 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. WattStopper: www.wattstopper.com/#sle.
 - 3. nLight Lighting Controls.
 - 4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
 - b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
 - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.

- d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 8. Sensitivity: Field adjustable.
 9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 10. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
 11. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
 12. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
- C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
 - c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
 - d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - f. Provide selectable audible alert to notify occupant of impending load turn-off.
 - g. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.
 2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
 3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 400 square feet.
 4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- D. Wall Dimmer Occupancy Sensors:
1. General Requirements:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.
 - b. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset

- memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- E. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - e. Finish: White unless otherwise indicated.
 2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 3. Ultrasonic Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet at a mounting height of 9 feet.
 4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.
- F. Directional Occupancy Sensors:
1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
 - a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - b. Provide field selectable setting for disabling LED motion detector visual indicator.
 - c. Finish: White unless otherwise indicated.
 2. Passive Infrared (PIR) Directional Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
 3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
- G. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 3. Input Supply Voltage: Dual rated for 120/277 V ac.

4. Load Rating:
 - a. Incandescent Load: Not less than 15 A.
 - b. Fluorescent Load: Not less than 20 A.

2.03 OUTDOOR PHOTO CONTROLS

- A. Manufacturers:
 1. Intermatic, Inc: www.intermatic.com/#sle.
 2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
 3. Substitutions: See Section 01 6000 - Product Requirements.
 4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. Stem-Mounted Outdoor Photo Controls:
 1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
 2. Housing: Weatherproof, impact resistant polycarbonate.
 3. Photo Sensor: Cadmium sulfide.
 4. Provide external sliding shield for field adjustment of light level activation.
 5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
 6. Voltage: As required to control the load indicated on the drawings.
 7. Failure Mode: Fails to the on position.
 8. Load Rating: As required to control the load indicated on the drawings.
 9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of lighting control devices provided under this section.
 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
 - b. In-Wall Time Switches: 48 inches above finished floor.
 - c. In-Wall Interval Timers: 48 inches above finished floor.

2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
 3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect Engineer to obtain direction prior to proceeding with work.
- C. Install lighting control devices in accordance with manufacturer's instructions.
 - D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - E. Install lighting control devices plumb and level, and held securely in place.
 - F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.
 - G. Provide required supports in accordance with Section 26 0529.
 - H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
 - I. Occupancy Sensor Locations:
 1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
 - J. Outdoor Photo Control Locations:
 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.
 - K. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.
 - L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
 - M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
 - N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
 - O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- E. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect Engineer.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect Engineer.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

- A. See Section 01 9113 - General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect Engineer, and correct deficiencies or make adjustments as directed.
- D. Training: Train 's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
 - 4. Location: At project site.

END OF SECTION

SECTION 26 2200
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General purpose transformers.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.13 - Conduit for Electrical Systems: Flexible conduit connections.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.
- B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.
- C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.
- F. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.
- K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

1. Vibration Isolators: Include attachment method and rated load and deflection.
 2. K-factor Rated Transformers: Include K-factor ratings.
 3. Buck-boost Transformers: Include voltage selection tables and wiring diagrams for autotransformer configurations.
- C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
 - D. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.
 - E. Field Quality Control Test Reports.
 - F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
 - G. Maintenance Data: Include recommended maintenance procedures and intervals.
 - H. Project Record Documents: Record actual locations of transformers.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
 1. Greater than 10 kVA: 104 degrees F maximum.
 2. Less than 10 kVA: 77 degrees F maximum.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE; _____: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Substitutions: See Section 01 6000 - Product Requirements.
- E. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet.
 - 2. Ambient Temperature:
 - a. Greater than 10 kVA: Not exceeding 104 degrees F.
 - b. Less than 10 kVA: Not exceeding 77 degrees F.
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hydropscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- C. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- D. Winding Taps:
 - 1. Less than 3 kVA: None.
 - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
 - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
 - 4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- E. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- F. Sound Levels: Standard sound levels complying with NEMA ST 20.
- G. Mounting Provisions:
 - 1. Less than 15 kVA: Suitable for wall mounting.
 - 2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- H. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Construction: Steel.
 - a. Less than 15 kVA: Totally enclosed, non-ventilated.
 - b. 15 kVA and Larger: Ventilated.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 - 4. Provide lifting eyes or brackets.
- I. Accessories:

1. Mounting Brackets: Provide manufacturer's standard brackets.
2. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA 250, type 3R assembly.
3. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

2.04 BUCK-BOOST TRANSFORMERS

- A. Description: Self-cooled, four winding, buck-boost transformers listed and labeled as complying with UL 506 or UL 1561, and suitable for field connection as an autotransformer; ratings as indicated on the drawings.
- B. Insulation System and Allowable Average Winding Temperature Rise:
 1. Less than 0.25 kVA: Class 105 degree C insulation system with 55 degrees C rise.
 2. 0.25 kVA and Larger: Class 180 degree C insulation system with 115 degree C rise.
- C. Coil Conductors: Continuous windings.
- D. Lugs: Suitable for terminating conductors sized for full rated load ampacity of transformer when operating in buck-boost configuration indicated.
- E. Mounting Provisions: Suitable for wall mounting.
- F. Transformer Enclosure: Comply with NEMA ST 20.
 1. Environment Type per NEMA 250: Type 3R.
 2. Construction: Steel, totally enclosed, non-ventilated.
 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.

2.05 SOURCE QUALITY CONTROL

- A. Factory test transformers according to NEMA ST 20.
- B. Sound Level Tests: Perform factory test designated in NEMA ST 20 as "design" test on each production unit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Install transformers plumb and level.
- G. Transformer Support:
 1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.
 2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
 3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

- 4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.
- K. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.
- L. Identify transformers in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

3.04 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2413

SWITCHBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- F. Section 26 4300 - Surge Protective Devices.

1.04 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e (Amended 2017).
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- F. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less; 2013.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- K. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- L. UL 891 - Switchboards; Current Edition, Including All Revisions.
- M. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Switchboards are provided by owner and installed by electrical contractor.
- B. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
 5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- C. Service Entrance Switchboards:
1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
 2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
 3. Obtain Utility Company approval of switchboard prior to fabrication.
 4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 4. Include documentation of listed series ratings upon request.
 5. Include documentation demonstrating selective coordination upon request.
- D. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.
- E. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as production (routine) tests.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Field Quality Control Test Reports.
- H. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.
- I. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Enclosure Keys: Two of each different key.
 3. Drawout Devices:
 - a. Handles Necessary for Racking of Devices: One for each electrical room containing switchgear with drawout devices.

- b. Lifting Yokes: One of each different yoke required, for each electrical room containing drawout devices.
- c. Removable Covers: One for blocking each different opening size when device is temporarily removed from its compartment.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.09 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Switchboards - Basis of Design: Square D.
- B. Switchboards - Other Acceptable Manufacturers:
 - 1. ABB/GE:
 - 2. Eaton Corporation; _____:
 - 3. Schneider Electric; Square D Products; _____:
- C. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 SWITCHBOARDS

- A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- D. Front-Connected Switchboards:
 - 1. Main Device(s): Individually-mounted.
 - 2. Feeder Devices: Panel/group-mounted.
 - 3. Arrangement: Front accessible only (not rear accessible), rear aligned.
 - 4. Gutter Access: Bolted covers.
- E. Service Entrance Switchboards:
 - 1. Listed and labeled as suitable for use as service equipment according to UL 869A.

2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
 3. Comply with Utility Company requirements for electrical service.
 4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
- F. Service Conditions:
1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude: Less than 6,600 feet.
 - b. Ambient Temperature:
 - 1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
 2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- G. Short Circuit Current Rating:
1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.
- H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- I. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- J. Bussing: Sized in accordance with UL 891 temperature rise requirements.
1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
 2. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 3. Phase and Neutral Bus Material: Copper.
 4. Ground Bus Material: Copper.
- K. Conductor Terminations: Suitable for use with the conductors to be installed.
1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
 2. Load Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Lug Type:
- L. Enclosures:
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 2. Finish: Manufacturer's standard unless otherwise indicated.
 3. Enclosure Space Heaters:
 - a. Provide in each switchboard section installed outdoors and in unconditioned indoor spaces.
 - b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
 - c. Heater Control: Thermostat.
 - d. Heater Power Source: Provide connection to transformer factory-installed in switchboard or suitable external branch circuit as indicated or as required.
 4. Outdoor Enclosures:

- a. Enclosure Type: Non-walk-in type unless otherwise indicated.
 - b. Color: Manufacturer's standard.
 - c. Access Doors: Lockable, with all locks keyed alike.
- M. Future Provisions:
 - 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
 - 2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.
 - 3. Arrange and equip through bus and ground bus to accommodate future installation of additional switchboard sections where indicated.
- N. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list switchboards as a complete assembly including surge protective device.
- O. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
 - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- P. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- Q. Owner Metering:
 - 1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
 - 2. Measured Parameters:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase and neutral.
 - c. Frequency (Hz).
 - d. Real power (kW): For each phase, 3-phase total.
 - e. Reactive power (kVAR): For each phase, 3-phase total.
 - f. Apparent power (kVA): For each phase, 3-phase total.
 - g. Power factor.
 - h. Real energy (kWh).
 - i. Current demand.
 - 3. Meter Accuracy: Plus/minus 1.0 percent.
 - 4. Features:
 - a. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
 - b. Remote monitoring capability via PC.
- R. Instrument Transformers:
 - 1. Comply with IEEE C57.13.
 - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 - 3. Current Transformers: Connect secondaries to shorting terminal blocks.
 - 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Circuit Breakers:
 - 1. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - 2. Molded Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
 - 2) Provide electronic trip circuit breakers where indicated.
 - b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - 2) Provide interchangeable trip units where indicated.
 - c. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.
 - (c) Short time pickup and delay.
 - (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated.
 - 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
 - 3) Provide communication capability where indicated: Compatible with system indicated.
 - d. Provide the following circuit breaker types where indicated:
 - 1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
 - 2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
 - e. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - 3. Insulated Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
 - b. Operation:
 - 1) Provide manually operated circuit breakers unless otherwise indicated.
 - 2) Provide electrically operated circuit breakers where indicated.

- 3) Pad-Lock Provision: For preventing circuit breaker closing operation.
- c. Construction:
 - 1) Provide fixed-mount circuit breakers unless otherwise indicated.
 - 2) Provide drawout circuit breakers where indicated.
- d. Drawout Circuit Breakers:
 - 1) Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
 - 2) Provide safety interlock to prevent racking of circuit breaker while in the ON position.
 - 3) Pad-Lock Provision: For preventing circuit breaker drawout operation.
- e. Minimum Interrupting Capacity:
 - 1) 42,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 65,000 rms symmetrical amperes at 480 VAC.
- f. Trip Units: Solid state, microprocessor-based, true rms sensing.
 - 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.
 - (c) Short time pickup and delay.
 - (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated.
 - 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
 - 3) Provide communication capability where indicated: Compatible with system indicated.
- g. Provide the following circuit breaker types where indicated:
 - 1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
 - 2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- h. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

2.04 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
 1. Dielectric tests.
 2. Mechanical operation tests.
 3. Grounding of instrument transformer cases test.
 4. Electrical operation and control wiring tests, including polarity and sequence tests.
 5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.

- C. Verify that mounting surfaces are ready to receive switchboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Install switchboards plumb and level.
- G. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 03 3000.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Install all field-installed devices, components, and accessories.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Set field-adjustable circuit breaker tripping function settings as indicated.
- L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- M. Provide filler plates to cover unused spaces in switchboards.
- N. Identify switchboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- C. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- D. Inspect and test in accordance with NETA ATS, except Section 4.
- E. Perform inspections and tests listed in NETA ATS, Section 7.1.
- F. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers. Tests listed as optional are not required.
- G. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- H. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- I. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- J. Test shunt trips to verify proper operation.
- K. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

- A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

3.06 PROTECTION

- A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 26 2416
PANELBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.04 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e (Amended 2017).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- O. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- P. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
- D. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Panelboard Keys: Two of each different key.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.09 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 2. Listed series ratings are not acceptable.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.
 3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 4. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - c. Provide painted steel boxes for surface-mounted panelboards, finish to match fronts.
 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 4. Lockable Doors: All locks keyed alike unless otherwise indicated.

- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
 - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- L. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- N. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- O. Load centers are not acceptable.
- P. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Feed-through lugs.
 - 2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Copper.
 - 2. Ground Bus Material: Copper.
- D. Circuit Breakers:
 - 1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
 - 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted enclosures unless otherwise indicated.
 - 2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:

1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Copper.
 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - a. Provide the following field-adjustable trip response settings:
 - 1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - 2) Long time delay.
 - 3) Short time pickup and delay.
 - 4) Instantaneous pickup.
 - 5) Ground fault pickup and delay where ground fault protection is indicated.
 - b. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
 - c. Provide communication capability where indicated: Compatible with system indicated.
 6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
 7. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.

- c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
 - d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
 - e. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
 9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
 10. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - c. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - d. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 - e. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

2.06 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
- J. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- K. Provide grounding and bonding in accordance with Section 26 0526.
 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

- 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- L. Install all field-installed branch devices, components, and accessories.
- M. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- N. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- O. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.
- P. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- Q. Provide filler plates to cover unused spaces in panelboards.
- R. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated.
- S. Identify panelboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- E. Test GFCI circuit breakers to verify proper operation.
- F. Test AFCI circuit breakers to verify proper operation.
- G. Test shunt trips to verify proper operation.
- H. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.

3.05 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.

1.03 RELATED REQUIREMENTS

- A. Section 26 0533.16 - Boxes for Electrical Systems.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.04 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2017h.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); 2017g.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
 - 6. Notify Architect Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Project Record Documents: Record actual installed locations of wiring devices.

1.07 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 (NEC).
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- E. Provide GFCI protection for receptacles installed in kitchens.
- F. Provide GFCI protection for receptacles serving electric drinking fountains.
- G. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
- C. Verify all finishes with architect.

2.03 WALL SWITCHES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell.com/#sle.
 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 4. Greengate/Cooper.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Commercial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.04 WALL DIMMERS

- A. Manufacturers:
 1. nLight

2. Wattstopper
- B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

2.05 RECEPTACLES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell.com/#sle.
 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 2. NEMA configurations specified are according to NEMA WD 6.
 3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.
- C. Convenience Receptacles:
 1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
 1. GFCI Receptacles - General Requirements: Self-testing, with light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 3. Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

2.06 WALL PLATES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 3. Lutron Electronics Company, Inc: www.lutron.com/sle.
 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Wall Plates: Comply with UL 514D.
 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- D. Weatherproof Covers for Wet or Damp Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
 - 1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 3. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect Engineer to obtain direction prior to proceeding with work.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or

improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

- O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- P. Do not install devices back-to-back.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 2813

FUSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.03 RELATED REQUIREMENTS

- A. Section 26 2513 - Low-Voltage Busways: Fusible switches.

1.04 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Provide fuse cabinet in a location as instructed by the Owner's Representative.. Provide a schedule of all fuses including service and sizes in the cabinet.
 - 3. Extra Fuses: Three set(s) of three for each type and size installed.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 (NEC).
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with a service representative or facility within 200 miles of Project.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 MAINTENANCE MATERIALS

- A. See Section 016000 - Product Requirements, for additional provisions.
- B. Furnish three of each size and type fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.
- B. GE Industrial: www.geindustrial.com.
- C. Littelfuse, Inc: www.littelfuse.com.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Motor Load Feeder Switches: Class RK1 (time delay).
- H. Motor Branch Circuits: Class L time delay.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 2816.13
ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Enclosed circuit breakers.

1.03 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.04 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e (Amended 2017).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- J. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- K. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of circuit breaker upon request.
- C. Field Quality Control Test Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- E. Project Record Documents: Record actual installed locations of enclosed circuit breakers.
- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

1.09 FIELD CONDITIONS

- A. Maintain ambient temperature between 23 degrees F and 104 degrees F during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Source Limitations: Furnish enclosed circuit breakers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
 - 1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
 - 2. Listed series ratings are not acceptable.
- E. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- F. Conductor Terminations: Suitable for use with the conductors to be installed.

- G. Provide thermal magnetic circuit breakers for circuit breaker frame sizes less than 250A amperes.
- H. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- I. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
 - 3. Provide surface-mounted enclosures unless otherwise indicated.
- K. Provide externally operable handle with means for locking in the OFF position.
- L. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion circuit breakers with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
- M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.03 MOLDED CASE CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - b. 14,000 rms symmetrical amperes at 480 VAC.
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- C. Conductor Terminations:
 - 1. Provide mechanical lugs unless otherwise indicated.
 - 2. Provide compression lugs where indicated.
 - 3. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
- E. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- F. Provide the following circuit breaker types where indicated:
 - 1. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - 2. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.

- G. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
- H. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
- I. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install enclosed circuit breakers plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- I. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- J. Identify enclosed circuit breakers in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- E. Test GFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.
- G. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2816.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Enclosed safety switches.

1.03 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.04 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Project Record Documents: Record actual locations of enclosed switches.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.09 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- N. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Provide compression lugs where indicated.
 - c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
 - a. Provide means for locking handle in the ON position where indicated.
- O. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Identify enclosed switches in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 3213
ENGINE GENERATORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Packaged engine generator system and associated components and accessories:
 - 1. Generator set enclosure.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 23 1113 - Facility Fuel-Oil Piping:
 - 1. Installation of diesel fuel system day tank specified in this section.
- C. Section 23 3100 - HVAC Ducts and Casings.
- D. Section 23 5100 - Breechings, Chimneys, and Stacks: Engine exhaust piping.
 - 1. Includes installation of exhaust silencer specified in this section.
- E. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- F. Section 26 0529 - Hangers and Supports for Electrical Systems.
- G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 3600 - Transfer Switches.

1.04 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.
- C. NEMA MG 1 - Motors and Generators; 2018.
- D. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2018.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 99 - Health Care Facilities Code; 2018.
- G. NFPA 110 - Standard for Emergency and Standby Power Systems; 2019.
- H. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.
- I. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
 - a. Transfer Switches: See Section 26 3600.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
 - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.

5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
 1. Include generator set sound level test data.
 2. Include characteristic trip curves for overcurrent protective devices upon request.
 3. Include alternator thermal damage curve upon request.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
- D. Derating Calculations: Indicate ratings adjusted for applicable service conditions.
- E. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.
- F. Specimen Warranty: Submit sample of manufacturer's warranty.
- G. Evidence of qualifications for installer.
- H. Evidence of qualifications for maintenance contractor (if different entity from installer).
- I. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- J. Manufacturer's factory emissions certification.
- K. Manufacturer's certification that products meet or exceed specified requirements.
- L. Source quality control test reports.
- M. Provide NFPA 110 required documentation from manufacturer where requested by authorities having jurisdiction, including but not limited to:
 1. Certified prototype tests.
 2. Torsional vibration compatibility certification.
 3. NFPA 110 compliance certification.
 4. Certified rated load test at rated power factor.
- N. Manufacturer's detailed field testing procedures.
- O. Field quality control test reports.
- P. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- Q. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- R. Maintenance contracts.
- S. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
- T. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Extra Filter Elements: One of each type, including fuel, oil and air.

1.07 QUALITY ASSURANCE

- A. Comply with the following:
 1. NFPA 70 (National Electrical Code).
 2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.
 3. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
 1. Authorized service facilities located within 200 miles of project site.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.
- E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
 1. Contract maintenance office located within 200 miles of project site.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.09 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Packaged Engine Generator Set - Basis of Design: CAT.
- B. Packaged Engine Generator Set - Other Acceptable Manufacturers:
 1. Caterpillar Inc: www.cat.com/#sle.
 2. Kohler Co: www.kohlerpower.com/#sle.
- C. Substitutions: See Section 01 6000 - Product Requirements.
- D. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

2.02 PACKAGED ENGINE GENERATOR SYSTEM

- A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. System Description:
 - 1. Application: Emergency/standby.
 - 2. Configuration: Single packaged engine generator set operated independently (not in parallel).
 - 3. Where design is based on single generator set, use of multiple, smaller unit(s) operated in parallel to obtain equivalent total system power rating is not permitted.
- D. Packaged Engine Generator Set:
 - 1. Type: Gaseous (spark ignition).
 - 2. Basis of Design: CAT.
 - 3. Power Rating: As indicated on drawings, standby.
 - 4. Voltage: As indicated on drawings.
 - 5. Main Line Circuit Breaker:
 - a. Type: Thermal magnetic.
 - b. Trip Rating: Select according to generator set rating.
 - c. Features:
 - 1) Shunt trip.
 - 2) Auxiliary contacts.
- E. Generator Set General Requirements:
 - 1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
 - 2. Factory-assembled, with components mounted on suitable base.
 - 3. List and label engine generator assembly as complying with UL 2200.
 - 4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
 - 5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
 - 6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.
- F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.
- G. Starting and Load Acceptance Requirements:
 - 1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
 - 2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
 - 3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
 - 4. Maximum Load Step: Supports 100 percent of rated load in one step.
 - 5. Motor Starting Capability: Supports starting of motor load indicated with a maximum voltage dip of 5 percent.
- H. Exhaust Emissions Requirements:
 - 1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
 - 2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

- I. Sound Level Requirements:
 - 1. Do not exceed 77 dBA when measured at 23 feet from generator set in free field (no sound barriers) while operating at full load; include manufacturer's sound data with submittals.

2.03 ENGINE AND ENGINE ACCESSORY EQUIPMENT

- A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.
- B. Engine Fuel System - Gaseous (Spark Ignition):
 - 1. Fuel Source: Natural gas.
 - 2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
 - 3. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:
 - a. Carburetor.
 - b. Gas pressure regulators.
 - c. Fuel shutoff control valves.
 - d. Low gas pressure switches.
- C. Engine Starting System:
 - 1. System Type: Electric, with DC solenoid-activated starting motor(s).
 - 2. Battery(s):
 - a. Battery Type: Lead-acid.
 - b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
 - c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
 - 3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
 - 4. Battery Charger:
 - a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
 - b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
 - c. Recognized as complying with UL 1236.
 - d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
 - e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
 - f. Provide alarm output contacts as necessary for alarm indications.
 - 5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.
- D. Engine Speed Control System (Governor):
 - 1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
 - 2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.
- E. Engine Lubrication System:
 - 1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.

2. Oil Heater: Provide thermostatically controlled oil heater to improve starting under cold ambient conditions.
- F. Engine Cooling System:
1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
 2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
 3. Ducted Radiators: Where ducted radiator air discharge is to be field-installed, provide suitable radiator duct flange/adaptor.
 4. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.
- G. Engine Air Intake and Exhaust System:
1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
 2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
 3. Exhaust Silencer: Provide critical grade or better exhaust silencer with sound attenuation not less than basis of design; select according to manufacturer's recommendations to meet sound performance requirements, where specified.

2.04 ALTERNATOR (GENERATOR)

- A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.
- B. Exciter:
1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
 2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
 3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.
- C. Temperature Rise: Comply with UL 2200.
- D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.
- E. Enclosure: NEMA MG 1, drip-proof.
- F. Total Harmonic Distortion: Not greater than five percent.
- G. Alternator Heater: Provide strip heater to prevent moisture condensation on alternator windings.

2.05 GENERATOR SET CONTROL SYSTEM

- A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.
- B. Control Panel:
1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
 2. Generator Set Control Functions:
 - a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
 - b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
 - c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
 - d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
 - e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.

- f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
 - g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
 - 3. Generator Set Status Indications:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase.
 - c. Frequency (Hz).
 - d. Real power (W/kW).
 - e. Reactive power (VAR/kVAR).
 - f. Apparent power (VA/kVA).
 - g. Power factor.
 - h. Duty Level: Actual load as percentage of rated power.
 - i. Engine speed (RPM).
 - j. Battery voltage (Volts DC).
 - k. Engine oil pressure.
 - l. Engine coolant temperature.
 - m. Engine run time.
 - n. Generator powering load (position signal from transfer switch).
 - 4. Generator Set Protection and Warning/Shutdown Indications:
 - a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
 - 1) Overcrank (shutdown).
 - 2) Low coolant temperature (warning).
 - 3) High coolant temperature (warning).
 - 4) High coolant temperature (shutdown).
 - 5) Low oil pressure (warning).
 - 6) Low oil pressure (shutdown).
 - 7) Overspeed (shutdown).
 - 8) Low fuel level (warning).
 - 9) Low coolant level (warning/shutdown).
 - 10) Generator control not in automatic mode (warning).
 - 11) High battery voltage (warning).
 - 12) Low cranking voltage (warning).
 - 13) Low battery voltage (warning).
 - 14) Battery charger failure (warning).
 - b. In addition to NFPA 110 requirements, provide the following protections/indications:
 - 1) High AC voltage (shutdown).
 - 2) Low AC voltage (shutdown).
 - 3) High frequency (shutdown).
 - 4) Low frequency (shutdown).
 - 5) Overcurrent (shutdown).
 - c. Provide contacts for local and remote common alarm.
 - d. Provide lamp test function that illuminates all indicator lamps.
 - 5. Other Control Panel Features:
 - a. Event log.
- C. Remote Annunciator:
 - 1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
 - 2. Generator Set Status Indications:
 - a. Generator powering load (via position signal from transfer switch).
 - b. Communication functional.
 - 3. Generator Set Warning/Shutdown Indications:

- a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following indications:
 - 1) Overcrank (shutdown).
 - 2) Low coolant temperature (warning).
 - 3) High coolant temperature (warning).
 - 4) High coolant temperature (shutdown).
 - 5) Low oil pressure (warning).
 - 6) Low oil pressure (shutdown).
 - 7) Overspeed (shutdown).
 - 8) Low fuel level (warning).
 - 9) Low coolant level (warning/shutdown).
 - 10) Generator control not in automatic mode (warning).
 - 11) High battery voltage (warning).
 - 12) Low cranking voltage (warning).
 - 13) Low battery voltage (warning).
 - 14) Battery charger failure (warning).
- b. Provide audible alarm with silence function.
- c. Provide lamp test function that illuminates all indicator lamps.
- D. Remote Emergency Stop: Provide approved red, mushroom style remote emergency stop button where indicated or required by authorities having jurisdiction.

2.06 GENERATOR SET ENCLOSURE

- A. Enclosure Type: Sound attenuating, weather protective.
- B. Enclosure Material: Steel or aluminum.
- C. Hardware Material: Stainless steel.
- D. Color: Manufacturer's standard.
- E. Access Doors: Lockable, with all locks keyed alike.
- F. Openings: Designed to prevent bird/rodent entry.
- G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.
- H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.
- I. Utilize an upward discharging radiator hood.
- J. Exhaust Silencers: Where exhaust silencers are mounted within enclosure in main engine compartment, insulate silencer to minimize heat dissipation as necessary for operation at rated load under worst case ambient temperature.
- K. Enclosure Space Heater: Provide thermostatically controlled enclosure space heater to prevent condensation and improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

2.07 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.
- C. Generator Set production testing to include, at a minimum:
 - 1. Operation at rated load and rated power factor.
 - 2. Single step load pick-up.
 - 3. Transient and steady state voltage and frequency performance.
 - 4. Operation of safety shutdowns.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive equipment.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.
- D. Arrange equipment to provide minimum clearances and required maintenance access.
- E. Unless otherwise indicated, mount generator set on properly sized, minimum 6 inch high concrete pad constructed in accordance with Section 03 3000.
- F. Provide required support and attachment in accordance with Section 26 0529.
- G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.
- H. Install day tank in accordance with Section 23 1113.
- I. Provide duct for cooling air intake/exhaust in accordance with Section 23 3100.
- J. Provide engine exhaust piping in accordance with Section 23 5100, where not factory installed.
 - 1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
 - 2. Do not exceed manufacturer's maximum back pressure requirements.
- K. Do not insulate piping for engine components restricted by manufacturer.
- L. Install exhaust silencer in accordance with Section 23 5100, where not factory installed.
- M. Provide grounding and bonding in accordance with Section 26 0526.
- N. Identify system wiring and components in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
- C. Notify Owner and Architect Engineer at least two weeks prior to scheduled inspections and tests.
- D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.
- F. Preliminary inspection and testing to include, at a minimum:
 - 1. Inspect each system component for damage and defects.
 - 2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
 - 3. Check for proper oil and coolant levels.
- G. Prepare and start system in accordance with manufacturer's instructions.

- H. Perform acceptance test in accordance with NFPA 110.
- I. Inspection and testing to include, at a minimum:
 - 1. Verify compliance with starting and load acceptance requirements.
 - 2. Verify voltage and frequency; make required adjustments as necessary.
 - 3. Verify phase sequence.
 - 4. Verify control system operation, including safety shutdowns.
 - 5. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).
 - 6. Perform load tests in accordance with NFPA 110 (1.5 hour building load test followed by 2 hour full load test).
- J. Provide field emissions testing where necessary for certification.
- K. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.
- L. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- M. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.
- E. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters and fill fuel storage tank.

3.06 PROTECTION

- A. Protect installed engine generator system from subsequent construction operations.

3.07 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.
- C. During 1 year warranty period conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.
- D. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION

SECTION 26 3600
TRANSFER SWITCHES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
 - 1. Automatic transfer switches.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 3213 - Engine Generators: For interface with transfer switches.
 - 1. Includes additional testing requirements.
 - 2. Includes related demonstration and training requirements.

1.04 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2020.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 110 - Standard for Emergency and Standby Power Systems; 2019.
- G. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
 - a. Engine Generators: See Section 26 3213.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 5. Notify Architect Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
 - 1. Where applicable, include characteristic trip curves for overcurrent protective devices upon request.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
- D. Specimen Warranty: Submit sample of manufacturer's warranty.
- E. Evidence of qualifications for installer.
- F. Evidence of qualifications for maintenance contractor (if different entity from installer).
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- H. Manufacturer's certification that products meet or exceed specified requirements.
- I. Source quality control test reports.
- J. Manufacturer's detailed field testing procedures.
- K. Field quality control test reports.
- L. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- M. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- N. Maintenance contracts.
- O. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
- P. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.07 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70 (National Electrical Code).
 - 2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 2 system.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
 - 1. Authorized service facilities located within 200 miles of project site.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with power transfer systems of similar size, type, and complexity; manufacturer's authorized installer.
- E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
 - 1. Contract maintenance office located within 200 miles of project site.

- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.09 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Transfer Switches:
 - 1. ABB/GE: www.electrification.us.abb.com/#sle.
 - 2. ASCO Power Technologies: www.ascopower.com/#sle.
 - 3. Eaton Corporation: www.eaton.com/#sle.
 - 4. Same as manufacturer of engine generator(s) used for this project.

2.02 TRANSFER SWITCHES

- A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Applications:
 - 1. Utilize open transition transfer unless otherwise indicated or required.
 - 2. For transfer of highly inductive loads (e.g. large motors and transformers), utilize open transition transfer with in-phase monitor or delayed transition transfer.
 - 3. Neutral Switching (Single Phase, Three Wire and Three Phase, Four Wire Systems):
- D. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.
- E. Automatic Transfer Switch:
 - 1. Transfer Switch Type: As indicated on the drawings.
 - 2. Transition Configuration: As indicated on the drawings.
 - 3. Voltage: As indicated on the drawings.
 - 4. Ampere Rating: As indicated on the drawings.
 - 5. Neutral Configuration: Solid neutral (unswitched), except as indicated.
 - 6. Load Served: As indicated on the drawings.
 - 7. Primary Source: As indicated on the drawings.
 - 8. Alternate Source: As indicated on the drawings.
- F. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

- G. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.
- H. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.
- I. Switching Methods:
 - 1. Open Transition:
 - a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
 - b. Where in-phase transfer is indicated, utilize in-phase monitor to initiate transfer when phase angle difference between sources is near zero to limit in-rush currents.
 - 2. Delayed Transition:
 - a. Provide break-before-make transfer with programmable time delay in a neutral position not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
 - 3. Obtain control power for transfer operation from line side of source to which the load is to be transferred.
- J. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.
- K. Enclosures:
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 - b. Outdoor Locations: Type 3R or Type 4.
 - 2. Provide lockable door(s) for outdoor locations.
 - 3. Finish: Manufacturer's standard unless otherwise indicated.
- L. Short Circuit Current Rating:
- M. Automatic Transfer Switches:
 - 1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
 - 2. Control Functions:
 - a. Automatic mode.
 - b. Test Mode: Simulates failure of primary/normal source.
 - c. Voltage and Frequency Sensing:
 - 1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
 - 2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
 - 3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
 - d. Outputs:
 - 1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
 - 2) Auxiliary contacts; one set(s) for each switch position.
 - e. Adjustable Time Delays:
 - 1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
 - 2) Transfer to alternate/emergency source time delay.
 - 3) Retransfer to primary/normal source time delay.
 - 4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.

- f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.
 - g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.
- 3. Status Indications:
 - a. Connected to alternate/emergency source.
 - b. Connected to primary/normal source.
 - c. Alternate/emergency source available.
- 4. Automatic Sequence of Operations:
 - a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
 - b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
 - c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
 - d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.
- N. Interface with Other Work:
 - 1. Interface with engine generators as specified in Section 26 3213.

2.03 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive transfer switches.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install transfer switches plumb and level.
- F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Identify transfer switches and associated system wiring in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

- C. Prepare and start system in accordance with manufacturer's instructions.
- D. Automatic Transfer Switches:
 - 1. Inspect and test in accordance with NETA ATS, except Section 4.
 - 2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The insulation-resistance tests listed as optional are not required.
- E. Provide additional inspection and testing as required for completion of associated engine generator testing as specified in Section 26 3213.
- F. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of transfer switches.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.
- E. Coordinate with related generator demonstration and training as specified in Section 26 3213.

3.06 PROTECTION

- A. Protect installed transfer switches from subsequent construction operations.

3.07 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of transfer switches for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.
- C. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Provide on-site response within 4 hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- E. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION

SECTION 26 4300
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.

1.03 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 2413 - Switchboards.
- C. Section 26 2416 - Panelboards.

1.04 ABBREVIATIONS AND ACRONYMS

- A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
- B. SPD: Surge Protective Device.

1.05 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
 - 1. SPDs with EMI/RFI filter: Include noise attenuation performance.
- C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.
- D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
 - 1. UL 1449.
 - 2. UL 1283 (for Type 2 SPDs).
- E. Field Quality Control Test Reports.

- F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
- H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- I. Project Record Documents: Record actual connections and locations of surge protective devices.

1.08 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.09 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.10 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.11 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
- C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Field-installed, Externally Mounted Surge Protective Devices:
 - 1. ABB/GE: www.geindustrial.com/#sle.
 - 2. Current Technology; a brand of Thomas & Betts Power Solutions: www.tnbpowersolutions.com/#sle.
 - 3. Schneider Electric; Square D Brand SurgeLogic Products: www.surgeologic.com.
- B. Factory-installed, Internally Mounted Surge Protective Devices:
 - 1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.
- C. Substitutions: See Section 01 6000 - Product Requirements.
- D. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.

- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. Protected Modes:
 - 1. Wye Systems: L-N, L-G, N-G, L-L.
- E. UL 1449 Voltage Protection Ratings (VPRs):
 - 1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
 - 2. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.
- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 1. Indoor clean, dry locations: Type 1.
 - 2. Outdoor locations: Type 3R.
- H. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
 - 1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
 - 2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.
- I. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.
 - 1. Switchboards: See Section 26 2413.
 - 2. Panelboards: See Section 26 2416.

2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

- A. Surge Protective Device:
 - 1. Protection Circuits: Field-replaceable modular or non-modular.
 - 2. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.
 - 3. UL 1449 Nominal Discharge Current (I-n): 20 kA.
 - 4. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
 - 5. Diagnostics:
 - a. Protection Status Monitoring: Provide indicator lights to report the protection for each phase.
 - b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.

2.04 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

- A. Surge Protective Device:
 - 1. Protection Circuits: Field-replaceable modular or non-modular.
 - 2. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.
 - 3. UL 1449 Nominal Discharge Current (I-n): 20 kA.
 - 4. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
 - 5. Diagnostics:
 - a. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
 - b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- C. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
- D. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
- E. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Section 7.19.1.
- D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.04 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 5100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Lamps.
- F. Accessories.

1.03 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0533.16 - Boxes for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.
- F. Section 26 5600 - Exterior Lighting.

1.04 REFERENCE STANDARDS

- A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns; 2006.
- B. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast; 2004.
- C. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- D. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015, with Errata (2017).
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.
- G. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- H. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices; 2020.
- I. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- M. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- N. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Architect Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - 2. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
 - 3. Fluorescent Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
- D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.
- E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
- G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.09 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 2-year manufacturer warranty for linear fluorescent ballasts.
- C. Provide 5-year pro-rata warranty for batteries for emergency lighting units.
- D. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.
- E. Provide 3-year full warranty for fluorescent emergency power supply units.

1.11 EXTRA MATERIALS

- A. See Section 016000 - Product Requirements, for additional provisions.
- B. Furnish two of each plastic lens type.
- C. Furnish one replacement lamps for each lamp type.
- D. Furnish two of each ballast type.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products that comply with requirements of NFPA 70 and NFPA 101.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Provide products complying with Federal Energy Management Program (FEMP) requirements.
- F. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- G. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- H. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- I. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- J. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- K. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
 - 1. Sealed maintenance-free lead calcium unless otherwise indicated.
 - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status.
- G. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 - 2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
 - 3. Provide compatible accessory wire guards where indicated.
 - 4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 - 2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
- C. Accessories:
 - 1. Provide compatible accessory high-impact polycarbonate vandal shields where indicated.
 - 2. Provide compatible accessory wire guards where indicated.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
 - 4. Provide fixtures complying with NFPA 101.
 - 5. Style: Translucent glass face with green letters on white background.
 - 6. Housing: Extruded aluminum.
 - 7. Lamps: LED.
 - 8. Directional Arrows: Universal type for field adjustment.
 - 9. Mounting: As indicated.
 - 10. Battery: 6 volt, nickel-cadmium type, with 1.5 hour capacity.
 - 11. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
 - 12. Input Voltage: 120 volts.

2.05 BALLASTS AND DRIVERS

- A. Manufacturers:
 - 1. Alloy LED; www.alloyled.com/#sle.
 - 2. California Accent Lighting, Inc: www.calilighting.com/#sle.
 - 3. General Electric Company/GE Lighting: www.gelighting.com/#sle.
 - 4. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 5. OSRAM SYLVANIA, Inc: www.osram.us/ds/#sle.

6. Philips Lighting North America Corporation; www.usa.lighting.philips.com/#sle.
 7. Substitutions: See Section 01 6000 - Product Requirements.
 8. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
 9. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
- B. Ballasts/Drivers - General Requirements:
1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- C. Dimmable LED Drivers:
1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Provide required seismic controls in accordance with Section 26 0548.
- G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- H. Suspended Ceiling Mounted Luminaires:
 1. Do not use ceiling tiles to bear weight of luminaires.
 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 4. Secure pendant-mounted luminaires to building structure.
 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.

6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- I. Recessed Luminaires:
 1. Install trims tight to mounting surface with no visible light leakage.
 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- J. Suspended Luminaires:
 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
 4. Install canopies tight to mounting surface.
 5. Unless otherwise indicated, support pendants from swivel hangers.
- K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- L. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
- M. Install accessories furnished with each luminaire.
- N. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture; use flexible conduit.
- O. Bond products and metal accessories to branch circuit equipment grounding conductor.
- P. Emergency Lighting Units:
 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- Q. Exit Signs:
 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- R. Remote Ballasts: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.
- S. Identify luminaires connected to emergency power system in accordance with Section 26 0553.
- T. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Perform field inspection in accordance with Section 014000.
- D. Operate each luminaire after installation and connection to verify proper operation.
- E. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.
- F. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect Engineer.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect Engineer. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect Engineer or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect Engineer or authority having jurisdiction.
- D. Aim and adjust fixtures as indicated.
- E. Position exit sign directional arrows as indicated.

3.06 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean finishes and touch up damage.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect Engineer, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps, ballasts, modules, drivers, etc that have failed..

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 26 5600
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Ballasts.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- F. Section 26 2813 - Fuses.

1.03 REFERENCE STANDARDS

- A. ANSI O5.1 - American National Standard for Wood Poles - Specifications and Dimensions; 2017.
- B. IEEE C2 - National Electrical Safety Code; 2017.
- C. IES LM-63 - IESNA Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
- D. AASHTO LTS-5 - American Association of Highway and Transportation Officials - Standard Specification for Structural Supports for Highway Signs, Luminaries, and Traffic Signals; 5th Edition, 2009.
- E. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- F. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015, with Errata (2017).
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.
- I. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Notify Architect Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 STRUCTURAL DESIGN CRITERIA FOR POLES

- A. Design Standard: Structural design of the poles and foundations shall meet the following design standard: AASHTO LTS, 5th Edition, Standard Specification for Structural Supports for Highway Signs, Luminaries, and Traffic Signals, 2009.
- B. Dead Load: Weight of luminaire, supports, miscellaneous equipment that will be installed on the pole, and the weight of the pole.

- C. Live Load: 500 lb (2224 N) load distributed as stated in the referenced design standard.
- D. Ice Load: Load as indicated in the referenced design standard.
- E. Wind Load: Pressure from wind on the luminaires, supports, miscellaneous equipment on the pole, and the pole calculated and applied as indicated in the referenced design standard.
 - 1. Basic Wind Speed: As indicated in the design standard for the area where the pole will be installed or the design speed indicated on the structural drawings. Whichever is higher.
 - 2. Wind Importance Factor: 1.0.
 - 3. Minimum Design Life: 50 years.
 - 4. Velocity Conversion Factor: from AASHTO LTS-5 Table 3-2. Minimum 1.0.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution.
 - 3. Provide structural calculations for each pole proposed for substitution.
 - 4. Detail equipment drawings indicating dimensions, weights, loads, required clearances, assembly instructions, components, and location and size of each field connection.
 - 5. Anchor bolt templates for each different pole with a plan indicating where each template applies.
 - 6. Design calculations signed and sealed by an engineer licensed to practice in the state where the project is located for the design of the poles and foundation.
 - 7. Wiring Diagrams: For power, signal, and control wiring.
- C. Pole, Foundation, and Component Certification: Certification signed by the manufacture of the poles certifying that the poles, foundations, and components are designed per the applicable requirements in AASHTO LTS-5 based on the pole height, site conditions, and components that will be supported on the pole. The certification shall be based on design calculations submitted by a professional engineer registered in the state where the poles will be erected.
- D. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
 - 3. Lamps: Include rated life and initial and mean lumen output.
 - 4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- E. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
- F. Special Inspection Reports: For the foundation installation including the drilling of piers or subgrade of footings and installation of anchor bolts.
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- H. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Extra Lamps: One of each type and wattage.
- J. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.07 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 (NEC).
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- C. Store and handle poles and fixtures to prevent damage prior to installation..

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 2-year manufacturer warranty for all LED luminaires, including drivers.

1.10 COORDINATION

- A. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.11 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Furnish two of each type and wattage lamp installed.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- H. Recessed Luminaires:
 1. Ceiling Compatibility: Comply with NEMA LE 4.
 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.

3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- I. LED Luminaires:
 1. Components: UL 8750 recognized or listed as applicable.
 2. Tested in accordance with IES LM-79 and IES LM-80.
 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 BALLASTS AND DRIVERS

- A. Manufacturers:
 1. General Electric Company/GE Lighting: www.gelighting.com.
 2. OSRAM Sylvania, Inc: www.osram.us.
 3. Philips Lighting North America Corporation; www.usa.lighting.philips.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
 5. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
- B. Ballasts/Drivers - General Requirements:
 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 LUMINAIRE INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Provide required seismic controls in accordance with Section 26 0548.
- G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- I. Pole-Mounted Luminaires:
 1. Maintain the following minimum clearances:
 - a. Comply with IEEE C2.
 - b. Comply with utility company requirements.
 2. Foundation-Mounted Poles:

- a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 3000.
 - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
 - 2) Position conduits to enter pole shaft.
- b. Install foundations plumb.
- c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
- d. Tighten anchor bolt nuts to manufacturer's recommended torque.
- e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
- f. Install anchor base covers or anchor bolt covers as indicated.
- 3. Grounding:
 - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
 - b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.
- 4. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
- 5. Install non-breakaway in-line fuse holders and fuses complying with Section 26 2813 in pole handhole or transformer base for each ungrounded conductor.
- J. Install accessories furnished with each luminaire.
- K. Bond products and metal accessories to branch circuit equipment grounding conductor.
- L. Install lamps in each luminaire.
- M. Bond luminaires, metal accessories, and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00. Final inspection, testing and adjusting must be done at night.
- D. Operate each luminaire after installation and connection to verify proper operation.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect Engineer.
- F. Measure illumination levels to verify conformance with performance requirements. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect Engineer. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect Engineer.
- C. Aim and adjust luminaires to provide illumination levels and distribution indicated on Drawings.

3.06 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosure.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect Engineer, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 27 0529

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- D. BICSI ITSIMM - Information Technology Systems Installation Methods Manual, 7th Edition; 2017.
- E. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- F. MFMA-4 - Metal Framing Standards Publication; 2004.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. TIA-569 - Telecommunications Pathways and Spaces; 2019e.
- J. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.
- K. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Architect Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 3000.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable supports, channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

- C. Derating Calculations for Fiberglass Channel/Strut Framing Systems: Indicate load ratings adjusted for applicable service conditions.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. TIA-569.
 - b. NFPA 70.
 - c. Applicable building code.
 - d. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Materials for Metal Fabricated Supports: See Section 05 5000.
- C. Conduit Supports: Straps and clamps suitable for conduit to be supported.
 - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 2. Conduit Clamps: Bolted type unless otherwise indicated.
- D. Cable Supports: Suitable for cables to be supported, including but not limited to J-hooks, bridle rings, drive rings, and flexible harnesses/slings.
 - 1. Applications:
 - a. Do not exceed 5 feet between cable supports.
 - b. Maximum Number of Cables per Cable Support:
 - 1) J-Hooks: 50, regardless of capacity.
 - c. Allowable Cable Types:
 - 1) J-Hooks: Category 3, Category 5e, and Category 6.
 - 2. Comply with TIA-569.
 - 3. Cable Supports Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.
 - 4. J-Hooks: Noncontinuous cabling support with removable top retainer clip.
 - a. Material: Use galvanized steel, factory-painted steel, or stainless steel.
 - b. Provide support surfaces with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported.

- c. Provide multitiered J-hooks where required to support multiple cabling systems.
 - d. Color coding to be visible from below after installation.
- E. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- F. Metal Channel/Strut Framing Systems:
 - 1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 2. Comply with MFMA-4.
 - 3. Channel/Strut Used as Raceway, Where Indicated: Listed and labeled as complying with UL 5B.
 - 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 - 6. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.
- G. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
 - 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2-inch diameter.
 - b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
 - c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
 - e. Outlet Boxes: 1/4-inch diameter.
- H. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 - 1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
 - 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- I. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 4. Hollow Masonry: Use toggle bolts.
 - 5. Hollow Stud Walls: Use toggle bolts.
 - 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood: Use wood screws.
 - 9. Plastic and lead anchors are not permitted.
 - 10. Powder-actuated fasteners are not permitted.
 - 11. Hammer-driven anchors and fasteners are not permitted.
 - 12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.
 - d. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
 - 13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Architect Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect Engineer, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Provide required seismic controls.
- I. Equipment Support and Attachment:
 - 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 - 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- K. Secure fasteners in accordance with manufacturer's recommended torque settings.
- L. Remove temporary supports.
- M. Identify independent communications component support wires above accessible ceilings, where permitted, with color distinguishable from other support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 27 0533.13
CONDUIT FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. PVC-coated galvanized steel rigid metal conduit (RMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Galvanized steel electrical metallic tubing (EMT).
- F. Rigid polyvinyl chloride (PVC) conduit.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 8400 - Firestopping.
- C. Section 26 0533.13 - Conduit for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. BICSI ITSIMM - Information Technology Systems Installation Methods Manual, 7th Edition; 2017.
- D. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- E. BICSI TDMM - Telecommunications Distribution Methods Manual, 13th Edition; 2014.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- G. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2018.
- J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. TIA-568.0 - Generic Telecommunications Cabling for Customer Premises; 2020e.
- N. TIA-569 - Telecommunications Pathways and Spaces; 2019e.
- O. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- P. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- Q. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- R. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- S. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- T. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, TIA-569, BICSI ITSIMM, BICSI TDMM, manufacturers' instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use galvanized steel rigid metal conduit (RMC), PVC-coated galvanized steel rigid metal conduit (RMC), or rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, reinforced thermosetting resin conduit (RTRC), or high-density polyethylene (HDPE) conduit.
 - 3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit (RMC), PVC-coated galvanized steel rigid metal conduit (RMC), or rigid PVC conduit.
- D. Embedded Within Concrete:
 - 1. Within Slab on Grade: Not permitted.
 - 2. Within Slab Above Ground: Not permitted.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).
- G. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC).
- H. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70 and TIA-569.
- B. Provide conduit, fittings, supports, and accessories required for complete communications pathway.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Where conduit size is not indicated, size to comply with NFPA 70, TIA-569, and BICSI TDMM, but not less than applicable minimum size requirements specified. Where specified standards differ, comply with most stringent.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International; _____: www.alliedeg.us/#sle.
 - 2. Nucor Tubular Products; _____: www.nucortubular.com/#sle.
 - 3. Western Tube, a division of Zekelman Industries; _____: www.westerntube.com/#sle.

4. Wheatland Tube, a division of Zekelman Industries; _____:
www.wheatland.com/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

2.04 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.
- C. PVC-Coated Boxes and Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
 3. Material: Use steel or malleable iron.
 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.
 5. Conduit Bodies: Standard conduit bodies designed for electrical raceways are not permitted.
- D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
1. AFC Cable Systems, a division of Atkore International; _____:
www.afcweb.com/#sle.
 2. Electri-Flex Company; _____: www.electriflex.com/#sle.
 3. International Metal Hose; _____: www.metalhose.com/#sle.
 4. _____.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

2.06 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International; _____:
www.alliedeg.us/#sle.
 2. Nucor Tubular Products; _____: www.nucortubular.com/#sle.
 3. Western Tube, a division of Zekelman Industries; _____:
www.westerntube.com/#sle.
 4. Wheatland Tube, a division of Zekelman Industries; _____:
www.wheatland.com/#sle.
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

2.07 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
1. ABB; Carlon; _____: www.electrification.us.abb.com/#sle.
 2. Allied Tube & Conduit, a division of Atkore International; _____:
www.alliedeg.us/#sle.
 3. Cantex Inc; _____: www.cantexinc.com/#sle.
 4. Heritage Plastics, a division of Atkore International; _____:
www.heritageplastics.com/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements.

- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.
 - 3. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
 - a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.
- E. Install galvanized steel electrical metallic tubing (EMT) in accordance with NECA 101.
- F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- G. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- H. Connections and Terminations:
 - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 - 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 - 3. Use suitable adapters where required to transition from one type of conduit to another.
 - 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 - 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 - 6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect cables.
 - 7. Secure joints and connections to provide mechanical strength and electrical continuity.
- I. Penetrations:
 - 1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 - 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 - 3. Provide sleeves and/or slots for penetrations as indicated or as required to facilitate installation.
 - 4. Conceal bends for conduit risers emerging above ground.
 - 5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 - 6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.

7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 8400.
- J. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed cables or connected equipment. This includes, but is not limited to:
 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where conduits are subject to earth movement by settlement or frost.
- K. Provide grounding and bonding.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

3.03 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.04 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of cables.

END OF SECTION

SECTION 28 4600
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.

1.03 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.
- B. Section 21 1300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
- C. Section 23 3300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

1.04 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. NFPA 3 - Recommended Practice for Commissioning of Fire Protection and Life Safety Systems; 2015.
- E. NFPA 4 - Standard for Integrated Fire Protection and Life Safety System Testing; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Drawings must be prepared using AutoCAD Release 2002 or newer.
- C. Evidence of designer qualifications.
- D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction as well as compliance with contract documents, including but not limited to floor plans, riser diagrams, and description of operation:
 - 1. Copy (if any) of list of data required by authority having jurisdiction.
 - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 3. Shop Drawings:
 - a. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A.14.6.2.4, and complete listing of software required.
 - b. System zone boundaries and interfaces to fire safety systems.
 - c. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming. Plans shall show the address for addressable devices.

- d. Circuit and conduit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
 - 1) Calculation method shall be shown including wire size and values used.
 - 2) Calculation shall be Lump Sum at the end of the circuit or Point to Point. Load Centering shall not be used.
 - e. List of all devices on each signaling line circuit, with spare capacity indicated.
- 4. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 - a. Information to include: Model numbers, listing, ratings, and power requirements.
 - b. Product cut sheets, calculations, certificates, etc. shall be submitted in a bound format or a single electronic document (such as PDF), shall be tabbed in a logical manner, and shall contain the information indicated.
 - c. Voltage Drop Calculations - Duplicate on drawings
 - 1) Use methods specified in NFPA 72.
 - 2) Voltage drop calculations shall start at 85% of nominal voltage, i.e. a 24VDC system shall be calculated as starting at 20.4VDC.
 - 3) Circuit voltage not to drop below 16 VDC or the UL listed minimum voltage for device powered, whichever is higher.
 - 4) Device current to be based on UL listed minimum voltage.
 - 5) Circuit resistance shall include wire length out to last device and back to panel, including elevation changes.
 - 6) Calculation method shall be shown including wire size and values used.
 - 7) Calculation shall be Lump Sum at the end of the circuit or Point to Point. Load Centering shall not be used.
 - d. Battery calculations - Duplicate on drawings
 - 1) Use methods specified in NFPA 72.
 - 2) A minimum 20% safety factor to the calculated Amp-Hours shall be provided.
- 5. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
- 6. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
- 7. Certification by Contractor that the system design complies with Contract Documents.
- 8. Incomplete submittals or submittals that do not comply with these specifications may be rejected without a review.
- E. Evidence of installer qualifications.
- F. Inspection and Test Reports:
 - 1. Submit inspection and test plan prior to closeout demonstration.
 - 2. Submit documentation of satisfactory inspections and tests.
 - 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- G. Operating and Maintenance Data: See Section 01 7800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
 - 1. Complete set of specified design documents, as approved by authority having jurisdiction.
 - 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 - 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 - 4. List of recommended spare parts, tools, and instruments for testing.
 - 5. Replacement parts list with current prices, and source of supply.
 - 6. Detailed troubleshooting guide and large scale input/output matrix.
 - 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.

8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- H. Project Record Documents: See Section 01 7800 for additional requirements; have one set available during closeout demonstration:
 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- I. Closeout Documents:
 1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
- J. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
 1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.
 2. In addition to the items in quantities indicated in PART 2, furnish the following:
 - a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
 - b. One copy, on CD-ROM and one copy on USB flash drive, of all software not resident in read-only-memory.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
 1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
 - a. Demonstrated qualifications through written assessment of at least NICET level II, or AE approved equivalent. This includes individuals installing conduit, boxes, or wire for fire alarm devices.
 3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
 4. Contract maintenance office located within 100 miles of project site.
 5. Certified in the State in which the Project is located as fire alarm installer.
- C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
- C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Alarm Control Units and Accessories - Basis of Design: Honeywell Gamewell FCI.
- B. Fire Alarm Control Units and Accessories - Other Acceptable Manufacturers:
 - 1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com.
 - 2. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com.
 - 3. Honeywell Security & Fire Solutions/Notifier: www.notifier.com.
 - 4. Honeywell Security & Fire Solutions/Silent Knight: www.silentknight.com.
 - 5. Siemens Building Technologies, Inc: www.usa.siemens.com.
 - 6. Simplex, a Tyco Business: www.simplex-fire.com.
- C. Initiating Devices and Notification Appliances:
 - 1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com.
 - 2. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com.
 - 3. Honeywell Security & Fire Solutions/Notifier: www.notifier.com.
 - 4. Honeywell Security & Fire Solutions/Silent Knight: www.silentknight.com.
 - 5. Siemens Building Technologies, Inc: www.sbt.siemens.com.
 - 6. Simplex, a Tyco Business: www.simplex-fire.com.
 - 7. System Sensor.
 - 8. Same manufacturer as control units.
 - 9. Provide initiating devices and notification appliances made by the same manufacturer, where possible.
- D. Substitutions: See Section 01 6000 - Product Requirements.
 - 1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with Contract Documents.
 - 2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.02 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
 - 1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
 - 2. Provide all labor to complete required work.
 - 3. Protected Premises: Entire building shown on drawings.
 - 4. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards.
 - b. The requirements of the local authority having jurisdiction.
 - c. Applicable local codes.
 - d. Contract Documents (drawings and specifications).
 - e. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
 - 5. Evacuation Alarm: Single smoke zone; general evacuation of entire premises.
 - 6. Hearing Impaired Occupants: Provide visible notification devices in all public areas and in dwelling units.

- a. This shall include, but not be limited to, all public restrooms, break rooms, exam rooms, fitting rooms, work rooms, conference rooms, open office areas, and corridors.
- 7. Fire Alarm Control Unit: New, located as indicated on drawings.
- B. Supervising Stations and Fire Department Connections:
 - 1. Public Fire Department Notification: By on-premises supervising station.
 - 2. On-Premises Supervising Station: Existing proprietary station operated by Owner, located at _____.
 - 3. Remote Supervising Station: UL-listed central station under contract to facility.
 - 4. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.
 - 5. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), dual cell dialer.
- C. Circuits:
 - 1. Signaling Line Circuits (SLC) Within Single Building: Class B.
 - 2. Signaling Line Circuits (SLC) Between Buildings: Class A.
 - 3. Notification Appliance Circuits (NAC): Class B.
- D. Spare Capacity:
 - 1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 - 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 - 3. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- E. Power Sources:
 - 1. Primary: Dedicated branch circuits of the facility power distribution system.
 - 2. Secondary: Storage batteries.
 - 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
 - 4. Unless noted otherwise on the plans, power booster panels (NAC) shall not be fed from a separate notification power booster panel (daisy chained). Each NAC shall be triggered by a SLC circuit.
- F. Guards for Protection of Components
 - 1. Description: Welded wire mesh or polycarbonate of size and shape for the manual station, smoke detector, strobe, or other device requiring protection.
 - a. Factory fabricated and furnished by manufacturer of the device.
 - b. Finish: Clear, or paint of color to match the protected device.
 - c. Listed components of Safety Technology International Incorporated may be used with applicable de-ratings for strobes, horns, etc.

2.03 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 - 1. Sprinkler water control valves.
 - 2. Duct smoke detectors.
 - 3. Door hold-open smoke detectors.
 - 4. Elevator shut-down control circuits.
 - 5. Elevator pit and machine room isolation valves.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
 - 1. Sprinkler water flow.
 - 2. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
 - 3. Smoke Detector(s)
 - 4. Heat Detector(s)
 - 5. Manual Pull Stations
- C. Elevators:
 - 1. Heat detectors shall be used in elevator shafts and machine rooms to activate elevator shunt trip per NFPA 72 and ASTM A17.1.

2. Smoke detectors shall be located in machine room and elevator lobbies to initiate elevator primary and secondary recall per NFPA 72 and ASTM A17.1.
 3. Tamper switches serving elevator pit and machine room sprinklers shall be monitored.
 4. Water flow switches without a delay feature shall be used to immediately upon signal activate elevator shunt trip. Switch shall be of a double pole type with one contact going directly to the shunt trip device and the second contact being monitored by the fire alarm panel.
 5. Provide necessary relay modules for elevator functions per code, such as: recall, shunt trip, and firefighters helmet light.
 6. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
 7. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
 8. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.
- D. HVAC:
1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
- E. Doors:
1. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from. Refer to Section 08 7100.

2.04 COMPONENTS

- A. General:
1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
 3. Provide legible, permanent labels for each addressable device, using address used in control panel.
- B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.
- C. Master Control Unit: As specified for Basis of Design above, or equivalent.
- D. Remote Annunciators: Locate as indicated on drawings.
- E. Addressable Modules:
1. Provide addressable modules suitable for connection to fire alarm control unit signaling line circuits.
 2. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.
 3. Monitor Modules: Unless devices are explicitly permitted to be connected together as zone, provide separate addressable monitor module for each conventional dry-contact input device in order to be individually identifiable by addressable fire alarm control unit.
 4. Control Modules: Provide as indicated or as required for selective control of notification appliances.
 5. Releasing Control Modules: Provide as indicated or as required for control of listed solenoids in releasing applications.
 6. Relay Modules: Provide as indicated or as required to perform necessary functions via dry-contact interface. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.
 7. Signaling Line Circuit (SLC) Isolating Modules: Provide as indicated or as required to automatically isolate short circuits on connected sections of SLC loops and allow other sections to continue to function normally. Provide automatic reset upon correction of short circuit.

- F. Initiating Devices:
 - 1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
 - b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
 - 2. Manual Pull Stations: Dual Action.
 - a. Provide 1 extra.
 - 3. Smoke Detectors: Photoelectric.
 - a. Provide 1 extra.
 - 4. Heat Detectors: Adjustable from 100F to 155F. Fixed temperature..
 - a. Provide 1 extra.
- G. Notification Appliances:
 - 1. Bells: Red Enamel.
 - 2. Horn/Strobes White Trim Clear Strobe.
 - a. Selectable candela with candela visible when installed.
 - b. Provide 1 extra.
 - 3. Strobes: White Trim Clear Strobe.
 - a. Selectable candela with candela visible when installed.
 - b. Provide 1 extra.
- H. Conduit:
 - 1. Install all wiring in a conduit or raceway. Conduit fill shall not exceed 40 percent of the interior cross sectional area where three or more cables are included within a single conduit.
 - 2. Install conduit in accordance with the National Electrical Code, NFPA 70.
 - 3. Conduit shall be 3/4 inch minimum.
 - 4. Wiring for low voltage control, alarm notification, emergency communication, and similar power-limited auxiliary functions may be installed in the same conduit as initiating and signaling line circuits. Design system to permit simultaneous operation of all circuits without interference or loss of signals.
 - 5. Fire Alarm Conduit: All fire alarm wiring shall be in hot-galvanized electric metallic tubing colored RED from the factory.
 - a. Junction covers shall be painted red and labeled "Fire Alarm".
 - b. Fire alarm conduit shall have the wording "Fire Alarm" factory stamped onto each 10' section of conduit. If conduit is to be exposed in a finished area, see criteria below.
 - c. If conduit is to be ran in an area with finished exposed ceiling spaces, consult with architect engineer for appropriate conduit and junction box color to match other equipment.
 - 6. Conduits shall not enter the control panel or any other component provided except where entry is specified by the manufacturer.
- I. Wire:
 - 1. All fire alarm system wiring shall be new.
 - 2. Wiring shall comply with local, state, and national codes and as recommended by the manufacturer. Number and size of conductors shall be as recommended by the manufacturer, but shall be not less than 18 AWG for initiating device and signaling line circuits, and 16 AWG for notification appliance circuits.
 - 3. All wiring and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
 - 4. FPLP red cable shall be used for all interior fire alarm circuits including that in conduit.
 - 5. Any wire that goes underground, such as to PIV switches or to other buildings, shall be listed and approved for wet locations in accordance with NFPA 70.
 - 6. All field wiring shall be supervised for open circuits, short circuits, and grounded conditions.

- J. Control Panel: Connected to a separate dedicated branch circuit with a separate dedicated disconnect switch; circuit labeled FIRE ALARM.
- K. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.
- L. Wiring runs shall be tested for continuity, short circuits and grounds before any system devices are installed or energized.
- M. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
- N. Locks and Keys: Deliver keys to Owner.
- O. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
 - 1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
 - 2. Provide one for each control unit where operations are to be performed.
 - 3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
 - 4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.
- B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- C. Obtain Owner's approval of locations of devices, before installation.
- D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

- A. The contractor is responsible for testing all components in accordance with the manufacturers required and suggested procedures and in accordance with NFPA 72. If this specification incorporates a detailed Acceptance Test Procedure (ATP) prepared by the engineer than it shall also be followed.
- B. Every fire alarm system shall be pre-tested by the contractor prior to scheduling any inspections by the architect engineer, owner, or local jurisdictions. Testing shall comply with this section and NFPA 72.
- C. Notify Owner 7 days prior to beginning completion inspections and tests.
- D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
 - 1. A signed Record of Completion shall be provided to the inspector prior to their inspection.
- E. Provide the service of a competent, factory-trained technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.
- F. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- G. Provide all tools, software, and supplies required to accomplish inspection and testing.
- H. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
- I. All smoke detectors shall be tested using canned smoke, or other approved method that will functionally test the smoke chamber. The use of magnets to commission smoke detectors is strictly prohibited.
- J. Smoke detectors shall not be installed until the construction cleanup of all trades is complete per NFPA 72 and this section.
 - 1. Orange shipping covers, rubber gloves, tape, or other devices shall not be used to try and get around these basic requirements.

2. Smoke detectors installed before the clean-up of all other dust or particle producing trades and without prior written approval of the engineer and local AHJ shall be replaced at the sole expense of the installing contractor.
 3. AE reserves the right to permanently and indelibly mark any detector installed this way.
 4. Contractor is urged to use marked, temporary detectors for pre-testing of system and replace with new detectors prior to final testing.
- K. All new smoke detectors that show to be "Dirty" through system sensitivity shall be replaced.
- L. Audibility testing shall not be conducted until all doors, windows, walls, ceilings, and carpeting are in place. Final audibility testing that does not affect speaker placement should be done after space is fully furnished.
- M. At a minimum the following tests shall be conducted, documented and given to AE at closeout:
1. Open initiating device circuits and verify that the trouble signal actuates.
 2. Open and short signaling line circuits and verify that the trouble signal actuates.
 3. Open and short Notification Appliance Circuits and verify that trouble signal actuates.
 4. Ground all circuits and verify response of trouble signals.
 5. Check presence and audibility of tone throughout building spaces. This includes measuring dBA levels.
 - a. A minimum of 15 dBA above ambient shall be obtained in every occupiable space (throughout) per NFPA 72. This includes storage rooms, electrical rooms, telephone rooms, and any other occupiable space.
 6. Each of the alarm, trouble, or supervisory conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
 7. Each notification circuit shall be tested under standby power. End-of-line voltage readings shall be taken at the end-of-line resistor for Class "B" circuits, or at the booster panel for Class "A" circuits. Circuit voltage drop shall be recorded and compared to calculated voltage drop. Note: Some systems incorporating synchronizing modules can impair results. If the module cannot be bypassed for voltage readings, the manufacturer should be contacted for guidance.
 8. System off-site reporting shall be verified for alarm, supervisory, trouble, correct address, facility name, contact phone number, and contact name.
 9. When the system is equipped with optional features or connected to external, non-fire devices, the manufacturer's manual should be consulted to determine the proper testing procedures.
- N. The commissioning inspector shall use the system record drawings and other documents specified under this specification during the testing procedure to verify operation as programmed. In conducting the commissioning test, the inspector shall request demonstration of any or all input and output functions.
- O. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.
- P. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
1. Record all system operations and malfunctions.
 2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
 3. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.03 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
1. Hands-On Instruction: On-site, using operational system.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
1. Initial Training: 1 session pre-closeout.

- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.
- D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

3.04 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
 - 1. Be prepared to conduct any of the required tests.
 - 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 - 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 - 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 - 5. Repeat demonstration until successful.

3.05 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner, a proposal as an alternate to the base bid, for a maintenance contract for entire warranty period, to include the work described below; include the total cost of contract, proposal to be valid at least until 30 days after date of Substantial Completion.
- C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
 - 1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 - 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
 - 3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Provide on-site response within 2 hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- G. Comply with Owner's requirements for access to facility and security.

END OF SECTION

SECTION 31 0916.21

PILE LOAD TESTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pile load testing and documenting results.

1.02 RELATED REQUIREMENTS

- A. Section 01 4000 - Quality Requirements: Testing laboratory services.
- B. Section 31 63 33 - Micropiles
- C. Section 31 66 15 - Helical Foundation Piles

1.03 REFERENCE STANDARDS

- A. ASTM D1143/D1143M - Standard Test Methods for Deep Foundation Elements Under Static Axial Compressive Load; 2020.
- B. ASTM D3689/D3689M - Standard Test Method for Deep Foundations Under Static Axial Tensile Load; 2007, with Editorial Revision (2013).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate test method and equipment, load type, calibration equipment.

1.05 QUALITY ASSURANCE

- A. Monitor test pile placement and elevations under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Maintain one copy of each test method document on site.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Provide equipment, load carrying devices, loads, and instrumentation as required by test methods specified in PART 3.
- B. Test Crib: Provide one test crib for pile load testing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify site conditions will support cribbing and load for testing purposes.

3.02 PREPARATION

- A. Establish stable working elevation for test equipment.

3.03 TESTING

- A. Perform load tests for piles specified in the following Sections:
 - 1. Section 31 63 33 - Micropiles
- B. Load test the following:
 - 1. 10 percent of piles at locations as directed by Geotech.
- C. Perform the following tests on each test pile:
 - 1. Static axial compression load test as specified in ASTM D1143/D1143M.
 - 2. Static axial tensile load test as specified in ASTM D3689/D3689M.
 - 3. Subject piles to 1-3/4 times design load.
- D. Acceptable Permanent Set of Piles After Load Testing: 1/8 inch.
- E. If tested piles do not comply with requirements, perform additional testing of other piles.

3.04 FIELD QUALITY CONTROL

- A. Field inspection and monitoring of testing will be performed under provisions of Section 01 4000.
- B. An independent inspection firm will be engaged to observe and document test method and results.
- C. Document test equipment used, method of calibration and recording, test results, recommendations or modification of piling method used.
- D. Accurately record actual dimensions and locations of tested piles and movement or distortion caused by testing.

3.05 EQUIPMENT REMOVAL

- A. Remove test and temporary load equipment from site.

END OF SECTION

**SECTION 31 1000
SITE CLEARING**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

1.03 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 01 5713 - Temporary Erosion and Sediment Control.
- D. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- E. Section 02 4100 - Demolition: Removal of built elements and utilities.
- F. Section 31 2200 - Grading: Topsoil removal.
- G. Section 31 2323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
 - 1. Areas for temporary construction and field offices.

1.05 QUALITY ASSURANCE

- A. An independent testing agency shall perform field quality test, as specified in Section 014533 - Special Inspections
- B. Employ services of a Geotechnical Consultant, approved by Architect Engineer, for the following services:
 - 1. Develop clearing techniques best suitable to site conditions at the time of construction.

PART 2 PRODUCTS

2.01 MATERIALS - NOT USED

PART 3 EXECUTION

3.01 SITE CLEARING

- A. Comply with other requirements specified in Section 01 7000 - Execution and Closeout Requirements.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.

3.03 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.
- B. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
 - 1. At vegetation removal limits.
 - 2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
 - 3. Around other vegetation to remain within vegetation removal limits.
- C. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
- D. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.04 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 31 2200

GRADING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Removal of topsoil.
- B. Rough grading the site for site structures and building pads.
- C. Finish grading.

1.03 RELATED REQUIREMENTS

- A. Section 31 1000 - Site Clearing.
- B. Section 31 2316 - Excavation.
- C. Section 31 2323 - Fill: Filling and compaction.

1.04 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.05 QUALITY ASSURANCE

- A. An independent testing agency shall perform field quality test, as specified in Section 014533 - Special Inspections
- B. Employ services of a Geotechnical Consultant, approved by Architect Engineer, for the following services:
 - 1. Develop stripping techniques best suitable to site conditions at the time of construction.
 - 2. Review and advise on size of earthmoving equipment. Verify that soils on Site will not lose strength during earthmoving operations.
 - 3. Observe site grading.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Friable loam.
 - 1. Graded.
 - 2. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
- D. Notify utility company to remove and relocate utilities.
- E. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.
- F. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.

- G. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- H. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

- A. Remove subsoil and topsoil from areas to be filled or further excavated to a depth of 6", without mixing with foreign materials. Separate subsoil from topsoil.
- B. Do not remove topsoil when wet.
- C. When excavating through roots, perform work by hand and cut roots with sharp axe.
- D. See Section 31 2323 for filling procedures.
- E. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

3.04 SOIL REMOVAL

- A. Stockpile excavated topsoil on site.
- B. Stockpile excavated subsoil on site.
- C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.05 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 3 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.
- E. Place topsoil to the following compacted thicknesses:
 - 1. Areas to be Seeded or Sodded: 4 inches minimum.
- F. Place topsoil during dry weather.
- G. Remove roots, weeds, rocks, and foreign material while spreading.
- H. Near plants spread topsoil manually to prevent damage.
- I. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- J. Lightly compact placed topsoil.
- K. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.06 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

3.07 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Architect Engineer as to remedy.
- C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL

- A. See Section 31 2323 for compaction density testing.

3.09 CLEANING

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile areas to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 31 2316
EXCAVATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building to utility main connections.

1.03 RELATED REQUIREMENTS

- A. Document 00 31 00 - Available Information: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 01 5713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- C. Section 01 4000 - Quality Requirements: Qualifications for Geotechnical Consultant.
- D. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring. General requirements for dewatering of excavations and water control.
- E. Section 31 2316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

1.04 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.05 QUALITY ASSURANCE

- A. An independent testing agency shall perform field quality test, as specified in Section 014533 - Special Inspections
- B. Employ services of a Geotechnical Consultant, approved by Architect Engineer for the following services:
 - 1. Determine equipment sizes, and develop excavation, proof-rolling, undercutting, filling, and compaction techniques best suitable to site conditions at the time of construction.
 - 2. Observe the site excavation.
 - 3. Perform applicable laboratory and field tests.
 - 4. Provide professional judgment in determining the limits of undercutting. This judgment shall be to the satisfaction of Architect Engineer.
 - 5. Inspect bottom of individual and continuous footings. For each strata of soil on which footings will be placed, conduct at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to Architect Engineer.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.

- C. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect Engineer.

3.03 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
- B. Notify Architect Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
 - 1. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- D. Comply with Occupational Safety and Health Administration (OSHA) Safety and Health Regulations for Construction, 29 CFR 1926, Subpart P - Excavations.
- E. Frost Protection: When freezing temperature may be expected, do not excavate to the full depth indicated unless the footings or slabs are to be poured immediately after the excavation has been completed. If placing of concrete is delayed, protect the bottoms of excavations from frost until concrete is placed.
- F. Shoring And Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross braces, in good serviceable condition.
 - 1. Establish requirements for trench shoring and bracing to comply with local codes, OSHA, and authorities having jurisdiction.
 - 2. Install and maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses in order to protect work, to insure safety to workmen and public, and to protect and maintain existing structures, footings, roadways, utilities, etc. adjacent thereto.
 - 3. Design and installation is the sole responsibility of the Contractor and shall be reviewed by a Registered Professional Engineer at the Contractor's expense.
- G. Do not interfere with 45 degree bearing splay of foundations.
- H. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect Engineer. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 PROOF-ROLLING UNDER THE BUILDING AND PAVEMENTS

- A. Following clearing, stripping, and/or excavating, all subgrade soils are to be proof-rolled under the supervision of Geotechnical Consultant with at least a 10 ton roller or similar mechanical compactor, to verify that any localized soft, compressible soils are detected. If soft or unstable soils are detected, Geotechnical Consultant, after obtaining approval from the Architect Engineer, shall determine the course of action.
- B. Do not proof-roll wet subgrades; wait for subgrades to dry out.
- C. Extra payment for removal of soft and unstable soil and replacement with structural fill in accordance with Section 31 2316 - Excavation and Section 31 2323 - Fill will be based on the "Unit Price" quoted by the Contractor.
 - 1. Extra payment shall be applied against the allowance established in the contract for the item: Undercutting. The portion of the allowance not used shall be credited to the Owner based on the same unit price quoted in the Contract Documents. Any additional undercutting required above the allowance established, shall be based on the same "Unit Price" quoted by the Contractor, but only after consultation with Geotechnical Consultant and approved by Architect Engineer.
 - 2. The undercut material shall be disposed of off the site and shall not be used for fill.
 - 3. Measurement for determining the extent of undercutting will be by the average end area method for the volume of excavated material below existing subgrade. A registered

engineer or surveyor shall be engaged by Contractor to perform these measurements.
The report of this surveyor shall be submitted to the Architect Engineer for approval.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces by Architect Engineer before placement of foundations.

3.06 PROTECTION

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 31 2316.13

TRENCHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Trench excavation.
- B. Backfill and compaction.
- C. Backfilling and compacting for utilities outside the building to utility main connections.

1.03 RELATED REQUIREMENTS

- A. Document 00 31 00 - Available Project Information: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 31 2200 - Grading: Site grading.
- C. Section 31 2316 - Excavation: Building, foundation, and pavement excavating.
- D. Section 31 2323 - Fill: Backfill materials.

1.04 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 2200 - Unit Prices, for general requirements applicable to unit prices for earthwork.

1.05 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.
- C. Bedding: Fill placed under, beside and to 6 inches over pipe, prior to subsequent backfill operation.

1.06 REFERENCE STANDARDS

- A. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- B. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)); 2012 (Reapproved 2021).
- D. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.
- E. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2017a, with Editorial Revision.

1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Compaction Density Test Reports.

1.08 QUALITY ASSURANCE

- A. An independent testing agency shall perform field quality test, as specified in Section 014533 - Special Inspections
- B. Employ services of a Geotechnical Consultant, approved by Architect Engineer, for the following services:

1. develop excavation, proof-rolling, undercutting, filling, and compaction techniques best suitable to site conditions at the time of construction.
2. Analyze soil materials to be used as fill.
3. Perform applicable laboratory and field tests.
4. Provide professional judgment in determining the limits of undercutting. This judgment shall be to the satisfaction of Architect Engineer.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 2200 for additional requirements.
- C. Locate, identify, and protect utilities that remain and protect from damage.
- D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Protect plants, lawns, rock outcroppings, and other features to remain.
- F. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Architect Engineer.

3.03 TRENCHING

- A. Grade top perimeter of excavation to prevent surface water collection.
- B. Notify Architect Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume.
- C. General: Cut trenches neat and clean.
 1. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- D. Utility Preparation: Rake trench bottom to uniform grade.
 1. Remove unsuitable subgrade and backfill.
 2. Compact subgrade to density equal to or greater than subsequent fill material requirements.
- E. Maintain trenches and prevent loose soil or rocks from entering.
- F. Notify Architect Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- G. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. Cut trenches wide enough to allow inspection of installed utilities.
- J. Hand trim excavations. Remove loose matter.
- K. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- L. Remove excavated material that is unsuitable for re-use from site.
- M. Remove excess excavated material from site.
- N. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

- O. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect Engineer.

3.04 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with granular fill or bedding. Payment for undercutting will be by the unit price quoted by the contractor and quantified by the geotechnical engineer after obtaining approval from the Architect-Engineer.
- B. Provide 6 inches of sand bedding under plastic piping systems, unless indicated otherwise.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials in 8 inch lifts.
- B. Provide sand bedding to 6 inch minimum over the top of plastic piping systems, unless indicated otherwise.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- G. Correct areas that are over-excavated.
 - 1. Thrust bearing surfaces: Fill with concrete.
 - 2. Other areas: Use granular fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- H. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
 - 2. At other locations: 90 percent of maximum dry density.
- I. Reshape and re-compact fills subjected to vehicular traffic.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D3017, or ASTM D6938.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: One for every 200 linear feet of trench per lift of fill in place.

3.07 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 31 2323

FILL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Filling, backfilling, and compacting for building volume below grade, paving, and site structures.
- B. Backfilling and compacting for utilities outside the building to utility main connections.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.03 RELATED REQUIREMENTS

- A. Section 01 5713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.

1.04 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 2200 - Unit Prices, for general requirements applicable to unit prices for earthwork.

1.05 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.

1.06 REFERENCE STANDARDS

- A. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- B. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)); 2012 (Reapproved 2021).
- C. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision.
- D. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2017a, with Editorial Revision.

1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Proposed Fill Material: For each soil type proposed for use, include the following:
 - 1. Classification per ASTM D 2487-00, Plasticity Index (PI), and Liquid Limit (LL).
 - 2. Proctor tests results.
- C. Fill Composition Test Reports: Results of laboratory tests on actual materials use
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

1.08 QUALITY ASSURANCE

- A. Employ services of a Geotechnical Consultant, approved by Architect Engineer for the following services:
 - 1. Develop filling and compaction techniques best suitable to site conditions at the time of construction.
 - 2. Observe site filling.
 - 3. Analyze soil materials proposed to be used as fill.
 - 4. Perform applicable laboratory and field tests.

- B. An independent testing agency shall perform field quality test, as specified in Section 014533 - Special Inspections
- C. Perform all testing work in accordance with the following:
 - 1. Fill Properties:
 - a. Plasticity Index shall be determined as per ASTM D4318-00 "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils".
 - b. Sieve Analysis shall be as per ASTM D422-63(1998) "Standard Test Method for Particle-Size Analysis of Soils".
 - c. Water Content Density Relationship shall be determined as per ASTM D 1557 "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)" Modified Proctor Test.
 - d. Relative density shall be determined as per ASTM D4253-00 "Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table".
- D. Compacted fill that does not reach the required density may be rejected by Geotechnical Consultant with approval from Architect Engineer. Recompact the Work to the required density, or remove the material in the area(s) affected, and replace removed material with fill compacted to the required density.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. Review size of earthmoving equipment with Geotechnical Consultant. Ensure that the silty clay soils on site will not lose strength during earthmoving operation

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. General Fill: Imported borrow or local borrow capable of forming a stable embankment and free of roots and other unsatisfactory debris.
 - 1. Do not use with 5 feet of building or pavement.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- B. Structural Fill: Imported borrow or local borrow.
 - 1. Graded.
 - 2. Free of debris and rocks larger than 6 inches except within upper 18 inches of finished subgrade maximum rock size is 1-1/2 inch.
 - 3. Conforming to ASTM D2487 Group Symbol GC, SC and CL.
 - 4. Plasticity Index less than 20.
- C. Concrete for Fill: As specified in Section 033000 (03300); compressive strength of 2500 psi.
- D. Granular Fill: Graded from 1/4 inch to 1-1/2 inch; 1 to 2 inch for use around trees.
- E. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
- F. Topsoil: Friable loam; imported borrow or local borrow.
 - 1. Free of roots, rocks larger than 1 inch, subsoil, debris, large weeds and foreign matter.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the Work are as indicated.
- B. Identify required lines, levels, contours, and datum locations.
- C. See Section 31 2200 for additional requirements.
- D. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

- A. Scarify subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
 - 1. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
 - 2. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.
- E. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- F. Correct areas that are over-excavated.
 - 1. Load-bearing foundation surfaces: Fill with concrete or structural fill.
 - 2. Under pavement, slabs-on-grade, and similar construction: Use structural fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density within 2% of optimum moisture content.
 - 3. Other areas: Use general fill, flush to required elevation, compacted to minimum 90 percent of maximum dry density.
- G. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under pavement, slabs-on-grade, and similar construction: Use structural fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density within 2% of optimum moisture content.
 - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 90 percent of maximum dry density.
- H. Reshape and re-compact fills subjected to vehicular traffic.
- I. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FILL AT SPECIFIC LOCATIONS

3.05 FIELD QUALITY CONTROL.

- A. The contractor shall employ and pay for services of an independent testing agency to perform field quality control tests, as specified in Section 01 40 00.

- B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor").
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- D. Frequency of Tests (General or Structural fill): One for each 2500 sq. ft. of lift.
- E. Frequency of Tests (Trench fill) : One for every 200 lineal feet of trench per lift of fill in place.

3.06 PROTECTION AND MAINTENANCE

- A. Protection Of Graded Areas: Protect newly graded areas from traffic, erosion, and effects of ponding of water. Keep free of trash and debris.
 - 1. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
 - 2. Provide and maintain positive surface drainage to prevent ponding and subsequent saturation of excavation or fill materials. Saturated soils shall be removed and replaced or shall be dried to specified moisture content and recompacted without additional charge to Owner.
- B. Reconditioning Compacted And/Or Excavated Areas: Where completed areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction. Failure of the disturbed soil to reach the required density, as evidenced by density tests, is cause for rejection by Geotechnical Consultant after obtaining approval from Architect Engineer of the work in the affected area(s). Remove and replace soils which cannot recompact to the required density.
- C. Settling: Where settling is measurable or observable at fill areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.07 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 31 3116
TERMITE CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Chemical soil treatment.

1.03 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 2006.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Test Reports: Indicate regulatory agency approval reports when required.
- D. Certificate of compliance from authority having jurisdiction indicating approval of toxicants.
- E. Maintenance Data: Indicate re-treatment schedule .
- F. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Approved by manufacturer of treatment materials.
 - 2. Licensed in the State in which the Project is located.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.
 - 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.
 - 2. Inspect annually and report in writing to Owner. Provide inspection service for 5 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

2.02 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA (1) approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

3.02 APPLICATION

- A. Comply with manufacturer's written instructions.

3.03 APPLICATION - CHEMICAL TREATMENT

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
 - 1. Under Slabs-on-Grade.
 - 2. In Crawl Spaces.
 - 3. At Both Sides of Foundation Surface.
 - 4. Soil Within 10 feet of Building Perimeter For a Depth of 2 feet.
- D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.
- F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- G. Re-treat disturbed treated soil with same toxicant as original treatment.
- H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.04 PROTECTION

- A. Do not permit soil grading over treated work.

END OF SECTION

SECTION 31 6333
MICROPILES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Drilling, placement of pressure injected grout and internal reinforcement

1.03 RELATED REQUIREMENTS

- A. Section 01 4533 - Special Inspections: Code required special tests and inspections.
- B. Section 31 0916.21 - Pile Load Tests: Requirements for pile load tests.

1.04 REFERENCE STANDARDS

- A. ASTM C109
- B. ASTM C150 - Standard Specification for Portland Cement; 2011.
- C. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete; 2008a.
- D. ASTM C937 - Standard Specification for Grout Fluidifier for Preplaced-Aggregate Concrete; 2010.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Record actual locations of piles, pile diameter, and pile length. Accurately record the following on project record documents:
 - 1. Sizes, lengths, and locations of piles and footing groups.
 - 2. Sequence of placement.
 - 3. Final base and top elevations.
 - 4. Deviation from indicated locations.
 - 5. Placement and configuration of reinforcement.
 - 6. Location and type of casings, if used.

1.07 QUALITY ASSURANCE

- A. Design piles under direct supervision of Grubbs, Hoskyn, Barton & Wyatt, or another Geotechnical Engineer approved by the Architect Engineer with experienced in design of this Work and licensed in the State in which the Project is located.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- C. Welders: AWS certified.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete Grout: Provide grout with ultimate compressive strength of 4,000 psi at 28 days, using materials as follows:
 - 1. Portland Cement: ASTM C150.
 - 2. Pozzolan: Fly ash or other approved material conforming to requirements of ASTM C618, Class F.
 - 3. Fine Aggregate: ASTM C33.

- 4. Water: Fresh, clean, and free of deleterious salts, alkali, acids, and organic matter.
- B. Reinforcement: Deformed bars in accordance with ASTM A615/AASHTO M31. The grade, thickness and number of bars shall be indicated by the designer and shall conform to any minimum and/or maximum properties shown on the plans. Continuous spiral deformations (i.e. continuous threadbars) shall be used. Bar tendon couplers, if required, shall develop the ultimate tensile strength of the bars without evidence of any failure.

PART 3 EXECUTION

3.01 PREPARATION

- A. Use placement method that will not cause damage to nearby structures.
- B. Protect structures near the Work from damage.

3.02 INSTALLATION

- A. Drill concentric and vertical pile shafts to diameters and depths indicated.
- B. Maintain shafts free of water.
- C. Progressively raise auger and simultaneously pressure inject concrete grout with equipment designed for such placement. Place grout in accordance with provisions of Section 03 3000.
- D. Except where otherwise specifically directed by supervising engineer, drill each pile hole and fill with grout in an uninterrupted operation.
- E. Place reinforcing steel in accordance with Section 03 2000 immediately after placement of wet grout.
- F. Set tops of piles to elevations indicated.
- G. Extend reinforcement for connection of caps and grade beams.

3.03 TOLERANCES

- A. Maximum Variation From Vertical: 1 in 48.
- B. Maximum Variation From Design Top Elevation: 2 inches.
- C. Maximum Out-of-Position: 2 inches.

3.04 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 4000.
- B. Perform load tests to requirements of Section 31 0916.21.
- C. Test Piles: Same diameter and type as specified for other piling, placed in same manner.

3.05 UNACCEPTABLE PILES

- A. Unacceptable Piles: Piles that fail, are placed out of position, are below elevations, or are damaged.
- B. Provide additional piles or replace footings failing to conform to specified requirements.

END OF SECTION

SECTION 31 6615
HELICAL FOUNDATION PILES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Helical anchors used to support tension loads.
- B. Helical piles used to support compression loads.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Base bids on anchor/pile quantity and lengths as indicated.
- B. If the actual number of installed anchors/piles or the total installed length differs, an adjustment to the Contract Sum will be made based on unit prices defined in the Agreement.
- C. No additional payment will be made for withdrawn, damaged, rejected, or misplaced piles; for any portion of a pile remaining above the cut-off elevation; for backdriving; for cutting off piles, or for any cut off length of piles.
- D. Quantity and length measurements will be determined by Installation Logs kept and submitted by Architect Engineer and verified by Contractor, based on the following:
 - 1. Length: By the linear foot measured from point to existing site elevation as indicated.
 - 2. Test Anchors/Piles: Assume 5 feet longer than longest designed length.

1.03 DEFINITIONS

- A. Specific terms used in this section are defined below. Terms not defined below are defined in DFI TM-GLOS-1 first and then by common usage.
- B. Geotechnical Capacity (or, Ultimate Soil Capacity): Maximum load resisted.
- C. Limit State: Condition beyond which a helical foundation component is unfit for service.
 - 1. Serviceability Limit State: Foundation no longer useful for its intended function.
 - 2. Strength Limit State: Foundation is unsafe.
- D. Loads: Forces or other actions that result from weight of all building materials, occupants and their possessions, environmental effects, differential movement, and restrained dimensional changes. Permanent loads are those loads in which variations over time are rare or of small magnitude. All other loads are variable loads (see also Nominal Load below).
- E. Load Test: Procedure to test capacity and relation of load to movement.
- F. Nominal Load: Magnitude of loads determined by Architect Engineer, including dead load, live load and other imposed by building code requirements
- G. Safety Factor: Ratio of ultimate pullout resistance to nominal load.

1.04 REFERENCE STANDARDS

- A. AISC 360 - Specification for Structural Steel Buildings; 2016 (Revised 2021).
- B. ASTM A29/A29M - Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought; 2020.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
- F. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.
- G. ASTM D1143/D1143M - Standard Test Methods for Deep Foundation Elements Under Static Axial Compressive Load; 2020.

- H. DFI TM-GLOS-1 - Deep Foundation Institute Technical Manual; Glossary of Foundation Terms; 1981.
- I. SAE J429 - Mechanical and Material Requirements for Externally Threaded Fasteners; 2014.

1.05 SUBMITTALS

- A. Product Data: Product list, with manufacturer's model designations; published capacities for installed assemblies, including load transfer devices.
- B. Design Data: Submit documentation of foundation design, signed and certified by foundation designer; include:
 - 1. Statement that proposed foundations meet specified design criteria.
 - 2. Nominal load on each foundation element.
 - 3. Maximum allowable installation torque of each selected product.
 - 4. Calculated theoretical geotechnical capacity.
 - 5. Minimum effective torsional resistance requirements.
 - 6. Minimum embedment lengths and such other site specific embedment depth requirements.
 - 7. Inclination angle and location tolerance requirements.
 - 8. Pre-tensioning requirements, if any.
- C. Installation Logs:
 - 1. Submit a copy of the log of each individual foundation element within 24 hours after installation is completed.
- D. Field Test Reports.
- E. Project Record Documents: After work is complete, submit certification from surveyor that installed foundation locations are as shown on drawings.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Experienced in design of helical foundations of the type involved on this project, as evidenced by:
 - 1. State registration/licensure as a professional engineer.
 - 2. List of three or more similar projects designed within the previous three years and names of project representatives who can verify such participation.
- B. Installer Qualifications: Experienced in installation of helical foundations of the type involved on this project, as evidenced by:
 - 1. Manufacturer's certificate of competency in installing helical piles.
 - 2. List of three or more similar projects completed within the previous three years and names of representatives who can verify such participation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Helical Piles and Anchors:
 - 1. Foundation Supportworks, Inc; _____: www.foundationssupportworks.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 HELICAL FOUNDATION DESIGN CRITERIA

- A. It is Contractor's responsibility to design, or obtain qualified design, of the helical foundations as indicated in Contract Documents.
 - 1. Information necessary for design that is contained in Contract Documents includes:
 - a. Locations of foundation elements.
 - b. Nominal design load for each foundation element, including dead load, live load and other loads required by building codes.
- B. Helical Foundation Elements: One or more helical deformed plates (helix plates) attached to a central shaft with a load transfer device for attachment to a structure; entire element resisting applied loads by soil pressure.

1. Design foundations to support/resist the nominal design loads shown on drawings in accordance with AISC 360, Allowable Stress Design method.
 2. Select foundation elements based on allowable installation torque and calculated minimum embedment length; maximum embedment length, if any; and minimum effective torsional resistance.
 3. Corrosion Service Life: 50 years, minimum.
 4. Use solid square shaft helical anchors where subject to tension alone.
 5. Use hollow, round shaft helical foundations where subject to compression only or to alternating tension and compression.
- C. Helical Anchors:
1. Base design on published capacities that represent entire anchor including couplings and connections.
 2. Safety Factor: 2.0 times ultimate pullout/bearing resistance, minimum.
 3. Pre-tensioning of anchors is acceptable method of reducing deflection at service loads.
- D. Helical Piles:
1. Design with pile shaft sections in direct contact with couplings and no coupling bolts or welds in load path.
 2. Safety Factor: 2 times ultimate bearing resistance, minimum.
 3. Deflection: As indicated on drawings.
 4. Fit Up Tolerance: 1/16 inch, maximum.

2.03 MATERIALS

- A. All Components: Hot-dipped galvanized in accordance with ASTM A123/A123M.
- B. Helical Anchors: Solid, square shaft of hot rolled, solid, Round-Cornered-Square (RCS), carbon steel bar complying with ASTM A29/A29M.
1. Size: 1-1/2 inch square.
 2. Torque Strength: 6,000 foot-pounds.
 3. Minimum Yield Strength: 90 kips per square inch.
- C. Helical Anchors and Piles: Hollow, round shaft of structural steel tube or pipe (welded or seamless) complying with ASTM A500/A500M.
1. Size: 2-7/8 inches O.D. by 0.276 inch wall thickness.
 2. Torque Strength: 8,000 foot-pounds.
 3. Minimum Yield Strength: 60 kips per square inch.
- D. Helix Plates: Round steel plates formed into helical spiral on matching metal dies to true helical shape and uniform pitch; welded to central shaft with all plates tracking the same path as leading helix.
1. Material: Hot rolled carbon steel sheet, strip, or plate complying with ASTM A36/A36M or ASTM A572/A572M, Grade 50.
 2. Thickness: 3/8 inch
 3. Profile: True helix-shaped plates, normal to shaft, leading and trailing edges within 1/4 inch of parallel.
 4. Pitch: 3 inches plus or minus 1/4 inch. All helix plates shall have uniform pitch.
 5. Edge Profile: Circular edge.
 6. Spacing: Between 2.4 and 3.6 times helix diameter.
- E. Bolts: SAE J429, Grade 8, bolts with nut.
- F. Couplings: Integral to shaft.
- G. Anchor Plates or Pile Caps: Load-transfer assembly welded from structural steel complying with ASTM A36/A36M.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect structures near the work and underground utilities from damage.

- B. Mark underground utilities as required by authority having jurisdiction. Avoid contact with all marked underground facilities.
- C. Locate the starting point of installation in relation to existing site elevation.

3.02 INSTALLATION

- A. Install helical foundations as shown on drawings and approved design documentation. In event of conflict between drawings and approved anchorage design documentation, do not begin construction on any affected items until such conflict has been resolved.
- B. Comply with manufacturer's written installation requirements and recommendations for specific project site and conditions.
- C. Use installation methods that will not cause damage to existing adjacent or nearby structures.
- D. Keep and submit a log of helical foundation installations, including the following data:
 - 1. Date and time of installation.
 - 2. Location of foundation element.
 - 3. Installed foundation type and configuration.
 - 4. Foundation reveal.
 - 5. Total length of installed foundation element.
 - 6. Installed inclination of foundation element.
 - 7. For compression piles, installation torque measurements taken in one to three foot increments of total length.
 - 8. Actual effective torsional resistance.
 - 9. Calculated geotechnical capacity based on actual torsional resistance and soil parameters appropriate for subsurface conditions within three helix diameters above helix depth.
 - 10. Comments pertaining to interruptions, obstructions, or other relevant information.
- E. If required, position inclined helical anchors perpendicular in order to assist in advancement into soil before establishing required batter angle; after initial penetration, establish required angle of inclination
- F. Engage helical sections into soil and advance in a smooth, continuous manner at a rate of rotation of 5 to 25 RPM.
- G. Apply sufficient down pressure to uniformly advance helical sections a distance per revolution approximately equal to pitch of helix plates.
- H. Adjust rate of rotation and magnitude of down pressure for specific soil conditions and depths.
- I. Provide extension sections as required to achieve required results.
- J. Achieve both minimum embedment length and minimum effective torsional resistance prior to terminating foundation installation.
- K. Location Tolerances:
 - 1. Pile Head Horizontal Tolerance: Within 3 inches of location shown on drawings.
 - 2. Pile Shaft Angular Tolerance: Within 2 degrees of inclination angle shown on drawings.

3.03 ACHIEVEMENT OF EFFECTIVE INSTALLATIONS

- A. In the event that the initial installation of a foundation element does not achieve both minimum embedment length and minimum effective torsional resistance, adjust, repair, or replace that foundation element so that it does achieve both requirements.
 - 1. The following procedures are considered acceptable and do not require prior approval unless otherwise indicated.
 - 2. All other proposed remedies must be approved by Owner prior to implementation.
- B. Minimum Embedment Length Achieved Before Achieving Minimum Effective Torsional Resistance: Use one of the following procedures:
 - 1. Continue installation to greater depths until minimum effective torsional resistance is achieved, provided that, if maximum length constraint is applicable, continued installation does not exceed said maximum length.
 - 2. Demonstrate acceptable foundation performance through testing.

3. Replace foundation with one having a different helix configuration, as follows:
 - a. Embed replacement to a length placing last helix at least three times its own diameter beyond position of first helix of replaced foundation.
 - b. Achieve minimum effective torsional resistance.
 - c. Do not exceed any applicable maximum embedment length.
 - d. Test replacement.
- C. Allowable Torque Rating Reached Before Achieving Minimum Embedment Length: Use one of the following procedures:
 1. Replace foundation with one having either a higher torsional strength rating or a different helix configuration, as follows:
 - a. Achieve minimum embedment length and minimum effective torsional resistance.
 - b. Embed replacement to length that places last helix at least three times helix diameter beyond position of first helix of replaced foundation.
 - c. Do not exceed any applicable maximum embedment length limit.
 2. If allowed by location tolerance or approved by Owner, remove foundation section and reinstall as follows:
 - a. Position reinstalled foundation at least three times diameter of largest helix away from initial location.
 - b. Achieve original embedment length and torsional resistance criteria.
 - c. If repositioning requires installation of additional helical foundations, adjust nominal loads for spacing changes.
- D. Maximum Embedment Length Reached Before Achieving Minimum Effective Torsional Resistance: Use one of the following procedures:
 1. If allowed by location tolerance or approved by Owner, remove and reinstall foundation as follows:
 - a. Position reinstalled foundation at least three times diameter of largest helix away from initial location.
 - b. Achieve original minimum embedment length and minimum effective torsional resistance.
 - c. If repositioning requires installation of additional helical foundations, adjust nominal loads for spacing changes.
 2. Demonstrate acceptable foundation performance through testing.
 3. De-rate load capacity of helical foundation and install additional foundations as necessary; de-rated capacity and additional foundation location shall be subject to approval of Owner.
 4. Replace foundation with one having a different helix configuration; achieve minimum embedment length and minimum effective torsional resistance.
- E. Failure of Field Quality Control Test: Use one of the following procedures:
 1. Install foundation to a greater depth and installation torque and re-test provided that, if a maximum embedment length constraint is applicable, continued installation will not exceed said maximum length constraint.
 2. Replace foundation with one having a different helix configuration. Embed last helix at least three times its own diameter beyond position of first helix of replaced foundation without exceeding any applicable maximum embedment length requirements. Re-test replacement.
 3. If approved by Owner, de-rate load capacity of helical foundation and install additional foundations at positions that are at least three times diameter of largest helix away from any other foundation locations; space anchors in cohesive soils not closer than four helix diameters.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Test installed helical foundations indicated per ASTM D1143/D1143M

- C. Failure of Tests: Replace or re-drive, and re-test, helical foundations that any fail test and cannot be remedied using any of the procedures described above in "ACHIEVEMENT OF EFFECTIVE INSTALLATIONS" article.

END OF SECTION

SECTION 32 1216
ASPHALT PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Aggregate base course.
- B. Bituminous concrete paving.

1.03 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Preparation of site for paving and base.
- B. Section 31 2323 - Fill: Compacted subgrade for paving.

1.04 REFERENCE STANDARDS

- A. Arkansas Department of Transportation Standard Specifications for Highway Construction, Arkansas Department of Transportation, Latest Edition.
- B. AI MS-2 - Asphalt Mix Design Methods; 2015.
- C. AASHTO T 180: Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in) Drop.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Arkansas Highways standard.
- B. Mixing Plant: Complying with State of Arkansas Highways standard.
- C. Obtain materials from same source throughout.

1.06 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate Base Course: Class 7 aggregate base course in accordance with AHTD Standard Specifications for materials and workmanship.
- B. Tack Coat: Homogeneous, medium curing, liquid asphalt.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Asphalt Concrete Hot Mix Surface Course: Type II or III asphalt surface course in accordance with AHTD Standard Specifications for materials and workmanship.
- B. Asphalt Concrete Hot Mix Binder Course: Type I asphalt binder course in accordance with AHTD Standard Specifications for materials and workmanship.
- C. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.03 SOURCE QUALITY CONTROL

- A. Test mix design and samples in accordance with AI MS-2.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

- B. Verify gradients and elevations of base are correct.

3.02 AGGREGATE BASE COURSE

- A. Place on approved subgrade and compact base course in 8 inch maximum lifts to 98 percent of AASHTO T 180 maximum dry density per ArDOT criteria.

3.03 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with State of Arkansas Highways standards.
- B. Apply tack coat to contact surfaces of curbs, gutters and pavements.
- C. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.04 PLACING ASPHALT PAVEMENT

- A. Install Work in accordance with State of Arkansas Highways standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- D. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.
- E. Finished surface, when checked with a 10 foot straight edge placed perpendicular to the direction of slope, shall show no variation more than 1/8 inch. Unacceptable areas shall be removed and replaced at no expense to the owner.
- F. Final pavement exhibiting surface defects such as poor texture, roller marks, honeycomb, cracking, rich marks, brown spots, bleeding, or waving shall be removed and replaced at no expense to the owner.

3.05 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch.

3.06 FIELD QUALITY CONTROL

- A. An independent testing agency shall perform field quality test, as specified in Section 014533 - Special Inspections
- B. The contractor shall employ and pay for services of an independent testing agency to perform field quality control tests, as specified in Section 01 40 00.
- C. Evaluate aggregate base course compaction per AASHTO T 180. Frequency of tests: One for each 2500 sq. ft. of aggregate base course per lift.
- D. Provide field inspection and testing of asphalt paving. Take samples and perform tests in accordance with AI MS-2.

3.07 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 14 days or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 32 1313
CONCRETE PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Paving assemblies.
- B. Form materials.
- C. Reinforcement.
- D. Concrete materials.
- E. Concrete sidewalks, stair steps, integral curbs, gutters, parking areas, and roads.

1.03 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories.
- B. Section 31 2323 - Fill: Compacted subgrade for paving.
- C. Section 32 1216 - Asphalt Paving: Aggregate base course .

1.04 REFERENCE STANDARDS

- A. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- B. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- C. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- D. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- E. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- H. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.
- I. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
- J. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.
- K. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.
- L. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- M. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
- N. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2019.
- O. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.
- P. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018.
- Q. ASTM D5893/D5893M - Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements; 2010.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on joint filler, curing compound, admixtures, mix design, gradation, and other materials used in concrete mix.
- C. Test Data: Provide field quality control test reports.

1.06 EQUIPMENT

- A. Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and shall be maintained in satisfactory condition at all times.
- B. Joint Cleaning Equipment:
 - 1. Concrete Saw: A self-propelled power saw with water-cooled diamond or abrasive saw blades will be provided for cutting joints to the depths and widths specified or for refacing joints or cleaning sawed joints where sandblasting does not provide a clean joint.
 - 2. Waterblasting Equipment: Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary resupply equipment shall be of sufficient capacity to permit continuous operations. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch (25 mm) above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjustable as necessary to obtain satisfactory results. A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch at which the equipment is operating.
 - 3. Hand Tools: Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces.
- C. Sealing Equipment:
 - 1. Cold-Applied, Single-Component Sealing Equipment: The equipment for installing ASTM D5893/D5893M single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. The initially approved equipment shall be maintained in good working condition, serviced in accordance with the supplier's instructions, and shall not be altered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

1.07 TRIAL JOINT SEALANT INSTALLATION

- A. Prior to the cleaning and sealing of the joints for the entire project, a test section of at least 50 feet long shall be prepared using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, the test section shall be inspected to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, the materials shall be removed, and the joints shall be recleaned and resealed at no cost to the Owner. When the test section meets the requirements, it may be incorporated into the permanent work. All other joints shall be prepared and sealed in the manner approved for sealing the test section.

PART 2 PRODUCTS

2.01 PAVING ASSEMBLIES

- A. Comply with applicable requirements of ACI SPEC-301.

2.02 FORM MATERIALS

- A. Form Materials: As specified in Section 03 1000, comply with ACI SPEC-301.

- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).

2.03 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) yield strength; deformed billet steel bars; unfinished.

2.04 AGGREGATE BASE COURSE

- A. Aggregate Base Course: Class 7 aggregate base course in accordance with ArDOT Standard Specifications for materials and workmanship.

2.05 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Cement: ASTM C150/C150M, Normal - Type I Portland cement, gray color.
- C. Fine and Coarse Mix Aggregates: ASTM C33/C33M.
- D. Fly Ash: ASTM C618, Class C or F.
- E. Water: Clean, and not detrimental to concrete.
- F. Air-Entraining Admixtures: ASTM C260/C260M.

2.06 ACCESSORIES

- A. Curing Compound: ASTM C309, Type 1, Class A.
- B. Materials for sealing joints in the various paved areas indicated on the drawings shall be ASTM D 5893.

2.07 CONCRETE MIX DESIGN

- A. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect Engineer for preparing and reporting proposed mix designs.
- B. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended by manufacturer.
- C. Concrete Properties:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4000 psi.
 - 2. Total Air Content: 6 percent plus or minus 1 percent, determined in accordance with ASTM C 173/C 173M.
 - 3. Maximum Slump: 3 inches.
 - 4. Maximum Aggregate Size: 3/4 inch.

2.08 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 AGGREGATE BASE COURSE

- A. Place on approved subgrade and compact base course in 8 inch maximum lifts to 98 percent of AASHTO T 180 maximum dry density per ArDOT criteria.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Notify Architect Engineer minimum 24 hours prior to commencement of concreting operations.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

- A. Place reinforcement as indicated.
- B. Interrupt reinforcement at expansion joints.

3.06 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI PRC-305 when concreting during hot weather.
- B. Follow recommendations of ACI PRC-306 when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07 PLACING CONCRETE

- A. Place concrete in accordance with ACI PRC-304.
- B. Do not place concrete when base surface is wet.
- C. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
- D. Repair of Surface Defects: Immediately patch all repairable defective areas after form removal. If the repairs do not bring the Work into conformance, remove and re-pour.

3.08 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 1/2 inch wide expansion joints at 40 foot intervals, unless indicated otherwise, and to separate paving from vertical surfaces and other components.
- C. Saw cut contraction joints 1/8 inch wide at intervals indicated at an optimum time after finishing. Cut 1/4 into depth of slab.

3.09 FINISHING

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.
- C. Curbs and Gutters: Light broom, texture perpendicular to pavement direction.
- D. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.10 JOINT SEALING

- A. Sealing Joints: Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, a final cleaning with compressed air shall be performed. The joints shall be filled from the bottom up to 1/8 inch plus or minus 1/16 inch below the pavement surface. Excess or spilled sealant shall be removed from the pavement by approved methods and shall be discarded. The sealant shall be installed in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Architect/Engineer. When a primer is recommended by the manufacturer, it shall be applied evenly to the joint faces in accordance with the manufacturer's instructions. Joints shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

3.11 JOINT SEALING INSPECTIONS

- A. Joint Cleaning: Joints shall be inspected during the cleaning process to correct improper equipment and cleaning techniques that damage the concrete pavement in any manner. Cleaned joints shall be approved prior to installation of joint sealant.
- B. Joint Sealant Application Equipment: The application equipment shall be inspected to ensure proper installation. Evidences of bubbling, improper installation, failure to cure or set shall be cause to suspend operations until causes of the deficiencies are determined and corrected.
- C. Joint Sealant: The joint sealant shall be inspected for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified herein at no additional cost to the Owner.

3.12 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.13 FIELD QUALITY CONTROL

- A. An independent testing agency shall perform field quality test, as specified in Section 014533 - Special Inspections
- B. The contractor shall employ services of an independent testing agency to perform field quality control tests, as specified in Section 01 40 00.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- C. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
 - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 2. Perform one slump test for each set of test cylinders taken.
- D. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.14 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect/Engineer and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect/Engineer. The cost of additional testing shall be borne by the Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.
- E. Repair of Formed surfaces: Surface defects include color and texture irregularities, crack, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush cut holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Remove and replace concrete defective surfaces if defects cannot be repaired to satisfaction of Architect/Engineer.

- F. Repair of Unformed Surfaces: Test unformed surfaces for smoothness and verify surfaces plan to tolerances specified for each surface and finish. Correct high areas by grinding after concrete has cured at least 14 days. Correct low areas immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete.

3.15 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit vehicular traffic over pavement for 7 days minimum after finishing.

END OF SECTION

SECTION 32 1713
PARKING BUMPERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Precast concrete parking bumpers and anchorage.

1.03 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- B. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- C. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.
- D. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Parking Bumpers: Precast concrete, complying with the following:
 - 1. Profile: Manufacturer's standard.
 - 2. Cement: ASTM C150, Portland Type II - Sulfate Resistant; white color.
 - 3. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
 - 4. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
 - 5. Air Entrainment Admixture: ASTM C260/C260M.
 - 6. Concrete Mix: Minimum 5,000 psi compressive strength after 28 days, air entrained to 5 to 7 percent.
 - 7. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
 - 8. Embed reinforcing steel, and drill or sleeve for two dowels.
 - 9. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
 - 10. Minor patching in plant is acceptable, providing appearance of units is not impaired.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.
- C. Fasten units in place with 2 dowels per unit.

END OF SECTION

**SECTION 32 1723
PAVEMENT MARKINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Painted pavement markings.

1.02 RELATED REQUIREMENTS

- A. Section 32 1216 - Asphalt Paving.
- B. Section 32 1313 - Concrete Paving.

1.03 REFERENCE STANDARDS

- A. AASHTO M 247 - Standard Specification for Glass Beads Used in Pavement Markings; 2013 (Reapproved 2018).
- B. AASHTO M 249 - Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form); 2012 (Reapproved 2020).
- C. AASHTO MP 24 - Standard Specification for Waterborne White and Yellow Traffic Paints; 2015 (Reapproved 2020).
- D. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.

1.07 SEQUENCING

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of markings or a period recommended by manufacturer.

PART 2 PRODUCTS

2.01 PAINTED PAVEMENT MARKINGS

- A. Comply with State of Arkansas Highway Department standards.
- B. Comply with FHWA MUTCD.
- C. Painted Pavement Markings: As indicated on drawings.
 - 1. Marking Paint: In accordance with AASHTO MP 24.
 - a. Parking Lots: White.
 - b. Symbols and Text: White.
 - c. Wheelchair Symbols: Provide blue and white.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Verify that pavement is dry and ready for installation.

- B. Notify Architect Engineer of unsatisfactory conditions before proceeding.

3.02 PREPARATION

- A. Clean surfaces prior to installation.
 - 1. Remove dust, dirt, and other debris.
- B. Apply paint stencils by type and color at necessary intervals.

3.03 INSTALLATION

- A. General:
 - 1. Position pavement markings as indicated on drawings.
 - 2. Field location adjustments require approval of Architect Engineer.
- B. Painted Pavement Markings:
 - 1. Apply in accordance with manufacturer's instructions.
 - 2. Apply in accordance with State of Arkansas Highway Department standards.
 - 3. Apply in accordance with FHWA MUTCD standards.
 - 4. Marking Paint: Apply uniformly, with sharp edges.
 - a. Applications: One coat.
 - b. Wet Film Thickness: 0.015 inch, minimum.
 - c. Stencils: Lay flat against pavement, align with striping, remove after application.
 - d. Glass Beads: Apply directly to paint, 10 second lag time, 6 lbs/gal of paint, uniform thickness and coverage.
 - e. Length Tolerance: Plus or minus 3 inches.
 - f. Width Tolerance: Plus or minus 1/8 inch.

3.04 PROTECTION

- A. Prevent approaching traffic from crossing newly applied pavement markings.
- B. Replace damaged or removed markings at no additional cost to Owner.

END OF SECTION

SECTION 32 3119
DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative steel fences.
- B. Decorative aluminum fences.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
- D. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints; 2002 (Reapproved 2017).
- E. ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; 2008, with Editorial Revision (2017).
- F. CLFMI WLG 2445 - Wind Load Guide for the Selection of Line Post and Line Post Spacing; 2018.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit 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:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

PART 2 PRODUCTS

2.01 FENCES

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
- B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
 - 1. Total Coating Thickness: 2 mils, minimum.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set fence posts in accordance with the manufacturer recommended spacing.

END OF SECTION

SECTION 32 8400

IRRIGATION

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish all labor, materials, equipment and instructions necessary for the complete installation of the landscape irrigation system as drawn and specified. The work includes, but is not limited to:
 - 1. Trenching, backfilling, and compaction for irrigation lines.
 - 2. Provisions and installation for a turnkey automatic sprinkler system. Provide backflow preventer, controller, sensors, piping, heads, valves, valve access boxes, low voltage wiring, applicable connection fees and all other items required for a complete system as shown on the Drawings, called for in the specifications or as may be required for proper operation of the system. The system shall be installed in strict accordance with all applicable codes, ordinances and regulations.
 - 3. Test all systems, make operative and adjust.
 - 4. Submit Record Drawings, Maintenance Manual and satisfactory evidence to show that all work has been installed in accordance with the ordinance and code requirements.
 - 5. Maintain and operate until substantial completion.
 - 6. One-year Guarantee Period.
- B. Provide the number of heads required to assure 100% coverage.
- C. Coordinate exact locations of Point-of-Connection to the existing water meter with the owner.
- D. The Contractor shall install the irrigation system in accordance with the schedule requirements provided by the architect and general contractor.
- E. The Contractor shall include in their price the cost to retrofit the existing irrigation system to provide 100% coverage per the planting plan. Contractor shall visit the site prior to bidding the project to determine what is required to connect to the existing irrigation system.

1.02 QUALITY CONTROL

- A. To the greatest extent possible, provide system components produced by a single manufacturer. Provide secondary materials as recommended by the primary system manufacturer.
- B. The sprinkler system shall be designed, to the extent possible, to promote water, soil and energy conservation. The system shall include a rain sensing device and shall be consistent with any water conservation ordinance enacted by the city.
- C. Provide installation by a licensed mechanical contractor, landscape contractor or irrigation contractor, skilled in work required and completely familiar with manufacturer's recommended method of installation requirements. Contractor must have a minimum of two (2) consecutive years experience in this area of work and having completely installed other jobs of similar size and scope. Evidence of the Contractor's qualifications shall be presented before the award of contract.
- D. Approval and selection of Materials and Work: The selection of all materials and the execution of all operations required under the Contract Documents shall be subject to the approval of the Owner who shall have the right to reject any and all materials and any and all work which, in their opinion, does not meet the requirements of the Contract Documents at any stage of the operations. All rejected materials shall be removed from the site by the Contractor.
- E. The successful Contractor shall maintain a competent, skilled and satisfactory work force during and through the completion of the construction period. In no case, shall unskilled labor be allowed to operate equipment, assemble, glue, install, wire, test or adjust components of the system. If in the opinion of the Owner, the labor furnished by the Contractor is incompetent or inexperienced in the practice assigned, the Contractor shall remove such persons or reassign them to a practice acceptable to the Owner.

- F. Conform to all codes, statutes, laws and regulations governed by the following agencies for the protection of public safety:
- G. American Society for Testing Materials
- H. American Water Works Association
- I. National Electric Code
- J. National Sanitary Foundation
- K. Occupational Safety and Health Act
- L. Uniform Plumbing Code
- M. The Contractor shall make application, acquire, comply and pay for all licenses and/or permits required by Local, State, or National Governing Agencies as may be required to perform and complete the work as described in the Contract Documents.

1.03 SUBMITTALS

- A. General: Make all submittals far enough in advance of scheduled dates of installation to provide all required time for reviews, for possible revisions, and resubmittals, and for placing orders and securing delivery.
- B. Product Manual: Submit technical specification sheets and or performance data for all proposed system components. Submit the address and telephone number of the subcontractor installing the system and the local representative for the equipment.

1.04 PROJECT CONDITIONS

- A. The Contractor shall warrant that he has fully informed himself of the site conditions under which the work will be performed and is thoroughly familiar with the Contract Documents and all applicable codes and standards. Failure to have done so will not relieve the Contractor of his obligation to furnish all supervision, labor, tools, materials, equipment and supplies necessary to perform the provisions of the work detailed in the Contract Documents.
- B. Make necessary adjustments in the layouts as may be required to connect to existing stub-outs, should such not be located exactly as shown, and as may be required to work around existing work at no increase in cost to the Owner.
- C. The Contractor's attention is directed to the fact that there are other utilities located within the limits of the work. Before commencing any work required under the Contract, he shall determine the location of all utilities, subsurface drainage, structures and underground construction so that proper precaution may be taken not to disturb or damage during all operations. The Contractor shall be held responsible for making, at his own expense, all repairs to damaged utilities which could have been located or other construction resulting from the work covered by this Contract.
- D. Should utilities not shown on plans be found during excavations, promptly notify the Owner for instructions as to further action.

1.05 PROTECTION OF WORK AND MATERIALS

- A. Use all means necessary to protect the work before, during and after installation and to protect the materials and installed work of all other trades.
- B. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner.
- C. Store materials delivered to site, prior to actual use, in a secure place not to interfere with other trades or construction and protect from vandalism, damage by weather or other elements.

PART 2 PRODUCTS

2.01 GENERAL

- A. The sprinkler system design shall be based on the equipment of Rainbird Sprinkler Corporation and Hunter Industries or approved equal.

- B. Materials shall be newly manufactured and without flaws or defects, and of quality and performance as specified. Excess materials at completion are property of the Contractor, to be removed from the site.
- C. The Contractor shall be responsible for computing and supplying the required quantities necessary to make the irrigation system complete and operational in every way. Quantities shown on the drawings are for convenience only.

2.02 PIPE AND FITTINGS

- A. Mainline piping above ground shall be Copper tube, Type K, drawn temper; copper tube fittings; soldered joints.
- B. Mainline piping below ground shall be polyvinyl chloride (PVC) pipe; meeting ASTM D2241, Class 200 for solvent weld connections; or ASTM D1785, Sch40 for threaded connections.
- C. Lateral piping below ground shall be polyvinyl chloride (PVC) pipe; meeting ASTM D2241, Class 200 for solvent weld connections; Sch40 for threaded connections. The minimum pipe size shall be 1" in diameter.
- D. Polyvinyl chloride (PVC) fittings; meeting ASTM D2466, Sch40 for solvent weld connections; Sch40 for threaded connections. All fittings must be of domestic manufacture and shall be identified as to pressure rating or schedule, with a working pressure no lower than that of the pipe.
- E. Handling of Pipe and PVC Fittings: Exercise care in handling, loading, unloading and storing PVC pipe and fittings. Store under cover and transport in a vehicle with a bed long enough to allow no undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded until said section of pipe is cut out and rejoined with a coupling.
- F. Visual Inspection: Provide pipe homogenous throughout, free from visible cracks, holes, blisters, wrinkles or foreign materials
- G. PVC solvent cement shall comply with ASTM D2564, regular-bodied for pipe 2" and smaller, and medium for pipe 2 1/2" and larger. Use only the solvent approved and/or recommended by the pipe manufacturer to make solvent welded joints.
- H. Use Teflon tape or an appropriate sealant for all threaded connections.

2.03 CONTROL WIRES AND CONNECTORS

- A. Single Conductor Wire for direct burial applications, meeting UL Standard 493, UF-16/1 for "Control" wiring and UF-16/1 for "Common" wiring. Color code the common neutral wiring from all other wires.
- B. Wire Connectors shall be either 3M DBY / DBR or King "One Step" Connectors or approved equal.

2.04 AUTOMATIC CONTROLLER AND SENSORS

- A. Automatic controller shall be of a hybrid type that combines electromechanical and microprocessor-based circuitry capable of fully automatic and manual operation. The controller will be housed in a weather-proof, lockable, cabinet suitable for wall mounting.
- B. The rain sensor shall be a wall mounted device that shall interrupt the watering cycle from starting if approximately .10" of rainfall has accumulated due to precipitation at a rate equal to or greater than .25" per hour prior to or during an irrigation cycle.
- C. The freeze sensor shall be a wall mounted device that shall interrupt the watering cycle from starting if the ambient air temperature falls below 37 degrees Fahrenheit prior to or during an irrigation cycle.

2.05 VALVES

- A. The remote control valves shall be a normally closed, 24VAC solenoid actuated, globe/angle type valve. They shall have manual flow control stems for accurate regulation and/or shutoff of

outlet flow. Equip control valves with pressure regulating modules, if required, to regulate downstream pressure.

- B. Bronze gate valve for use as cut-off, isolation or manual drain valve on lines up to 2" in diameter shall be as manufactured by Nibco, Inc., Elkhart, IN or approved equal.

2.06 VALVE BOXES

- A. Provide valve boxes for all remote control valves and manual gate valves. The manufacturer shall be Armor, Plymouth Products Division, Sheboygan, WI or approved equal.
- B. When used with a single valve use a #181104 - 10" round box with a twist lock cover.

2.07 SPRINKLER HEADS

- A. All heads shall perform to manufacturer's specifications concerning diameter of throw and flow rates at given pressures.
- B. Provide 4" pop-up rotary sprinklers in all large turf areas. The full or part circle sprinkler shall be a single stream, gear driven rotor with a rotating nozzle turret that is independent of the riser stem. The sprinkler shall have a pressure activated wiper seal that will clean debris from the pop-up stem as it retracts. Matched precipitation shall be obtained by the changing of nozzles.

PART 3 EXECUTION

3.01 GENERAL

- A. Verify that the work of this section is installed in strict accordance with all applicable codes, regulations the design and the approved submittals. Contractor shall install all equipment as per manufacturer's current specifications and recommendations.
- B. VERIFY THAT WATER PRESSURE IS ADEQUATE FOR EFFICIENT OPERATION OF THE SPRINKLER SYSTEM AS DESIGNED AND INSTALLED. Coordinate exact location of Point-of-Connection with the Owner.
- C. Verify existing and proposed locations of all site utilities (i.e. gas, water, electric, telephone, fiber optics) prior to any trenching and laying of pipe.
- D. Flag the location of all sprinklers in accordance with the approved design and submittals. In the event of a discrepancy, immediately notify the Owner. Do not proceed with installation in areas of discrepancies until all such discrepancies have been fully resolved.
- E. The irrigation design is shown in schematic form only. Do not install any mainline, valves or wiring in public right-of-way.
- F. The Contractor is responsible for full and complete coverage of all irrigated areas and shall make any necessary minor adjustments at any time, at no additional cost to the Owner.

3.02 TRENCHING AND BACKFILLING

- A. Perform all excavation required for the installation of the work included under this Section, including shoring and bracing of earth banks to prevent cave in. Restore all surfaces and existing underground installations damaged or cut as a result of the excavations, to their original condition and in a manner approved by the Owner.
- B. Excavate trenches to a depth of minimum pipe coverage plus six inches. Remove all lumber, rubbish and large rocks from the trenches. Provide a uniform bearing for the entire length of each pipe line to prevent uneven settlement. Make the width of the trench a minimum of 1 1/2 times the diameter of the piping but not less than 4 inches.
- C. Upon completion of pipe installation and system testing, backfill the trenches with clean soil. Backfill material shall be free from rocks or any heavy unsuitable substances which could damage the pipe or create unusual settling problems. Backfilling shall be done in six inch layers and tamped down after each layer is put back as required to avoid settling in landscape areas and to 98% standard proctor in paved areas.
- D. If settling occurs within the warranted period, the Contractor shall be responsible for bringing the trenches up to finish grade and repairing plant damage without additional compensation.

3.03 PIPE INSTALLATION

- A. Never install PVC pipe when there is water in the trench. Never install PVC pipe when the temperature is 32 degrees Fahrenheit or below.
- B. Install the mainline at a bury depth of 18 inches and the lateral lines at a bury depth of 12 inches below finished grade. Maintain a 4 inch clearance between pipes that cross at an intersection and a 2 inch clearance between pipes that are buried in the same trench.
- C. Remove all foreign matter or dirt from the inside of the pipe before joining. Cap or plug all lines after installation and prior to testing to minimize infiltration of foreign matter or dirt.
- D. Snake pipe from side to side of trench bottom to allow for expansion and contraction. Install main lines and lateral lines in common trenches wherever possible.

3.04 PIPE AND FITTING CONNECTIONS

- A. Meet ASTM D2855 Standard Practice for making solvent-cemented joints with PVC pipe and fittings. Use only the solvent approved and/or recommended by the pipe manufacturer to make solvent welded joints. Thoroughly clean pipe and fittings of dirt, dust and moisture before applying solvent.
- B. Make solvent welds with a nonsynthetic bristle brush in the following sequence: Apply an even coat of solvent to the outside of the pipe. Then apply solvent to the inside of the fittings and then re-apply a light coat of solvent to the outside of the pipe, making sure that coated area on the pipe is equal to the depth of the fitting socket. Insert pipe quickly into the fitting and turn the pipe approximately 1/4 turn to distribute the solvent and remove air bubbles. Check all tees and ells for correct position, then hold joint for approximately 15 seconds so that pipe does not push out from the fitting. Allow at least 15 minutes drying time for each weld joint before moving.
- C. Allow all joints to set and cure for a minimum of 12 hours prior to pressurization of system.

3.05 WIRE INSTALLATION

- A. Verify that the work of this section is installed in strict accordance with the latest edition of the National Electric Code and local electrical codes.
- B. Install neutral and control wires, 12 inches below finish grade, in the same trenches as the main and lateral lines. The wires shall be installed in a neat and orderly fashion and bundled together and taped every 10 feet. Snake wires in trench to allow for expansion and contraction and provide slack loops at every splice, change of direction, at the valves, where the wire enters the conduit for the automatic controller and at least every 100 feet in runs more than 100 feet in length. The slack loops shall be created by wrapping 3 feet of wire around a 1/2 inch diameter pipe to form a coil.
- C. Connect each solenoid to the controller with a "control wire" which is typically red in color. Connect a "common neutral wire" to all solenoids which is typically white in color.
- D. Solder or join all wire connections by positive mechanical connectors. Splices must be properly insulated and waterproofed. Control wire splices will be allowed only in runs more than 500 feet and only in valve boxes.

3.06 VALVE INSTALLATION

- A. The remote control valves shall be installed in accordance with manufacturer's instructions. Valves shall be installed in Armor valve boxes or approved equal. Boxes shall be installed to a height that will be flush with finished grade. Provide a 6 inch layer of washed gravel in the bottom of the valve box. Valves shall be set a minimum of two feet behind curbs. Valves shall not be set in curves which are vulnerable to damage by truck trailers over running curbs.

3.07 FLUSHING AND PRESSURE TESTING

- A. Prior to backfilling and installation of sprinkler heads, open all control valves and use full line pressure to completely flush lines of foreign matter and dirt. INITIAL FLUSHING OF LINES SHALL NEVER BE THROUGH SPRINKLER HEADS.

- B. With zone valves closed, pressure test mainlines by supplying and maintaining full static pressure continuously for one full hour. Observe for evidence of leakage by monitoring flow meter and by visual inspection of the exposed pipe joints. Repair all leaks and retest until no water flow is observed.

3.08 SPRINKLER HEAD INSTALLATION

- A. After landscape finish grading is accomplished, install heads to finished grade in lawn and shrub areas and backfill with clean topsoil so head is stabilized and no lateral motion is exhibited during operation. Heads in the turf areas shall be set flush with the finished grade and not a hazard to pedestrians and/or maintenance machinery. Set sprinkler heads to plumb within 1/16" and a minimum of 4 inches and a maximum of 6 inches from walls, walks and curbs.
- B. Sprinkler heads to be spaced so as not to throw water on the buildings, walks or driveways. Heads shall be adjusted as required so that the system has 100% coverage.
- C. Provide connection to the PVC lateral lines, for large rotors, with PVC Swing Joints.

3.09 OPERATION, TESTING AND BALANCING

- A. Testing: Upon completion of the irrigation system, and after pressure testing and head installation, the entire system shall be tested for proper operation. All air shall be flushed from the system and all components checked for proper operation by the Contractor. The system shall be tested in strict accordance with all applicable codes, ordinances and regulations.
- B. Any portions requiring repair shall be replaced or repaired and test repeated. No testing shall be done until the last solvent welded joint has had 12 hours to set and cure.
- C. Balancing and Adjustment: The Contractor shall balance and adjust the various components of the system so that the overall operation is most efficient. This work shall include adjustment to all sprinkler heads and individual station adjustments on the controller. Observe that all zones function properly and in the correct sequence.

3.10 MAINTENANCE AND COMPLETION OF THE WORK

- A. The Contractor shall complete the irrigation system as drawn and specified, according to Schedule herein, and operate and maintain same until time of substantial completion of the project.
- B. The Contractor shall orient the Owner's personnel to the operation and adjustments of the controller according to local seasonal requirements. The Contractor shall also familiarize the Owner with sprinkler and valve adjustments. The Owner is, in general, to be totally familiarized with the overall operation, adjustment, maintenance and intent of the irrigation system, including the measures that should be taken to provide winterization for the system. Such instructions should be in written form. The contractor shall also provide a color coded laminated plan, in the controller door, showing the locations of all zones.

3.11 INSPECTION AND SUBSTANTIAL COMPLETION

- A. When Contractor is satisfied that the entire system is operating properly, that it is balanced and adjusted so that all work and clean-up is completed, he shall submit a written request for initial inspection to the Owner at least one week prior to anticipated date of inspection and testing.
- B. Submit reproducible as-built Record Drawings and Maintenance Manual to the Owner with request for inspection.
- C. Upon completion of repairs and replacements found necessary at time of inspection, the Owner will confirm the date of substantial completion.
- D. The date of substantial completion will determine:
 - 1. The final date of maintenance as part of this Section.
 - 2. The beginning date of the One-Year Guarantee Period.

3.12 GUARANTEE

- A. Guarantee all work, products, equipment and materials for one (1) year period beginning upon substantial completion.

- B. Guarantee applies to all losses with the exception of those due to Acts of God, vandalism or occupancy of the project.

3.13 FINAL INSPECTION

- A. At end of Guarantee Period and upon request for final inspection, jointly review all guaranteed work for Final Acceptance with the Owner.
- B. Submit written request for final inspection to the Owner at least two weeks prior to anticipated date of inspection.

3.14 FINAL ACCEPTANCE

- A. Upon completion by the Contractor of all required repairs and replacements found at time of final inspection, the Owner will confirm the date of Final Acceptance of the work.
- B. Confirmation of Final Acceptance by the Owner will constitute completion of the work of this Section.

END OF SECTION

SECTION 32 9223

SODDING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Fertilizing.
- C. Sod installation.

1.03 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Preparation of subsoil in preparation for work of this section.

1.04 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.05 REFERENCE STANDARDS

- A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Certificate: Certify grass species and location of sod source.

1.07 QUALITY ASSURANCE

- A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of Arkansas.
- B. Installer Qualifications: Company approved by the sod producer.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sod on pallets. Protect exposed roots from dehydration.
- B. Do not deliver more sod than can be laid within 24 hours.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- D. Furnish service and maintenance of sodded areas for three months from Date of Substantial Completion.
- E. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

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

2.02 MATERIALS

- A. Sod: TPI, Certified Turfgrass Sod quality; cultivated grass sod; type indicated in plant schedule on Drawings; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft. Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
 - 1. 419 Hybrid Bermuda Grass Type: 100 percent.

- B. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay, or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.
- C. Fertilizer: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:
 - 1. Nitrogen: 20 percent.
 - 2. Phosphoric Acid: 20 percent.
 - 3. Soluble Potash: 10 percent.
- D. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.03 ACCESSORIES

- A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.

2.04 SOURCE QUALITY CONTROL

- A. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
- B. Submit minimum 10 oz sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.
- C. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

- A. Prepare subgrade in accordance with Section 31 2200.

3.03 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after smooth raking of topsoil and prior to installation of sod.
- C. Apply fertilizer no more than 48 hours before laying sod.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod immediately after delivery to site to prevent deterioration.
- C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Where new sod adjoins existing grass areas, align top surfaces.
- E. Where sod is placed adjacent to hard surfaces, such as curbs, pavements, etc., place top elevation of sod 1/2 inch below top of hard surface.
- F. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- G. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.
- H. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller not exceeding 112 lbs.

3.05 MAINTENANCE

- A. Provide maintenance at no extra cost to Owner; Owner will pay for water.
- B. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- C. Neatly trim edges and hand clip where necessary.
- D. Immediately remove clippings after mowing and trimming.
- E. Water to prevent grass and soil from drying out.
- F. Roll surface to remove irregularities.
- G. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- H. Immediately replace sod to areas that show deterioration or bare spots.
- I. Protect sodded areas with warning signs during maintenance period.

END OF SECTION

SECTION 32 9300

PLANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Topsoil bedding.
- C. New trees, plants, and ground cover.

1.02 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.
- B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.03 REFERENCE STANDARDS

- A. ANSI/AHIA Z60.1 - American National Standard for Nursery Stock; 2014.

1.04 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years documented experience.
- B. Installer Qualifications: Company specializing in installing and planting the plants with 3 years experience.

1.05 FIELD CONDITIONS

- A. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.
- B. Do not install plant life when wind velocity exceeds 30 mph.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide one year warranty.
- C. Warranty: Include coverage for one continuous growing season; replace dead or unhealthy plants.
- D. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.
- B. Plant Materials: Certified by federal department of agriculture; free of disease or hazardous insects.

2.02 PLANTS

- A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.

2.03 SOIL MATERIALS

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0.

PART 3 EXECUTION

3.01 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.
- C. Scarify subsoil to a depth of 3 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.
- D. Dig pits and beds 6 inches larger than plant root system.

3.02 PLACING TOPSOIL

- A. Spread topsoil to a minimum depth of 4 inches over area to be planted. Rake smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Install topsoil into pits and beds intended for plant root balls, to a minimum thickness of 6 inches.

3.03 PLANT SUPPORT

END OF SECTION

SECTION 33 0561
CONCRETE MANHOLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Precast concrete manholes.
- B. Cast-in-place concrete manholes.
- C. Cast-in-place concrete base pad.
- D. Grade adjustments.
- E. Frames and covers.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.

1.04 REFERENCE STANDARDS

- A. AASHTO HB - Standards Specifications for Highway Bridges; Latest Edition
- B. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- C. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- D. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2021).
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- G. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill; 2011.
- H. ASTM C55 - Standard Specification for Concrete Building Brick; 2017.
- I. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
- J. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.
- K. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- L. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2020.
- M. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants; 2009 (Reapproved 2019).
- N. ASTM C1634 - Standard Specification for Concrete Facing Brick; 2017.
- O. Little Rock Water Reclamation Authority Standards and Specifications, Latest Edition.
- P. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions.
- C. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.
- D. Project Record Documents:

1. Record invert elevations of concrete manholes.
- E. Manhole Testing: Results of vacuum testing.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with utility company requirements.
- B. Local codes and utility company requirements take precedence over the Construction Documents.

1.07 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 CONCRETE MANHOLES

- A. Weight Rating: H 10 according to AASHTO HB.
- B. Precast Concrete Manholes: Comply with ASTM C478/C478M, reinforced.
 1. Wall Thickness: 6 inches.
 2. Base Thickness: 12 inches.
 3. Cone Thickness: 6 inches.
 4. Lid Thickness: 10 inches.
 5. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
 6. Joint Sealant: Comply with ASTM C990.
- C. Cast-In-Place Concrete Manholes: Comply with ASTM C94/C94M, reinforced.
 1. Wall Thickness: 6 inches.
- D. Cast-In-Place Concrete Base Pads: Comply with ASTM C94/C94M, reinforced.
 1. Thickness: 12 inches.
 2. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
- E. Cast-In-Place Concrete Materials: See Section 03 3000.
- F. Grade Adjustments:
 1. Concrete Bricks: ASTM C1634 or ASTM C55 Grade N, cored, normal weight; ___ by ___ by ___ inches.
- G. Frame and Cover: Cast iron construction, ASTM A48/A48M, Class 30B, machined flat bearing surface.

2.02 ACCESSORIES

- A. Lid and Frame: ASTM A48/A48M, Class 30, Cast iron construction, machined flat bearing surface, removable lid, closed lid design; traffic weight; lid molded with identifying name.
- B. Manhole Steps: Formed galvanized steel rungs; 3/4 inch diameter. Formed integral with manhole sections.
- C. Strap Anchors: Bent steel shape, ___ by ___ inch size by ___ inch thick, galvanized to ASTM A123/A123M, Grade specified for applicable material category.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

3.02 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 INSTALLATION

- A. Establish elevations and pipe inverts for inlets and outlets as indicated in drawings.
- B. Precast Concrete Manholes:
 - 1. Place base section plumb and level.
 - 2. Install joint sealant uniformly around section lip.
 - 3. Install cone or lid plumb and level on joint sealant.
- C. Cast-In-Place Concrete Base Pad:
 - 1. Form base pad according to Section 03 3000.
 - 2. Install reinforcement in maximum lengths. Offset end laps in both directions. Splice laps with tie wire.
 - 3. Place concrete in accordance with ACI PRC-304.
 - 4. Float base pad top surface level.
- D. Cast-In-Place Concrete Manholes:
 - 1. Form catch basin on concrete base pad plumb and level.
 - 2. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
 - 3. Place concrete in accordance with ACI PRC-304.
 - 4. Float catch basin top surface level.
- E. Grade Adjustments:
 - 1. Lay brick or masonry units uniformly on mortar bed with full head joints, running bond. Top with mortar, plumb and level.
 - 2. Lay concrete ring on mortar bed, plumb and level. Top with mortar, plumb and level.
 - 3. Place adjacent materials tight, and smooth following design grades.
- F. Frames and Covers:
 - 1. Place frame plumb and level.
 - 2. Mount frame on mortar bed at indicated elevation.
 - 3. Place grate in frame securely.

3.04 FIELD QUALITY CONTROL

- A. Perform field inspection for pipe invert elevations.
- B. If inspections indicate work does not meet specified requirements, adjust work and reinspect at no cost to Owner.

3.05 TESTING

- A. Test sanitary sewer manholes in accordance with ASTM C1244.
- B. If the vacuum reading drops more than one (1) inch before the appropriate time has elapsed, the manhole shall have failed the test. The Contractor shall be required to uncover, replace, or repair any or all sections of the manhole and retest.

END OF SECTION

SECTION 33 1416
SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Water pipe for site conveyance lines.
- B. Pipe valves.
- C. Fire hydrants.

1.03 DESCRIPTION OF WORK

- A. Exterior water distribution system work is shown on the drawings and includes all pipe, valves, meters if required, hydrants and other items required to provide service from 5 feet outside of building to tie in with local utility lines unless shown otherwise.
- B. Contractor shall pay all cost required by the utility company pertaining to construction and tie-in. Deposits required for permanent service will be paid by the Owner.

1.04 RELATED REQUIREMENTS

- A. Section 21 1100 - Facility Fire-Suppression Water-Service Piping.
- B. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- C. Section 33 0110.58 - Disinfection of Water Utility Piping Systems: Disinfection of site service utility water piping.

1.05 REFERENCE STANDARDS

- A. AWWA C502 - Dry-Barrel Fire Hydrants; 2018.
- B. Central Arkansas Water Standard Pipeline Materials and Construction Specifications, Latest Edition
- C. UL 246 - Hydrants for Fire-Protection Service; Current Edition, Including All Revisions.

1.06 DEFINITIONS

- A. Bedding: Fill placed under, beside and to 6 inches over pipe, prior to subsequent backfill operations.

1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- C. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- D. Testing: Results of hydrostatic tests.ASTM B418

1.08 QUALITY ASSURANCE

- A. Perform Work in accordance with utility company requirements.
- B. Comply with applicable requirements of locally adopted plumbing codes.
- C. Local codes and utility company requirements take precedence over the Construction Documents.
- D. Fire protection work shall also comply with NFPA requirements.
- E. Verify with local water utility company the meter size required to allow sufficient discharge flow pressure for proper sanitary operation of all fixtures in the Project, and fire protection if required.

- F. The contractor shall furnish the meter if the utility company does not.
- G. Obtain all necessary permits and approvals.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 WATER PIPE

- A. Ductile Iron Pipe (For pipe 3 inch diameter & greater): AWWA C151:
 - 1. Fittings: Ductile or gray iron, AWWA C110, with mechanical joints.
 - 2. Joints: AWWA C111, rubber gasket.
 - 3. Cement Lining: AWWA C104 with sealcoat.
 - 4. Encasement: AWWA C105 polyethylene encasement.
- B. Copper Tubing (For pipe less than 4 inch diameter): ASTM B88, Type K, annealed:
 - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 - 2. Joints: Compression connection or AWS A5.8, BCuP silver braze.
- C. PVC Pipe (For pipe less than 4 inch diameter): ASTM D 2241 SDR 17 for 250 psig rating.
 - 1. Fittings: ASTM D2466, PVC.
 - 2. Joints: ASTM D 3139 compression gasket ring.
- D. PVC Pipe: AWWA C900 Class 150:
 - 1. Fittings: Ductile or gray iron, AWWA C110, with mechanical joints.
 - 2. Joints: ASTM D3139 compression gasket ring.
- E. Marking Tape (for plastic pipe): Magnetic detectable conductor, clear plastic covering, imprinted with "Water Service " in large letters
- F. Trace Wire (for plastic pipe): 14 Ga. bare copper trace wire.

2.02 VALVES

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Gate Valves Up To 3 Inches:
 - 1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, post indicator, valve key, and extension box.
- C. Gate Valves 3 Inches and Over:
 - 1. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged ends, control rod, post indicator, valve key, and extension box.

2.03 PIPE NIPPLES FOR SCREWED CONNECTIONS

- A. Pipe Nipples for Screwed Connections Up to 3 Inches (75mm);
 - 1. Red Brass, Sch 80.ASTM B43

2.04 HYDRANTS

- A. Hydrants: Type as required by utility company.
- B. Hydrants: AWWA C502, UL 246, dry barrel type.
 - 1. Inside dimension: 7 inches minimum, with minimum 5 inches diameter valve seat opening.
- C. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.
- D. Finish: Primer and two coats of enamel in color required by utility company.

2.05 BEDDING AND COVER MATERIALS

- A. Pipe Bedding Material: Sand or granular fill as specified in Section 31 2323 - Fill.
- B. Pipe Cover Material: Structural fill under pavements, slabs-on-grade, and similar construction as specified in Section 31 2323 - Fill.
- C. Pipe Cover Material: General fill under lawns as specified in Section 31 2323 - Fill.

2.06 ACCESSORIES

- A. Concrete for Thrust Restraints: 2000 psi at 28 days.
- B. Trace Wire for Non-metallic Pipe: 14 Gage bare copper wire.

PART 3 EXECUTION

3.01 SANITARY AND SAFETY HAZARDS

- A. The operating routine shall include necessary protective measures to detect and remove or destroy any contaminant of concern or regulation that might enter the distribution system. Every precaution must be taken against the possibility of sewage contamination of the water in the distribution system. Water mains and sanitary sewers shall be constructed as far apart as practicable, and shall be separated by undisturbed and compacted earth. A minimum horizontal distance of ten feet shall be maintained between water lines and sewer lines or other sources of contamination. Water lines and sewers shall not be laid in the same trench, except on the written approval of the Arkansas Department of Health. Water mains necessarily in close proximity to sewers shall be placed so that the bottom of the water line is at least 18 inches above the top of the sewer line at its highest point. If this distance must unavoidably be reduced, the water line or the sewer line shall be encased in watertight pipe with sealed watertight ends extending at least ten feet either side of the crossing. Any joint in the encasement pipe shall be mechanically restrained. The encasement pipe may be vented to the surface if carrying water or sewer under pressure. Where a water line must unavoidably pass beneath the sewer line, at least 18 inches of separation shall be maintained between the outside of the two pipes in addition to the preceding encasement requirement. Exceptions to this shall be approved in writing by the Arkansas Department of Health.
- B. A minimum horizontal distance of three feet shall be maintained between water lines and other underground utilities of a non-sanitary nature (gas, electric, etc.). Exceptions to this shall be approved in writing by the Arkansas Department of Health.

3.02 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.03 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.04 INSTALLATION - PIPE

- A. Separation Of Water And Sewer Lines:
 - 1. Water and sewer lines shall have a 10'0" horizontal separation.
 - 2. Where water and sewer lines cross, an 18 inch vertical separation shall be made between the top of the lower pipe and the bottom of the upper pipe.
 - 3. The water line shall be above the sewer line if possible.
- B. Install pipe to indicated elevation to within tolerance of 5/8 inches.
- C. Install ductile iron piping and fittings in polyethylene encasement, per local utility company requirements, if any.
- D. Install ductile iron piping and fittings to AWWA C600.
- E. Route pipe in straight line.
- F. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- G. Install access fittings to permit disinfection of water system performed under Section 33 0110.58.
- H. Install trace wire for non-metallic pipe 6 inches above top of pipe. Pull trace wire up in valve and meter boxes.

- I. Install marking tape 12" below finished grade in lawn areas and under walks; 6" below bottom of pavements.

3.05 INSTALLATION - VALVES, HYDRANTS, BACKFLOW PREVENTERS

- A. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway in accordance with Section 21 1100.
- B. Set hydrants to grade, with nozzles at least 20 inches above ground in accordance with Section 21 1100.
- C. Provide a drainage pit with 6 cu. ft. of washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.
- D. Provide a drainage pit 36 inches square by 24 inches deep filled with 2 inches washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.
- E. Paint hydrants in accordance with Section 09 9113.

3.06 SERVICE CONNECTIONS

- A. Provide water service to utility company requirements with reduced pressure backflow preventer and water meter with bypass valves and sand strainer.

3.07 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

3.08 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform field inspection and testing in accordance with Section 01 4000.
- C. Perform hydrostatic pressure and leakage test of the system to 225 psi. for not less than two (2) hours in accordance with AWWA C600. Repair leaks and re-test piping sections that fail the test.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

END OF SECTION

SECTION 33 3113
SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Sanitary sewerage drainage piping, fittings, and accessories.
- B. Connection of building sanitary drainage system to municipal sewers.
- C. Cleanout access.

1.03 DESCRIPTION OF WORK

- A. Exterior sanitary sewer system work is shown on the drawings and includes all pipe, manholes, fittings and other items required to provide service from 5 feet outside of building to tie in with local utility lines, unless shown otherwise.

1.04 RELATED REQUIREMENTS

- A. Section 31 2316 - Excavation: Excavating of trenches.
- B. Section 31 2323 - Fill: Bedding and backfilling.
- C. Section 33 0561 - Concrete Manholes.

1.05 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.06 REFERENCE STANDARDS

- A. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- B. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe; 2018.
- C. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes; 2020.
- D. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- E. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2009.
- F. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 1998 (Reapproved 2005).
- G. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.
- H. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.
- I. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material; 2021.
- J. ASTM F1417 - Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air; 2011a.
- K. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- L. Little Rock Water Reclamation Authority Standards and Specifications, Latest Edition.

1.07 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.08 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories.
- C. Tests: Pressure test results of sewer lines.
- D. Project Record Documents:
 - 1. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. Cast Iron Soil Pipe: ASTM A74, service type, inside nominal diameter of 4 inches hub and spigot end.
- C. Joint Seals for Cast Iron Pipe: ASTM C564 rubber gaskets.
- D. Ductile Iron Pipe: ASTM A 746, Thickness Class 50 or 51, with cement mortar lining, bell and spigot end.
- E. Joint Seals for Ductile Iron Pipe: AWWA C111/A21.11; styrene butadiene rubber (SBR) or vulcanized SBR gaskets.
- F. Lining for Ductile Iron Pipe: Ceramic epoxy coating equal to PROTECTO 401, by Induron.
- G. PVC Pipe (for 4" pipe): ASTM D 3034 SDR 21 for 200 psig rating.
 - 1. Fittings: ASTM D 3034, PVC.
 - 2. Joints: ASTM D 3213 push-on gasket.
- H. Plastic Pipe: ASTM D 3034, Type PSM, SDR26, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter of 6 inches, bell and spigot style gasketed joints.
- I. Plastic Pipe: ASTM D 3034, Type PSM, SDR35, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter of 8 inches to 15 inches, bell and spigot style gasketed joints.
- J. Plastic Pipe: ASTM D3350, SDR 11, High Density Polyethylene (HDPE) material; inside nominal diameter of 6 inches, with cell classification of 335434C or better, thermal butt fusion joints and fittings in accordance with manufacturer's recommendations; pipe and fittings same material utilizing transition fittings when connecting to existing piping.
- K. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, and other configurations required.
- B. Cleanouts: Cleanout ferrule with plug shall be equal to Wade #8550 E.

2.03 BEDDING AND COVER MATERIALS

- A. Pipe Bedding Material: Granular fill as specified in Section 31 23 23 - Fill.
- B. Pipe Cover Material: Structural fill under pavements, slabs-on-grade, and similar construction as specified in Section 31 23 23 - Fill.
- C. Pipe Cover Material: General fill under lawns as specified in Section 31 23 23 - Fill.

PART 3 EXECUTION

3.01 GENERAL

- A. Perform work in accordance with applicable code(s).

3.02 TRENCHING

- A. Bottom Of Trenches: Remove and replace all unstable soil or rubble fill encountered at bottom of trench with thoroughly consolidated bedding material. Keep trench clear of water at all times. Allow 6 inches over-excavation for bedding under pipe.
- B. Backfill around sides and to 6 inches over top of pipe with bedding for plastic pipes or cover fill for metallic pipe in 6" maximum lifts, tamp fill under pipe haunches and compact, then complete backfilling.

3.03 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building sanitary sewer outlet and municipal sewer system .

3.04 INSTALLATION - CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for cast iron riser.
- C. Establish elevations and pipe inverts for inlets and outlets as indicated.
- D. Mount cleanout ferrule in bell end of cast iron soil pipe riser level at finished grade. Install 4" cleanouts on 4" piping and 6" cleanouts on 6" and larger piping.
- E. Secure cleanout top with a 2' diameter x 6" thick concrete pad at grade in lawn areas

3.05 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 4000.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Pressure Test: Test in accordance with ASTM F1417.
- D. Deflection Test: After the sewer line has been laid and backfilled, the Contractor shall pull a mandrell through the line without a mechanical pulling device. The maximum deflection allowable shall not exceed 5 percent of the internal pipe diameter.

3.06 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 4211
STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Stormwater drainage piping.
- B. Stormwater pipe accessories.

1.03 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for drainage structure construction.
- B. Section 31 2316 - Excavation: Excavating of trenches.
- C. Section 31 2323 - Fill: Bedding and backfilling.
- D. Section 33 0561 - Concrete Manholes.

1.04 REFERENCE STANDARDS

- A. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-MM (12- to 60-in.) Diameter; 2018.
- B. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- C. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2020.
- D. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric); 2020.
- E. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2021.
- F. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- G. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.
- H. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.
- I. ASTM F2648 - Standard Specification For 2 to 60 inch Annular Corrugated Profile Wall Polyethylene Pipe Fittings for Land Drainage Applications, Latest Edition
- J. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material; 2021.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories, and drainage structure castings.
- C. Project Record Documents:
 - 1. As-built storm drainage documents for the City of Little Rock Public Works Department showing location of pipe runs, connections, catch basins, curb inlets, junction boxes , and other structures with top elevations, invert elevations, and incoming pipe elevations. All structures shall be tied to PAGIS and be forwarded to Public Works in the format required by them.
- D. Project Record Documents:
 - 1. Record location of pipe runs, connections, catch basins, cleanouts, and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 STORMWATER PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. Cast Iron Soil Pipe: ASTM A74, Service grade, inside nominal diameter as indicated (4 inch to 15inch), hub and spigot end.
- C. Concrete Pipe: Reinforced, ASTM C76 (ASTM C76M), Class III with Wall type B; mesh reinforcement; inside nominal diameter as indicated (12 inch and larger), bell and spigot end joints.
- D. Plastic Pipe: ASTM D 3034, SDR 26, Type PSM, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter as indicated (4 inch to 15 inch), with bell and spigot gasketed joints.
- E. Plastic Pipe: ASTM F 679, PS 115, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter as indicated (18 inch to 48 inch), with bell and spigot gasketed joints.
- F. Corrugated Polyethylene Pipe: ASTM D3350, High Density Polyethylene (HDPE) corrugated wall pipe with integrally formed smooth liner, meeting the requirements of AASHTO M 294M Type S; inside nominal diameter as indicated (12 inch to 60 inch), with bell and spigot gasketed joints.
- G. Corrugated Polyethylene Pipe: ASTM F2648, High Density Polyethylene (HDPE) corrugated wall pipe with integrally formed smooth liner, meeting the requirements of ASTM F477: inside nominal diameter as indicated for 4 to 60 inch, with bell and spigot gasketed joints.
- H. Where required, other types of pipes will be called out on the Drawings.

2.02 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, and other configurations required.

2.03 DRAINAGE STRUCTURE COMPONENTS

- A. Precast concrete shall conform to ASTM C 478 or ASTM C 913.
- B. Castings shall comply with ASTM A 48, Class 30, true in form and dimensions, free from defects affecting strength. Machine fit and mark bearing surfaces between frames and covers or grates to prevent rocking.
- C. Concrete: Cast-in-place concrete of type specified in Section 033000.

2.04 BEDDING AND COVER MATERIALS

- A. Bedding: Sand as specified in Section 31 23 23 - Fill.
- B. Pipe Cover Material: Structural fill under pavements,slabs-on-grade, and similar construction as specified in Section 31 23 23 - Fill.
- C. Pipe Cover Material: General fill under lawns as specified in Section 31 23 23 - Fill.

PART 3 EXECUTION

3.01 TRENCHING

- A. Bottom Of Trenches: Remove and replace all unstable soil or rubble fill encountered at bottom of trench with thoroughly consolidated bedding material. Keep trench clear of water at all times. Allow 6 inches over-excavation for bedding under pipe.
- B. Backfill around sides and to 6 inches over top of pipe with bedding material for plastic pipes or cover fill for metallic or concrete pipe in 6" maximum lifts, tamp fill under pipe haunches and compact, then complete backfilling.

3.02 INSTALLATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection in accordance with Section 01 4000 - Quality Requirements.

3.04 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION