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Omaha, NE 68114-2334

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OPPD

**Omaha Public Power District
Training Facility Phase 2**

7264 L Road
Nebraska City, NE 68410

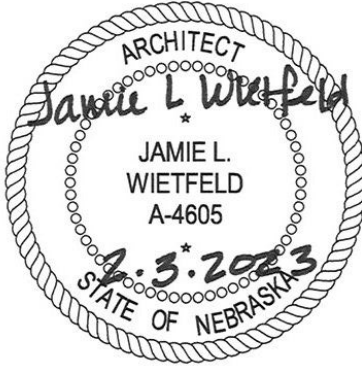
**Project Manual
Combined Contract**

BCDM Project Number: 5396-00
3 February 2023



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**Omaha Public Power District
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**SECTION 00 31 32
GEOTECHNICAL DATA**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Subsurface exploration report.
- B. General: The subsurface exploration report has been prepared for this site by Thiele Geotech Inc. The report is dated November 2, 2020 and is numbered TG Project No. 20600.00 and is included at the end of this section.
- C. Use of Data: This report is not a warranty of subsurface conditions or the continuity of such conditions between soil borings. The Contractor shall visit the site and acquaint himself with all existing conditions. This report provides recommendations for the construction of footings, foundations and grade supported slabs. Earthwork recommendations are also included. The Contractor shall perform the work in accordance with this report as well as Specification Section 31 20 00 - Earthwork and the Civil Drawings.

1.03 QUALITY ASSURANCE

- A. A soils engineer will be retained by the Contractor to observe performance of work in connection with excavating, trenching, filling, backfilling, and grading.
- B. Adjustment of Work: Readjust all work performed that does not meet technical or design requirements, but make no deviations from the Contract Documents without specific approval from the Architect.

PART 2 PRODUCTS (NOT USED)

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END OF SECTION



Geotechnical Exploration Report

OPPD Training Building

**7264 L Road
Nebraska City, Nebraska**

Prepared for:

Omaha Public Power District
444 South 16th Street Mall
Omaha, NE 68102

November 2, 2020

TG Project No. 20600.00



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Geotechnical Exploration Report
OPPD Training Building

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INTRODUCTION

Thiele Geotech, Inc. has completed a geotechnical exploration study for the proposed OPPD Training Building to be located at 7264 L Road in Nebraska City, Nebraska. The purpose of this study was to identify the general soil and ground water conditions underlying the site; to evaluate engineering properties of the existing soils; to provide earthwork and site preparation recommendations; and to recommend design criteria and parameters for foundations, pavements, and other earth supported improvements.

This study included soil borings, laboratory testing, and engineering analysis. A series of four test borings was spaced across the project site at strategic locations. The field and laboratory data are presented in the Appendix, along with a description of investigative methods.

The drilling and testing performed for this study were conducted solely for geotechnical analysis. No analytical testing or environmental assessment has been conducted. Any statements or observations in this report regarding odors, discoloration, or suspicious conditions are strictly for the information of our client. If an evaluation of environmental conditions is desired, a separate environmental assessment should be conducted. This study did not include biological assessment (e.g. mold, fungi, bacteria) or evaluation of measures for their control.

It should also be noted that this report was prepared for design purposes only, and may not be sufficient for a contractor in bid preparation. Prospective contractors should evaluate potential construction problems on the basis of their own knowledge and experience in the local area and on similar projects, taking into account their own intended construction methods and procedures.

This report is an instrument of service prepared for use by our client on this specific project. The report may be duplicated as necessary and distributed to those directly associated with this project, including members of the design team and prospective contractors. However, the technical approach and report format shall be considered proprietary and confidential, and this report may not be distributed in whole or in part to any third party not directly associated with this project. By using and relying on this report, all other parties agree to the same terms, conditions, and limitations to which the client has agreed.

PROJECT DESCRIPTION

Our understanding of the project is based upon information provided by OPPD, Lamp Rynearson, and BCDM Architects.

The project consists of constructing a new training building for OPPD at their existing Nebraska City Station located at 7264 L Road. Paved parking and drives are also proposed surrounding the structure.

The building will be a single-story, slab-on-grade, metal structure with dimensions of 135 feet by 75 feet. Maximum column loads of 30 to 35 kips were provided. Maximum continuous wall loads of 2 kips per lineal foot are assumed. Based on the preliminary grading plan, fills ranging from 1 to 3 feet will be required to achieve a finished floor elevation of 925 feet. Exterior grading will be similar.

SURFACE AND SUBSURFACE CONDITIONS

SITE CONDITIONS

The project site is located near the northwest corner of the existing OPPD Nebraska City facility on the north side of L Road. This area currently consists of vacant grass-surfaced land with an existing gravel-surfaced drive running through the east part of the site. The topography of the site is relatively flat, with a shallow depression along the east side of the gravel drive.

LOCAL GEOLOGY

The project site lies within the geologic floodplain of the Missouri River. Alluvial soils within the floodplain generally consist of silts and clays near the surface. The deeper deposits typically consist of fine to coarse sand with interbedded clay layers. The alluvial deposits are underlain by Pennsylvanian limestone and shale that form the bedrock unit underlying the region. The depth to bedrock varies dramatically due to erosion within the Missouri River valley.

SOIL CONDITIONS

The soils encountered in the test borings generally consisted of man-placed fill overlying alluvium.

Man-placed fill was encountered at the surface of all four test borings, extending to depths ranging from 8.5 to 18 feet. The fill was generally described as a grayish brown, dry to moist, hard to very hard, lean clay. Based on an assumed Standard Proctor (ASTM D698), the fill appears to have been compacted on average to over 100 percent of the maximum dry density.

Alluvium was encountered beneath the fill in borings B-1, B-2, and B-3, extending to the termination depth of each. The alluvium was generally described as a gray, very moist, firm, silt, or a gray, very moist to wet, very loose to medium dense, silty sand or poorly graded sand with silt.

Ranges of engineering properties from laboratory tests on selected samples are presented in Table 1.

Table 1 - Laboratory Results

Soil Layer	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (tsf)	Standard Penetration Values (N)*	Classification (LL/PI)
Man-placed fill	9 to 19	105 to 125	1.6 to 5.1	--	CL (28/14)
Alluvium	15 to 30	96	--	4 to 15	ML, SM, SP-SM (visual)

* Standard Penetration Values are actual field recorded values and have not been corrected for hammer energy

GROUND WATER OBSERVATIONS

Ground water levels were observed in the borings as presented in Table 2. Note that ground water levels may fluctuate due to seasonal variations and other factors. The materials encountered in the test borings have relatively low permeabilities and observations over an extended period of time through use of piezometers or cased borings would be required to better define current ground water conditions.

Table 2 - Water Level Observations

Boring Number	Boring Elevation (ft.)	Water Level (ft. below grade)		Ground Water Elevation (ft.)
		During Drilling	End of Drilling	
B-1	923	15.5	None Encountered	907.5
B-2	924	23.0	None Encountered	901

Ground water observations were made in the borings both during and after completion of drilling operations. The borings were drilled with hollow stem augers limiting observation during drilling operations. Upon removal of the augers, partial filling of the boring occurred due to the loss of cuttings into the boring. Water level observations taken after completion of the borings were limited to the remaining depth of the open boring. The water level observations include the condition observed (such as cave in) and the depth to which the observations could be made.

ANALYSIS AND RECOMMENDATIONS

GENERAL

A relatively thick layer of man-placed fill was encountered in all of the borings conducted for this project. These soils displayed high density and compressive strength properties and appeared to be placed in a controlled manner. Support of the proposed structure on shallow foundations is recommended in accordance with the Shallow Foundations section.

Roughly 3 feet of new fill is expected in limited areas in and around the building pad. The deeper alluvial soils are moderately compressible, and the weight of added fill will cause some settlement. Due to the limited aerial extent of the fill, the settlement will occur fairly quickly due to lateral drainage effects. We recommend that a minimum delay of one week be allowed after the building pad is graded before beginning construction of foundations or underfloor utilities.

As previously mentioned, the existing fill layer is very dense and well compacted. While the hard, compacted soil is good for support of buildings and pavements, this condition can result in minor problems with perched moisture near the ground surface. The fill is relatively impervious, but the upper 12 to 18 inches will develop a blocky, fissured structure after a few freeze-thaw cycles. This weathered layer will permit surface water to infiltrate and migrate along these fissures, but the deeper unweathered fill will prevent the moisture from percolating away. This can result in weeps from pavement joints and seepage from landscaped areas onto pavements. The available moisture can also exacerbate frost heave of sidewalks and pavements during the winter, especially on the north and east sides of the building. Excessive moisture around the root ball can also result in tree kill for transplanted trees. To minimize these problems, it is important to maintain very good surface drainage and prevent ponding in landscaped or lawn areas. Lawn irrigation should also be controlled and limited to the minimum amount necessary to maintain vegetation. However, problems associated with perched surface water cannot be entirely eliminated, and some effects from this condition are likely to manifest during the life of the constructed facility.

EARTHWORK AND EXCAVATIONS

Rubble and waste materials from site clearing should be removed from the site and lawfully disposed or recycled. Waste materials should not be buried on-site. Where trees are cleared, the stumps should be excavated and removed.

Relocation of any existing utility lines within the zone of influence of proposed construction areas should also be completed as part of the site preparation. The lines should be relocated to areas outside of the proposed construction. Excavations created by removal of the existing lines should be cut wide enough to allow for use of heavy construction equipment to recompact the fill. In addition, the base of

the excavations should be evaluated by a geotechnical engineering representative prior to placement of fill.

Topsoil and vegetation should be stripped to a depth of 4 to 6 inches in areas to be disturbed during grading, including borrow and fill areas. Stripping depths will likely vary and should be adjusted to remove all vegetation and root systems. A representative of the geotechnical engineer should monitor the stripping operations to observe that all unsuitable materials have been removed. Care should be exercised to separate these materials to avoid incorporation of the organic matter in structural fill sections.

Surfaces to receive fill should be broken up and recompacted to allow new fill to bond to the existing soil. Slopes steeper than 5H:1V should be benched before placing fill.

The excavated site soils will generally be suitable for reuse as structural fill, although some moisture conditioning may be required. Any off-site borrow should be a clean, inorganic silt or lean clay with a liquid limit less than 45 and a plasticity index less than 20. Borrow material should not contain an appreciable amount of roots, rock, or debris, and should not contain any foreign material with a dimension greater than 3 inches.

All fills should be placed and compacted as structural fill. Fill should be placed in thin lifts not to exceed 8 inches loose thickness. Structural fill should be compacted with a sheepsfoot type roller to a minimum of 95 percent of the maximum dry density (ASTM D698, Standard Proctor). Moisture content should be controlled to between -3 and +4 percent of optimum.

Backfill soils in utility trenches should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum. Lift thicknesses should be appropriately matched to the type of compaction equipment used. Backfill soils around foundations, basement walls, and retaining walls should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum. Granular backfill should not be used in exterior trenches or around foundation elements.

Quality control testing is an important part of any earthwork operation. It is recommended that a representative of the geotechnical engineer periodically monitor earthwork operations to verify proper compliance with these recommendations, including compaction levels.

OSHA's Construction Standards for Excavations require that the contractor's excavation activities follow certain worker safety procedures. These include a requirement that excavations over 4 feet deep be sloped back, shored, or shielded. The soils encountered in the test borings generally classify as type B and C soils according to the OSHA standard. The maximum allowable slope for an unbraced excavation in these soils is 1H:1V and 1.5H:1V, respectively, although other provisions and restrictions apply. Excavations over 20 feet deep require specific design by a licensed Professional Engineer. The

contractor is solely responsible for site/excavation safety and compliance with OSHA regulations. The geotechnical engineer assumes no responsibility for site safety, and the above information is provided only for consideration by the designers.

SHALLOW FOUNDATIONS

The site conditions identified are favorable for the use of conventional spread foundations to support structural loads. Based on our bearing capacity and settlement analysis, a net allowable bearing pressure of 2,500 pounds per square foot was determined. This allowable bearing pressure may be used to size wall footings and column pads. The bearing pressure was calculated based on a safety factor of 3 against bearing failure. Foundation settlements are estimated at less than 1 inch total and ½ inch differential over a span of 20 feet. If maximum design loads significantly exceed 35 kips for columns or 2 kips per foot for walls, these bearing pressures may not be applicable and should be reevaluated.

It is recommended that column footings be at least 3 feet square and that load bearing wall footings be at least 16 inches wide. Exterior footings and footings in unheated areas should be founded a minimum of 3.5 feet below adjacent grade to provide reasonable frost protection. It is recommended that all footings be steel reinforced.

The condition of the bearing soils can vary and should be observed by the geotechnical engineer at the time of excavation. If unsuitable bearing soils are identified, they should be improved by compaction or replaced by structural fill. As an alternative, the footing bottom could be extended through unsuitable materials if suitable material is present below.

SEISMIC SITE CLASS

Seismic structural design requirements are dictated by a site classification based on average soil properties within the top 100 feet. Based on our local experience, the soil profile was estimated below the maximum boring depth. The average undrained shear strength was then estimated based on the actual laboratory testing and on assumed soil properties for the deeper soil profile.

The site classifies as Site Class D (stiff soil profile) according to Table 1613.3.3 of the 2012 International Building Code.

FLOOR SLABS

To avoid localized slab failures, it is important that interior backfill around foundation elements and in plumbing trenches be properly compacted. Interior backfill should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D698, Standard Proctor).

To provide uniform support for floor slabs, the upper 6 inches of the subgrade should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent

of optimum (ASTM D698, Standard Proctor). Care should be taken to maintain the condition of the subgrade. Areas that become saturated, frozen, or disturbed should be reworked prior to slab placement. Any unstable areas should be excavated and replaced with structural fill. A granular cushion beneath the floor slab is considered a construction convenience and may be used, but is not considered critical to proper slab performance.

A 10 mil thick vapor retarder is recommended beneath the concrete to inhibit upward migration of moisture through the slab. Care should be taken when finishing concrete placed directly on a vapor retarder to minimize potential problems with curling and blistering.

Interior partition walls weighing up to 1,000 pounds per lineal foot may be supported directly on the floor slab. It is recommended that control joints be provided between partition walls that bear on the floor slab and walls supported on footings. Entrance slabs should be designed as structural stoops with a cavity beneath the slab to accommodate frost heave.

Contraction joints are important to control the location of cracks in the floor slab that result from stresses caused by normal drying shrinkage. Joints should be cut as soon as practical after the concrete has set sufficiently to support foot traffic, and must be cut before any shrinkage cracks form. Contraction joints should be cut to a minimum of $\frac{1}{4}$ of the slab thickness ($\frac{1}{5}$ of the thickness for early entry saw method). Joints should be spaced no more than 30 times the thickness of the slab or 15 feet maximum. Panels should be kept as square as possible, with the length to width ratio limited to 125 percent. Dowel bars should be used for load transfer across construction joints where slabs are subjected to heavy loads. Joints should be carefully planned and laid out to match column lines and to meet reentrant corners. Joints should be perpendicular to edges and should not form angles less than 45 degrees or over 225 degrees. To accommodate the relative movement that commonly occurs between floors and foundations, isolation joints should be provided against walls, and diamond or circular isolation joints should be constructed around columns.

PAVEMENTS

Pavement performance is directly affected by the degree of compaction, uniformity, and stability of the subgrade. This is particularly important where traffic from heavy trucks is anticipated. The final subgrade should be reworked and compacted immediately prior to pavement construction. The subgrade should then be proof rolled, and any unstable areas should be excavated and replaced to create a uniform and stable subgrade.

For concrete pavements, it is recommended that the upper 12 inches of the subgrade be compacted to a minimum of 90 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D1557, Modified Proctor). Subgrade preparation should extend a minimum of 2 feet laterally beyond the edge of the pavement.

For asphalt pavements, greater stability is required due to the extreme loading conditions placed on the subgrade during laydown. Subgrades for asphalt pavements should be prepared by compacting the upper 12 inches to a minimum of 92 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D1557, Modified Proctor). Subgrade preparation should extend a minimum of 2 feet laterally beyond the edge of the pavement, including the concrete curb and gutter section.

Under sidewalks, the upper 6 inches of the subgrade should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D698, Standard Proctor). Subgrade preparation should extend laterally 6 inches beyond the edge of the sidewalk.

Based on the forgoing subgrade preparation procedures, recommended minimum pavement thicknesses are provided in Table 3. These minimum thicknesses are prescriptive values based on traffic classification, and not on a detailed analysis using traffic counts. It should be noted that life cycle costs for concrete pavements are generally lower, despite their higher initial cost. Local experience has shown that well-constructed concrete pavements typically perform better, have lower maintenance costs, and have longer service lives than comparable asphalt pavements. Note that we do not recommend using an aggregate base as part of the pavement section due to concerns over drainage and freeze/thaw deterioration of the base material.

Table 3 - Minimum Pavement Thicknesses

Pavement Category	Pavement Type/Thickness (inches)	
	Concrete	Full Depth Asphalt
Sidewalks	4	--
Parking Areas	5	6
Drive Lanes (<i>concentrated traffic - occasional trucks</i>)	5	7
Medium Duty (<i>up to 3 trucks/day</i>)	6	8
Dumpster Pads (<i>including pickup area</i>)	7	--
<i>Subgrade Support Values: CBR = 3, k=120 pci</i> <i>Materials: (reference City of Omaha Standard Specifications for Public Works Construction, 2014 Edition)</i> <i>concrete - mix type L65 ($f'_c = 4,000$ psi) (Section 500)</i> <i>asphalt surface - mix type SPR w/ PG64-34 binder (Section 400)</i> <i>asphalt base - mix type SPR Coarse w/ PG64-34 binder (Section 400)</i>		

Contraction joints are important to control the location of cracks in concrete pavement that result from stresses caused by normal drying shrinkage and thermal effects. A proper jointing system will enhance structural capacity and prolong the life span of a concrete pavement as well as improve ride quality. Contraction joints should be cut to a minimum of $\frac{1}{4}$ of the slab thickness ($\frac{1}{5}$ of the thickness for early entry saw method). Joints should be cut as soon as practical after the concrete has set sufficiently to support foot traffic, and must be cut before any shrinkage cracks form. Joints should be spaced no more than 24 times the thickness of the slab or $12\frac{1}{2}$ feet maximum. Panels should be kept as square as possible, with the length to width ratio limited to 125 percent. Dowel bars should be used for load transfer across construction joints, and should be considered for contraction joints subjected to heavy truck traffic. Joints should be carefully planned and laid out to meet inlets, drainage structures, reentrant corners, and radiuses. Joints should be perpendicular to edges and radiuses, and should not form angles less than 45 degrees or over 225 degrees. Isolation joints should be provided around any structures.

We recommend that joints be sealed to reduce moisture infiltration and to reduce the accumulation of non-compressible materials. Joint sealing should be considered as a two part process, sealing of the exposed sawcut face of the concrete and sealing of the joint itself. Following sawcutting and cleaning the joints with compressed air, a penetrating concrete sealer (Silane, Silicate, or Silicate based) should be spray applied to the joint extending outwards a minimum of 8 inches either side of the sawcut. This penetrating sealer will help to limit moisture infiltration along the sawcut face, helping to mitigate premature joint damage from freeze-thaw cycles. Following the spray applied sealer, a hot pour joint sealer can be used to fill the sawcut. Use of backer rods is not recommended.

Backfill behind curbs and within islands/medians should consist of relatively impervious cohesive soils. Backfill should be compacted to a minimum of 95 percent of the maximum dry density (ASTM D698) to minimize subsidence and to reduce moisture infiltration around the edges of the pavement. Granular soils should not be used for fill in islands as this can increase infiltration into the subgrade. Porous fills, including granular material and loosely placed clay soils, also act as a reservoir that can allow moisture to seep through cracks and joints onto the pavement surface, sometimes long after the water is trapped. This condition is especially pronounced when loose backfill consolidates and allows surface water to pond.

SURFACE DRAINAGE AND LANDSCAPING

The long-term performance of any project is contingent upon keeping the subgrade soils at more or less constant moisture content, and by not allowing surface drainage a path to the subsurface. Positive surface drainage away from structures must be maintained at all times. Landscaped areas should be designed and built such that irrigation and other surface water will be collected and carried away from the structure.

Construction staging and grading should provide for removal of surface water from the site. If prolonged ponding of surface water occurs, removal and replacement of wet or disturbed soils may be necessary. Temporary grades should be established to prevent runoff from entering excavations or footing trenches. Backfill should be placed as soon as structural strength requirements are met, and should be graded to drain away from the building.

The final grade of the foundation backfill and any overlying pavements should have a positive slope away from foundation walls on all sides. For grass or landscape covered areas, a minimum slope of 1 inch per foot for 5 to 10 feet away from the building is recommended. A minimum slope of 2 percent is recommended for grassed or landscaped areas of the site away from the building. For paved areas, minimum slopes of 1 percent for concrete pavements and 1½ percent for asphalt pavements are recommended. Pavements and exterior slabs that abut the structure should be carefully sealed against moisture intrusion at the joint.

OTHER RECOMMENDATIONS

During detailed design, additional issues may arise and possible conflicts may occur with our recommendations. Such issues and conflicts should be resolved through dialogue between the geotechnical engineer and designers. It is recommended that the geotechnical engineer review the final design, including the plans and specifications, to verify that our recommendations are properly interpreted and incorporated into the design.

If any changes are made in the design of the project, including the nature or location of proposed facilities on the site or significant elevation changes, the analysis and recommendations of this report shall not be considered valid unless the changes are reviewed. The analysis and recommendations of this report should not be applied to different projects on the same site or to similar projects on different sites.

The analysis and recommendations in this report are based upon borings at specific locations. The nature and extent of variation between boring locations is impossible to predict. Because of this, geotechnical recommendations are preliminary until they have been confirmed through observation of site excavation and earthwork preparation. If variations appear during subsequent exploration or during construction, we may reevaluate our recommendations and modify them, if appropriate. The geotechnical engineer should be retained during construction to observe compliance with the recommendations of this report

and to provide quality control testing of earthwork construction. If these services are provided by others, including the contractor, the entity that provides construction phase observation and testing shares responsibility as the geotechnical engineer of record for implementing or modifying these recommendations.

Respectfully submitted,
Thiele Geotech, Inc.

Reviewed by,

Daniel J. Thiele, P.E.
Nebraska License E-6788

Prepared by,

Raeanna C. D. Thiele

Raeanna C. D. Thiele, P.E.
Nebraska License E-16864

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APPENDIX

Subsurface Exploration Methods

Legend of Terms

Boring Location Plan

Boring Logs

Soil Test Summary

SUBSURFACE EXPLORATION METHODS

The fieldwork for this study was conducted on October 23, 2020. The exploratory program consisted of four test borings drilled at the approximate locations shown on the Boring Location Plan. Boring locations were selected to provide the desired site coverage and were adjusted to accommodate access conditions. The boring locations were laid out using a handheld GPS unit with coordinates obtained from Google Earth. Elevations were interpolated from contours on the preliminary grading plan developed by Lamp Rynearson, dated October 23, 2020. The boring locations and elevations should only be considered accurate to the degree implied by the methods used to define them.

Test borings were advanced using flight augers powered by a truck-mounted drill rig. Soil samples were obtained at selected depths as indicated on the boring logs. A 3-inch nominal diameter thin-walled sampler was hydraulically pushed to obtain undisturbed samples. Disturbed samples were obtained by driving a 2-inch nominal diameter split barrel sampler while conducting standard penetration tests (SPT). The SPT values presented on the boring logs are actual field recorded numbers and have not been corrected for hammer energy or overburden.

The boring logs were prepared based on visual classification of the samples and drill cuttings, and by observation of the drilling characteristics of the subsurface formations. The logs have been supplemented and modified based on the laboratory test results and further examination of the recovered samples. The stratification lines on the boring logs represent the approximate boundary between soil types, but the insitu transition may be gradual.

Water level observations were made at the times stated on the boring logs. The borings were backfilled with drill cuttings at the completion of the fieldwork.

The field boring logs were reviewed to outline the depths, thicknesses, and extent of the soil strata. A laboratory testing program was then developed to further classify the basic soils and to evaluate the engineering properties for use in our analysis.

Laboratory tests to further classify the soils included visual classification, moisture content, dry unit weight, Atterberg limits, and fraction passing the #200 sieve. The shear strengths of cohesive samples were evaluated using the unconfined compression test.

The boring logs and related information in this report are indicators of subsurface conditions only at the specific locations and times noted. Subsurface conditions, including ground water levels, at other locations of the site may differ significantly from conditions that exist at the sampling locations. Also note that the passage of time may affect conditions at the sampling locations.

Soil Description Terms

Consistency - Fine Grained Very Soft, Soft, Firm, Hard, Very Hard	Consistency - Coarse Grained Very Loose, Loose, Medium Dense, Dense, Very Dense	Moisture Conditions Dry, Slightly Moist, Moist Very Moist, Wet (Saturated)
--	--	---

Sample Identification

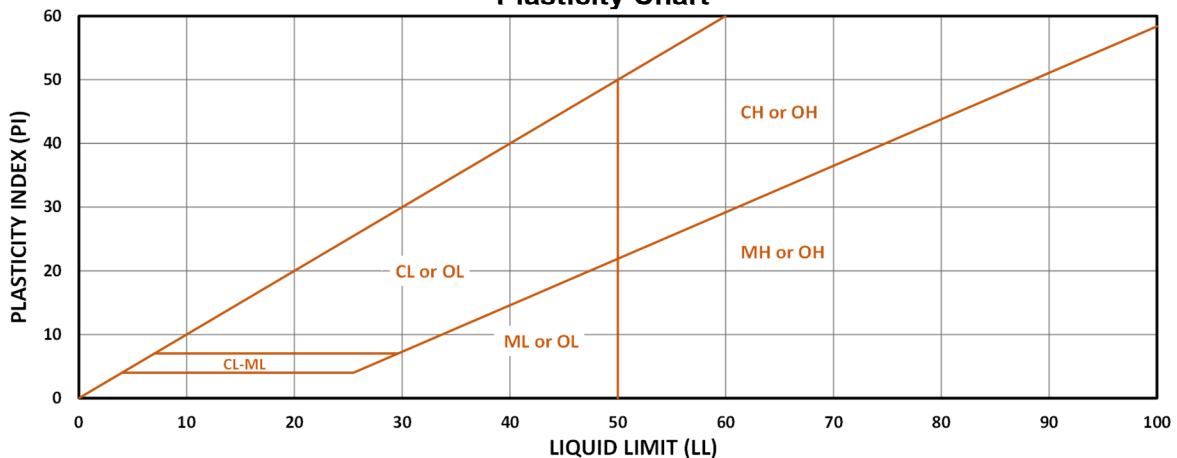
Sample Type U -- Undisturbed (Shelby Tube) S -- Split barrel (disturbed) C -- Continuous sample A -- Auger cuttings (disturbed)	Sample Data No. -- Number SPT -- Standard penetration test bpf -- blows per foot Rec -- Recovery	Laboratory Data MC -- Moisture content γ_d -- Dry unit weight q_u -- Unconfined compression LL/PI -- Liquid limit & plasticity index
--	---	--

Unified Soil Classification System

Peat	Pt	Highly organic soils	
Fat Clay	CH	Clay - Liquid Limit > 50 *	50% or more smaller than No. 200 sieve
Elastic Silt	MH	Silt - Liquid Limit > 50 *	
Lean Clay	CL	Clay - Liquid Limit < 50 *	More than 50% larger than No. 200 sieve and % sand > % Gravel
Silt	ML	Silt - Liquid Limit < 50 *	
Silty Clay	CL-ML	Silty Clay *	
Clayey Sand	SC	Sands with 12 to 50 percent smaller than No. 200 sieve *	More than 50% larger than No. 200 sieve and % sand > % Gravel
Silty Sand	SM		
Poorly-Graded Sand with Clay	SP-SC	Sands with 5 to 12 percent smaller than No. 200 Sieve *	More than 50% larger than No. 200 sieve and % gravel > % sand
Poorly-Graded Sand with Silt	SP-SM		
Well-Graded Sand with Clay **	SW-SC	Sands with less than 5 percent smaller than No. 200 sieve *	More than 50% larger than No. 200 sieve and % gravel > % sand
Well-Graded Sand with Silt **	SW-SM		
Poorly-Graded Sand	SP	Gravels with 12 to 50 percent smaller than No. 200 Sieve *	More than 50% larger than No. 200 sieve and % gravel > % sand
Well-Graded Sand **	SW		
Clayey Gravel	GC	Gravels with 5 to 12 percent smaller than No. 200 sieve *	More than 50% larger than No. 200 sieve and % gravel > % sand
Silty Gravel	GM		
Poorly-Graded Gravel with Clay	GP-GC	Gravels with less than 5 percent smaller than No. 200 sieve *	More than 50% larger than No. 200 sieve and % gravel > % sand
Poorly-Graded Gravel with Silt	GP-GM		
Well-Graded Gravel with Clay **	GW-GC	Gravels with less than 5 percent smaller than No. 200 sieve *	More than 50% larger than No. 200 sieve and % gravel > % sand
Well-Graded Gravel with Silt **	GW-GM		
Poorly-Graded Gravel	GP		
Well-Graded Gravel **	GW		

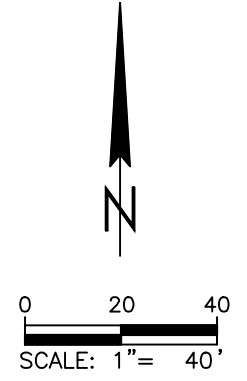
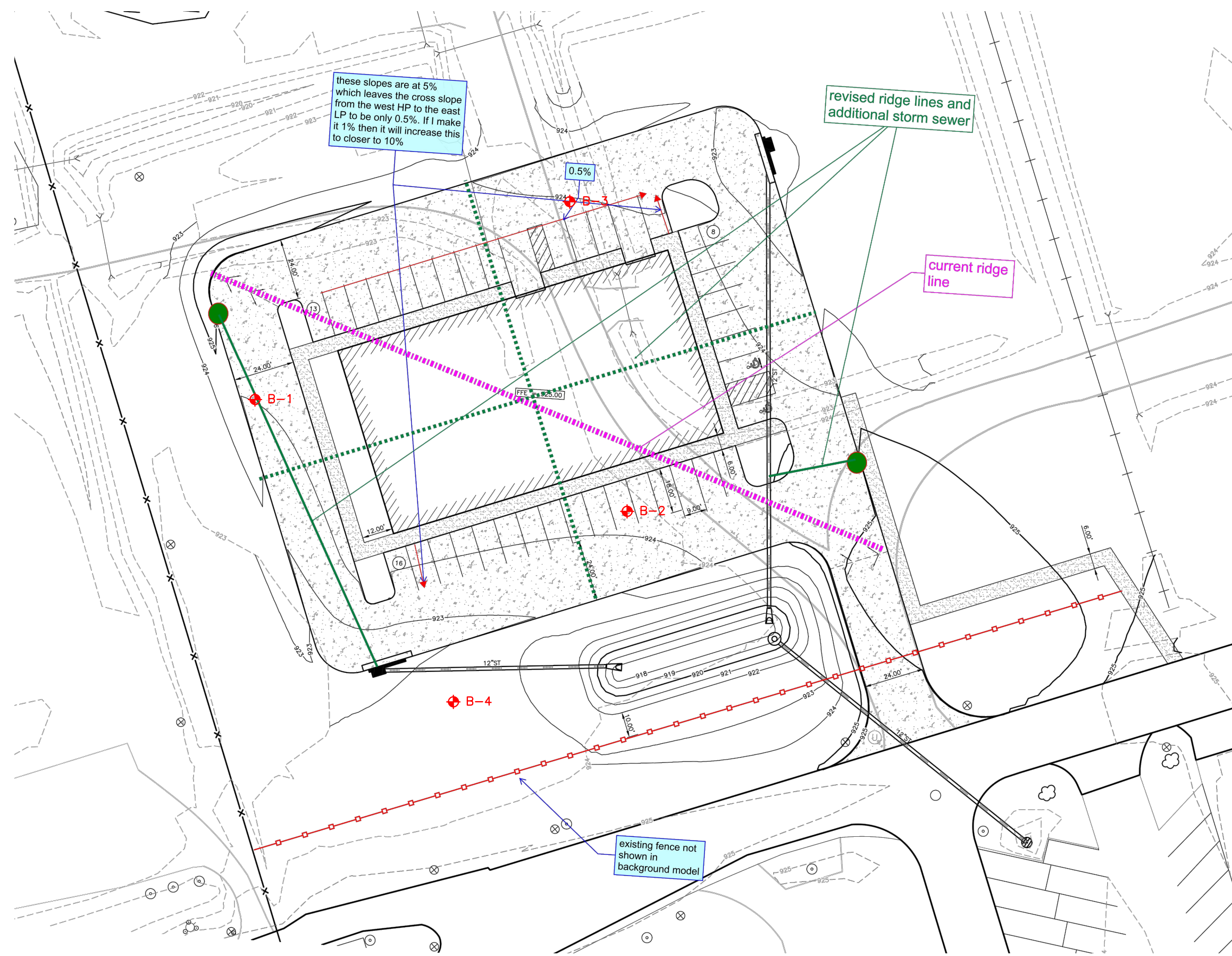
* See Plasticity Chart for definition of silts and clays
** See Criteria for Sands and Gravels for definition of well-graded

Plasticity Chart



Criteria for Sands and Gravels

Boulders	Cobbles	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	FINES (silt or clay)
Sieve size	12"	3"	3/4"	#4	#10	#40	#200
Well-graded sands (SW) $C_u = D_{60}/D_{10} \geq 6$ and $C_c = (D_{30})^2 / (D_{10} \times D_{60}) \leq 3$ and ≥ 1							
Well-graded gravels (GW) $C_u = D_{60}/D_{10} \geq 4$ and $C_c = (D_{30})^2 / (D_{10} \times D_{60}) \leq 3$ and ≥ 1							



LEGEND:

◆ BORING LOCATION



PROJECT
 OPPD TRAINING BUILDING
 7264 L ROAD
 NEBRASKA CITY, NE
 JOB # 20600.00 DATE: 10/23/20

BORING LOCATION PLAN



Thiele Geotech, Inc.
 13478 Chandler Road
 Omaha, NE 68138
 Telephone: 402-556-2171

BORING NUMBER B-1

CLIENT OPPD **PROJECT NAME** OPPD Training Building

PROJECT NUMBER 20600.00 **PROJECT LOCATION** 7264 L Road, Nebraska City, NE

DRILLING DATE 10/23/2020 **SURFACE** Grass **GROUND ELEVATION** 923 ft **BORING DEPTH** 25.0 feet

DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**

DRILLER Rick Jentz **DRILL RIG** CME 55 #48 **DURING DRILLING** 15.5 ft / Elev 907.5 ft

LOGGED BY Nick Phillips **CHECKED BY** Broc Burmeister **END OF DRILLING** None encountered, cave in at 14.6 ft

NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION						SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q _u (tsf)	ATTERBERG LIMITS			FINES CONTENT (%)
		MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0																		
0 - 5		slightly moist	grayish brown	very hard	lean clay	fill	trace sand	U-1	12			14.1	112.8		28	14	14	
5 - 10		moist					appreciable sand	U-2	12			18.0	110.0					
10 - 15		very moist	gray	firm	silt	alluvium	much sand	S-3		4		26.8						74.2
15 - 20					medium dense		fine grained	S-4		10		21.9						
20 - 25		wet						S-5		15		29.6						
25						poorly graded sand w/ silt		S-6		11		20.1						

Bottom of borehole at 25.0 feet.

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Thiele Geotech, Inc.
 13478 Chandler Road
 Omaha, NE 68138
 Telephone: 402-556-2171

BORING NUMBER B-2

CLIENT OPPD **PROJECT NAME** OPPD Training Building
PROJECT NUMBER 20600.00 **PROJECT LOCATION** 7264 L Road, Nebraska City, NE
DRILLING DATE 10/23/2020 **SURFACE** Grass **GROUND ELEVATION** 924 ft **BORING DEPTH** 25.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 55 #48 **DURING DRILLING** 23.0 ft / Elev 901.0 ft
LOGGED BY Nick Phillips **CHECKED BY** Broc Burmeister **END OF DRILLING** None encountered, cave in at 15.6 ft
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION						SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q _u (tsf)	ATTERBERG LIMITS			FINES CONTENT (%)	
		MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
0																			
		slightly moist	grayish brown	hard	lean clay	fill	appreciable sand, trace gravel	U-1	6			12.7	122.0	2.96					
5								U-2	12			14.2	117.3	2.80					
		moist		very hard															
10					hard				U-3	12			17.2	111.6	4.52				
15								U-4	6			16.2	107.2	1.59					
20		very moist	gray	very loose	silty sand	alluvium	fine grained	S-5		4		20.1						19.9	
25		wet		medium dense				S-6		10		27.9							

Bottom of borehole at 25.0 feet.

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Thiele Geotech, Inc.
 13478 Chandler Road
 Omaha, NE 68138
 Telephone: 402-556-2171

BORING NUMBER B-3

CLIENT OPPD **PROJECT NAME** OPPD Training Building
PROJECT NUMBER 20600.00 **PROJECT LOCATION** 7264 L Road, Nebraska City, NE
DRILLING DATE 10/23/2020 **SURFACE** Grass **GROUND ELEVATION** 923.5 ft **BORING DEPTH** 10.0 feet
DRILLING METHOD Flight **HOLE SIZE** 6 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 55 #48 **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Broc Burmeister **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION						SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q _u (tsf)	ATTERBERG LIMITS			FINES CONTENT (%)
		MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		dry	grayish brown	very hard	lean clay	fill	appreciable sand											
								U-1	7			9.4	124.7	5.09				
		slightly moist						U-2	10			12.0	119.3	3.81				
5																		
		moist		hard				U-3	10			19.3	108.5	1.94				
10																		

Bottom of borehole at 10.0 feet.



Thiele Geotech, Inc.
 13478 Chandler Road
 Omaha, NE 68138
 Telephone: 402-556-2171

BORING NUMBER B-4

CLIENT OPPD **PROJECT NAME** OPPD Training Building

PROJECT NUMBER 20600.00 **PROJECT LOCATION** 7264 L Road, Nebraska City, NE

DRILLING DATE 10/23/2020 **SURFACE** Grass **GROUND ELEVATION** 923.5 ft **BORING DEPTH** 10.0 feet

DRILLING METHOD Flight **HOLE SIZE** 6 inches **GROUND WATER LEVELS:**

DRILLER Rick Jentz **DRILL RIG** CME 55 #48 **DURING DRILLING** None encountered

LOGGED BY Nick Phillips **CHECKED BY** Broc Burmeister **END OF DRILLING** None encountered

NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION						SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q _u (tsf)	ATTERBERG LIMITS			FINES CONTENT (%)
		MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0																		
		slightly moist	grayish brown	hard	lean clay	fill	appreciable sand	U-1	12			10.7	106.6					
		moist						U-2	12			18.9	104.7	1.71				
5																		
		very moist	gray	medium dense	silty sand	alluvium	fine grained	U-3	12			15.3	95.8					
10																		

Bottom of borehole at 10.0 feet.



Thiele Geotech, Inc.
 13478 Chandler Road
 Omaha, NE 68138
 Telephone: 4025562171

SUMMARY OF LABORATORY RESULTS

CLIENT OPPD

PROJECT NAME OPPD Training Building

PROJECT NUMBER 20600.00

PROJECT LOCATION 7264 L Road, Nebraska City, NE

Boring Number	Sample Number	Depth	Water Content (%)	Unit Weight		Void Ratio	Sat. (%)	Unconfined Compression		Atterberg Limits		%<#200 Sieve	Class.	Other Tests
				Wet Density (pcf)	Dry Density (pcf)			q _u (tsf)	Strain (%)	LL	PI			
B-1	U-1	0.5-2.0'	14.1	128.7	112.8	0.493	77			28	14		CL	
	U-2	3.5-5.0'	18.0	129.8	110.0	0.531	91							
	S-3	8.5-10.0'	26.8									74.2	ML	
	S-4	13.5-15.0'	21.9											
	S-5	18.5-20.0'	29.6											
	S-6	23.5-25.0'	20.1											
B-2	U-1	0.5-2.0'	12.7	137.5	122.0	0.381	90	2.96	6.1					
	U-2	3.5-5.0'	14.2	134.0	117.3	0.436	88	2.80	8.0					
	U-3	8.5-10.0'	17.2	130.7	111.6	0.510	91	4.52	6.1					
	U-4	13.5-15.0'	16.2	124.6	107.2	0.572	77	1.59	10.1					
	S-5	18.5-20.0'	20.1									19.9	SM	
	S-6	23.5-25.0'	27.9											
B-3	U-1	0.5-2.0'	9.4	136.4	124.7	0.351	72	5.09	6.3					
	U-2	3.5-5.0'	12.0	133.6	119.3	0.413	79	3.81	11.0					
	U-3	8.5-10.0'	19.3	129.4	108.5	0.553	94	1.94	9.9					
B-4	U-1	0.5-2.0'	10.7	118.0	106.6	0.580	50							
	U-2	3.5-5.0'	18.9	124.5	104.7	0.609	84	1.71	11.1					
	U-3	8.5-10.0'	15.3	110.5	95.8	0.758	54							



DIVISION 01 – GENERAL REQUIREMENTS

**SECTION 01 10 00
SUMMARY**

PART 1 GENERAL

1.01 WORK UNDER THIS CONTRACT INCLUDES:

- A. All material, labor, tools, expendable equipment, transportation and utility services, and all incidental items necessary to perform and complete, in a workmanlike manner, the Work required for the Combined Construction, including General, Mechanical and Electrical Work, for the OPPD Training Building Phase 2.

1.02 WORK BY OTHERS (VIA THE OWNER)

- A. Work furnished, installed and/or accomplished by the Owner or Others includes the following:
 - 1. Furnishings and other interior movable equipment items not specified herein.
 - 2. Technical and Special Equipment.
 - 3. Other items as may be noted on the Drawings or specified herein.

1.03 UTILITY COMPANY CHARGES

- A. All utility company charges and fees related to permanent service shall be paid by the Owner or the Contractor as outlined in the Mechanical and Electrical Specifications. See Section 01 50 00 - Temporary Facilities and Controls for the division of responsibility for payment of utility costs for energy used during construction.

1.04 SEQUENCE AND SCHEDULING OF THE WORK SHALL BE IN ACCORD WITH THE FOLLOWING:

- | | |
|---------------------------|------------------|
| A. Receipt of Bids | March 3, 2023 |
| B. Substantial Completion | October 2, 2023 |
| C. Final Completion | October 31, 2023 |

1.05 WORK SEQUENCE

- A. The Contractor shall review the building and shall prepare a work sequence of events and major milestones. All events and milestones shall be reflected in a project schedule to be submitted to the Architect and Owner for review. Submit project schedule for review no later than 30 days following the Notice to Proceed.

1.06 CONSTRUCTION SCHEDULES

- A. If Contractor fails to adhere to the Construction Schedule, including accepted revisions, the Contractor shall promptly adopt such other or additional means and methods of construction as will make up the time lost and complete the Work in accordance with the Construction Schedule, at no additional cost to the Owner, except as specifically provided in the Contract.
- B. If the Owner notifies the Contractor of any change in the Contract, or if conditions arise which are likely to cause or are actually causing delays, the Contractor shall notify the Owner and Architect, in writing, within 5 days of such notice or the occurrence of such condition. This notice shall document the effect, if any, of such change or condition upon the Construction Schedule, with the reason therefore.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 23 00
ALTERNATES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 ALTERNATES

- A. ALTERNATE NO. 1 - Under this alternate, deduct the installation of data cabling, jacks, faceplates and cabling terminations, testing, and labeling. Work to be completed by OPPD Tech Group.

General / Low Voltage Contractor responsible for build out of Data Room, overhead ladder runway, racks, patch panels, managers, fiber panels, fiber, grounding, etc. as part of the Base Bid.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 25 00
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for requests for substitutions by the Contractor that do not require modification of Contract Sum or Contract Time.

1.03 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction proposed by the Contractor after award of the Contract and that do not require modification of Contract Sum or Contract Time are considered to be requests for substitutions.
- B. The following are not considered to be requests for substitutions:
 - 1. Substitutions requested during bidding, and accepted by Addendum prior to award of the Contract.
 - a. Substitutions requested during bidding period must be submitted no later than 14 calendar days prior to date of bid opening.
 - 2. Specified choices of products and options included in the Contract Documents.

1.04 SUBMITTALS

- A. Substitution Request Submittal: Submit the following:
 - 1. Submit 2 copies of each request for substitution for consideration.
 - 2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
 - 3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work that will be necessary to accommodate the proposed substitution.
 - b. A comparison of qualities of the proposed substitution with those of the Work specified.
 - c. Product Data, including Drawings and fabrication and installation procedures.
 - d. Samples, where applicable or requested.
 - 4. Engineer/Architect Action: If necessary, the Engineer/Architect will request additional information or documentation for evaluation. The Engineer/Architect will notify the Contractor of acceptance or rejection of the substitution in the form of a letter from the Engineer/Architect.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. The Architect will receive and consider the Contractor's request for substitution only when all of the following conditions are satisfied:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are In keeping with the general intent of the Contract Documents.
 - 3. The request is timely, fully documented, and properly submitted.
- B. Requests for substitutions must be based on at least one of the following conditions:
 - 1. The request is directly related to an "or-equal" clause in the Contract Documents.
 - 2. The specified product cannot be provided within the Contract Time.
 - 3. The specified product cannot receive necessary approval by a governing authority.

OPPD Training Building Phase 2

- 4. The specified product cannot be provided in a manner that is compatible with other materials.
- C. The Architect/Engineer's acceptance of Shop Drawings, Product Data, or Samples not complying with the Contract Documents does not constitute a valid request for substitution, nor do they constitute approval.
- D. It shall be the responsibility of the Mechanical Contractor to coordinate with the Electrical Contractor on all electrical requirements for the equipment prior to ordering. All requirement changes shall be the responsibility of the Mechanical Contractor/Supplier at no additional cost to the project.

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SUMMARY

- A. Section 00 50 00 - Construction Services Contract
 - 1. Applications for Payment
 - 2. Supplemental Off-Site Storage Agreement
 - 3. Consent of Surety to Reduction in or Partial Release of Retainage
 - 4. Consent of Surety to Final Payment
 - 5. Contractor's Affidavit of Payment of Debts and Claims
 - 6. Certification of Unemployment Compensation Contributions
 - 7. Contractor's Affidavit of Release of Liens
 - 8. Release or Waiver of Liens from Subcontractors and Suppliers
 - 9. Performance and Payment Bond
- B. Section 01 40 00 - Quality Requirements
 - 1. Testing Reports
 - 2. Receipts from Testing Payments
- C. Section 01 78 00
 - 1. Inspection Certificates
 - 2. Extra Stock
 - 3. Specified Product Warranties as listed in that Section
 - 4. Water System Disinfection Reports
 - 5. Operating and Maintenance Manuals
 - 6. Performance Test Reports
 - 7. Project Record Drawings

1.02 PROGRESS AND VALUE SCHEDULE

- A. Progress and Value Schedule shall be completed in duplicate on forms furnished by the Architect/Engineer at the Preconstruction Conference, and submitted prior to the first Application for Payment and shall reflect in detail all of the Work included under the Combined Contract.
- B. Value Schedule shall be broken out by individual specification section. A preliminary copy of this form shall be submitted to the Architect/Engineer to approve or modify the breakdown of line items before final copies are submitted.

1.03 PERFORMANCE BOND AND PAYMENT BOND

- A. Refer to the Construction Services Contract.

1.04 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- A. Shop Drawings, Product Data and Samples shall be submitted as follows:
 - 1. All shop drawings and product data submittals shall be submitted in electronic (PDF) format using Submittal Exchange, Procore, or other web-based platform. Submittal Exchange and Procore are website services designed specifically for transmitting submittals between construction team members.
 - 2. Shop drawings shall be numbered consecutively within each Division. Each shop drawing transmittal form shall list only items within the Division.
 - 3. All shop drawings and samples related to color choices and color issues shall be submitted at one time with all samples and colors submitted in triplicate.
 - 4. The distribution area in the center of the sheet shall be for the use of the Architect/Engineer only.

5. The Contractor shall review, mark-up and stamp all shop drawings prior to submittal to the Architect. The Architect will use red ink for his markings; the Contractor shall use a color other than red.
6. Changes from the Contract Documents on a shop drawing shall be listed in a letter of explanation accompanying the shop drawing.
7. A copy of the following list shall be updated monthly and submitted with the Application for Payment.
8. All shop drawing dimensions shall be in English units and metric units or English units only. Shop drawings with dimensions in metric units only will be rejected.

1.05 SUCCESSFUL CONTRACTOR/SUPPLIER

- A. The successful contractor/supplier may, at their option, obtain electronic drawing files for architectural drawings (A Series Drawings) for use in preparation of shop drawings. This information is available from BCDM upon written request. The use of these drawing files is intended solely for the preparation of drawings as required by these Contract Documents. All other uses are strictly prohibited by Copyright law. The user of these electronic drawing files assumes full responsibility for their accuracy and scale.

1.06 SHOP DRAWINGS, PRODUCT DATA AND RELATED SAMPLES

- A. Shop drawings, product data and related samples shall be submitted as noted within each specification section.

1.07 CERTIFICATES

- A. Miscellaneous Certifications shall be submitted in duplicate for all items so noted in individual Specification Sections.
- B. Asbestos Certification. Submit 2 copies of the certification regarding use of asbestos-free products as required by the Supplementary Conditions.
- C. Wood Treatment Certification. Submit 2 copies of a letter certifying that all wood requiring pressure treatment has been treated as specified for water resistance or fire resistance as outlined in Section 06 10 00 .
- D. Silicone Building Sealant Certification. Submit 2 copies of certificates indicating products have been pretested to comply with performance requirements indicated in Section 07 92 00.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 31 00
PROJECT MEETINGS**

PART 1 GENERAL

1.01 PRE-BID CONFERENCE

- A. There will be a Pre-Bid Conference held at the Project Location at 1:30 p.m. CST on Tuesday, February 14, 2023. Attendance of this Pre-Bid Conference is **mandatory** for all General Contractors. Other subcontractors are highly encouraged to attend this Pre-Bid Conference.

1.02 PRECONSTRUCTION CONFERENCE

- A. The Prime (General) Contractor and the Mechanical and Electrical Subcontractors shall attend a preconstruction conference at a time and location to be determined to discuss and clarify Contract Administration procedures. Representatives of the Owner and the Architect/Engineer will also attend.

1.03 PROGRESS MEETINGS

- A. The Prime (General) Contractor shall convene and conduct progress meetings during normal working hours at the construction site as required by the Architect/Engineer to discuss the progress of construction and properly coordinate respective responsibilities and schedules. The time, date, and location of these meetings shall be set by agreement of those involved. The Mechanical and Electrical Subcontractors shall also attend these meetings. A representative of the Owner and the Architect/Engineer will also attend these meetings when required to coordinate schedules and working relationships with the Contractor.
 - 1. OAC meeting will occur bi-weekly on a schedule determined by the Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 40 00
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 TESTING AGENCY

- A. Testing Agency for all soils testing including all overexcavation, recompaction, fill, building backfill, and miscellaneous backfill for mechanical and electrical items, and for all concrete testing, steel testing, special inspections and all other inspections hereinafter specified shall be Thiele Geotech Inc. Phone (402) 556-2171.

1.02 NOTIFICATION OF TESTING AGENCY

- A. Notification of Testing Agency that materials are ready for sampling, observation and testing shall be made by the Contractor. Such notification shall be made at least one day in advance.

1.03 SAMPLING

- A. Sampling shall be made by the Testing Agency's authorized representatives. The location from which the sample was taken shall be noted on the Test Report.

1.04 REPORTS SHALL BE DISTRIBUTED BY THE TESTING AGENCY AS FOLLOWS:

- A. Architect/Engineer one copy
- B. General Contractor one copy
- C. Owner one copy
- D. Concrete Producer (concrete tests only) one copy
- E. Steel Fabricator (steel tests only) one copy

1.05 PAYMENT

- A. Payments shall be made for testing and special inspections by the Owner.

1.06 THE CONTRACTOR

- A. The Contractor shall be responsible for maintaining close communication with the Testing Agency, particularly during the overexcavation/filling/recompaction phases for the building addition in order to assure that they are notified as to the schedule when such work is or is not going to take place. If the Contractor persistently fails to notify the Testing Agency when that work is not going to take place due to weather or other reasons, the costs of the unnecessary trips to the site by the Testing Agency shall be paid by the General Contractor from his/her own funds.

1.07 RETESTING

- A. Retesting and re-inspection of inspections due to failure shall be paid by the Contractor.

1.08 PATCHING

- A. Patching, if required by the taking of samples, shall be made by the Contractor.

1.09 TESTS ARE SPECIFIED IN THE FOLLOWING SECTIONS:

- A. 03 30 00 - Cast-in-Place Concrete
- B. 04 20 00 - Unit Masonry
- C. 05 31 00 - Steel Decking
- D. 05 40 00 - Cold-Formed Metal Framing
- E. 07 92 00 - Joint Sealants - Fire-Rated Joints and Penetrations
- F. Div. 21 thru 23 - Miscellaneous Backfill for Buried Mechanical Items
- G. Div. 26 thru 28 - Miscellaneous Backfill for Buried Electrical Items

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PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 WATER

- A. All water required for construction activities will be furnished by the Prime (General) Contractor as may be needed for the entire prosecution of the Work. The cost of the water used will be paid by the Prime (General) Contractor. The Contractor shall be responsible for furnishing all hoses and piping necessary to extend the water services to the construction areas, and shall be responsible for returning existing water sources to their original condition at completion of the project.

1.02 TEMPORARY POWER AND LIGHTING

- A. Temporary power will be provided throughout the construction period by the Prime (General) Contractor for use by all trades, Contractors, and Subcontractors for the following purposes:
 - 1. Operation of miscellaneous power tools and equipment
 - 2. Temporary lighting
 - 3. Power and lighting in temporary construction site office and storage buildings (if any).
 - 4. Testing and checking equipment
 - 5. Welding units
 - 6. Night security lighting
 - 7. Other general construction power needs
- B. All power sources, load centers, distribution boxes, circuit breakers, and other materials, including the methods of installing them, will be as required for safe working conditions and as required by applicable Codes and Ordinances.
- C. Where possible, at areas of the existing building in which construction work will take place, temporary lighting will be provided during the construction period by the Owner via the existing lighting for use by all trades, Contractors and Subcontractors up until such time where existing lighting which is to be removed is no longer operational. The Prime Contractor shall be responsible for adding whatever additional temporary lighting (over and above that provided by the existing building lighting) might be required for proper execution of the work. See list of required footcandle levels below. In areas where existing ceiling and lighting will be removed, the Prime (General) Contractor shall provide temporary lighting as specified below.
- D. At all new building areas, temporary lighting shall be provided during the construction period by the Prime (General) Contractor for use by all trades, Contractors, and Subcontractors for safe and adequate working conditions throughout the building, and shall provide minimum illumination measured in foot candles (FC) at the floor line as follows:

1. General area and walkway lighting	5 FC
2. Mechanical and electrical rooms	20 FC
3. General, electrical and mechanical rough work areas	10 FC
4. Concrete, masonry and finish work areas	20 FC
- E. Cost of electrical energy used during construction at all areas will be paid by the Owner. The Contractor shall make every effort to conserve the use of electrical energy and minimize those costs to the Owner.

1.03 SANITARY CONVENIENCES

- A. Sanitary conveniences for use by all persons employed on the Work shall be provided and maintained by the Prime (General) Contractor.

1.04 SECURITY AND WEATHER PROTECTION.

- A. The Prime (General) Contractor shall be responsible for proper security for the building at all times. He/she shall also schedule his/her work and provide temporary facilities and materials as required to assure continuous proper weather protection of all spaces for the duration of the

construction process.

- B. This requirement will be strictly enforced in order to minimize the potential for damage to the nearly completed Project and resulting time delays.

1.05 COLD WEATHER PROTECTION

- A. The Prime (General) Contractor shall be responsible for adequately protecting utilities, supplies, and equipment for the Work during cold weather. Items subject to cold weather damage shall be protected by covering, insulating, or storing in a heated space. During cold weather, temporary enclosures shall be erected at exterior openings which are not filled in immediately to minimize heat loss from the existing building.
- B. Temporary protection of new finishes. The Prime (General) Contractor and all Subcontractors shall protect carpet and other new finishes, whether installed under this Contract or by others as required to prevent damage to those materials due to construction activities which occur after those finishes are installed.

1.06 TEMPORARY HEAT

- A. Temporary heat for all building areas shall be furnished by the Prime (General) Contractor until the time when the permanent heating systems for those areas are operational. Up until that time, all temporary heating costs shall be paid for by the Prime (General) Contractor. Electric space heaters will not be acceptable for this preliminary heating source. After the permanent heating systems are operational, they may be used to supply temporary heat after approval to do so has been received from the Architect/Engineer, and the cost of fuel used will be paid by the Prime (General) Contractor.
- B. Wherever the permanent new heating and cooling systems are used to provide temporary heat and cooling, approval to use these systems must first be obtained from the Architect/Engineer. Costs for filter replacement, warranty extension to meet the requirements of the General Conditions, and cleaning at the termination of the heating and cooling periods shall be borne by the Prime (General) Contractor. Warranties for all equipment shall begin at the date of Substantial Completion even though the equipment may have been used for temporary heat and cooling prior to that time. See Section 01 11 00 for additional heating requirements of the existing building.
- C. **NO PROPANE BURNERS OR SIMILAR OPEN FLAME HEATERS WILL BE ALLOWED WITHIN THE BUILDING.**

1.07 MAINTENANCE OF EXITS

- A. During construction in the existing building, the Prime Contractor shall maintain means of egress, free and unobstructed from the existing exits as required by the City of Nebraska City, Nebraska Building Inspector, State Fire Marshal, and other responsible authorities.

1.08 BARRICADES, FENCES, AND PROTECTION

- A. The Prime (General) Contractor shall erect temporary barricades, fences and other protective items as necessary to provide for the general safety of the public during the construction of this project. As a minimum, 4-foot high sound snow fencing with posts at 10-foot centers shall be provided. These minimum requirements may be exceeded by the Contractor at his/her option since he/she is responsible for safety at the project site. Where the existing fencing is removed to provide temporary access to the site, it shall be reinstalled or replaced to match existing conditions at the end of the construction day.

1.09 OFFICES AND STORAGE FACILITIES FOR THE CONTRACTORS AND SUBCONTRACTORS

- A. The Prime (General) Contractor shall maintain on the site as necessary for the proper conduct of the Work offices and storage facilities for the Contractor and Subcontractors. After consulting with the Architect/Engineer, these shall be located on the site so that they cause no interference to Work performed on the site under this Contract or by others or to traffic on adjoining streets. Material and equipment may not be stored on parking and drive areas without

permission of the Owner, and such items may not be stored on public streets without permission of the City of Nebraska City, Nebraska.

- B. Removal of temporary offices and storage facilities. Upon completion of the project, or as directed by the Architect/Engineer, remove the temporary offices and storage facilities, and leave the premises in the condition required by the Contract. All areas affected by the construction shall be finely graded to the profile shown on the Drawings (or to their original profile at areas where the existing contours are shown to be unchanged) in preparation for installation of sod or seed by the Owner. The Contractor shall make every effort to restrict his/her construction activities to the areas shown to receive grade changes and enclosed by the construction fence.

1.10 PARKING

- A. Parking for construction personnel may take place on the existing parking lot areas as directed. Details related to on-site parking to be coordinated with the Owner. Parking on public streets must be coordinated and approved by the City of Nebraska City, Nebraska. Permitted parking on public streets shall not cause inconvenience and disturbance to neighbors and traffic near the site.

1.11 CLEAN UP

- A. The Prime (General) Contractor shall maintain all site areas involved in the Work of this Contract in a clean condition throughout the construction period. The Contractor shall also clean adjoining streets soiled by removal activities as may be required by the governing authorities. In addition, all paving areas shall be cleaned of all dirt, dust, debris and snow at time of Substantial Completion.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 MATERIALS AND EQUIPMENT

- A. Material and equipment shall be of the manufacturer, model, and type specified. Substitute materials and equipment approved prior to bidding, in accord with the Instructions to Bidders, are incorporated into this Project Manual as Addenda.

1.02 MATERIALS AND EQUIPMENT OF ACCEPTABLE MANUFACTURER

- A. An item of material or equipment may be used in place of an item which is specified by manufacturer and model number and type by conforming to all of the following provisions:
 - 1. The item is manufactured by one of the acceptable manufacturers listed in the Project Manual, Drawings, or Addenda.
 - 2. The item of material or equipment meets or exceeds the minimum qualities established by the specified item.
 - 3. The item is used throughout the project so that all items of material or equipment used in place of specified items are of the same make and type.
 - 4. The entire cost of all modifications which result from the use of items in place of specified items shall be borne by the Contractor who uses such items, at no additional cost to other Contractors or to the Owner.
- B. The Architect/Engineer has detailed and specified around a specific manufactured product for certain items. Although additional manufacturers are specified in Contract Documents, it is the Contractor's responsibility to coordinate the requirements of the product selected with all building components.

1.03 REPEATED FEATURES AND MATERIALS

- A. Repeated features and materials must be constructed alike, although detailed or indicated only once. Detail and ornament must continue throughout all moldings, bands, etc. Where items, devices and equipment are specified singular in number, the Specification shall apply to as many items, devices and pieces of equipment as are shown on the Drawings or required to complete the installation. Repeated items of equipment and materials shall be of the same manufacturer, model number and type.

1.04 WHEN BULKY MATERIALS AND EQUIPMENT ARE FURNISHED BY OTHERS

- A. The Prime (General) Contractor shall, upon receipt of notice in ample time, leave proper openings to permit the installation and properly close such openings afterwards.

1.05 WHEN EQUIPMENT IS FURNISHED BY OTHERS

- A. The Contractor shall use the manufacturer's detail drawings to establish roughing in dimensions and location of services. In case of conflict, the equipment detail drawings and dimensions shall be used, except where aesthetic or structural considerations make an adjustment necessary.

1.06 DISCREPANCIES

- A. In the event of discrepancies within the Drawings, within the Project Manual or between the Drawings and Project Manual, the discrepancies shall be brought to the attention of the Architect/Engineer immediately before proceeding with the affected work. The Architect/Engineer will make a written interpretation.
- B. If the Contractor fails to notify the Architect/Engineer of discrepancies and proceeds with the Work where discrepancies occur, such Work shall be considered done at the Contractor's risk. No excuse will thereafter be entertained for failure to carry out Work in a manner satisfactory to the Architect/Engineer.

1.07 STANDARDS

- A. Materials and processes for which standards have been adopted by ASTM, or other industry recognized organizations, shall conform to those standards. Methods shall be those

recommended by the manufacturer of the material involved.

1.08 MEASUREMENTS

- A. Before ordering material and doing work, the Contractor shall verify measurements at the building and the site and be responsible for same. Extra compensation will not be allowed for differences between actual dimensions and measurements indicated on the Drawings. The Contractor shall submit differences to the Architect/Engineer.

1.09 CHASES, OPENINGS, INSERTS, ETC

- A. The General Contractor shall build into all new construction necessary chases, slots and openings required for his/her own or other contractor's work as shown on the Drawings or requested by other contractor's for their work. He/she shall cooperate with other contractors in the proper installation of sleeves, inserts, etc., furnished by the contractor or subcontractor concerned unless otherwise shown or specified.

1.10 CUTTING AND PATCHING

- A. Cutting, fitting and patching necessary to fit the several parts of this or other contractor's work together, or cutting, fitting, and patching of existing construction and new work in place shall be the expense of the contractor concerned. Each contractor shall determine and be responsible for proper location and character of all inserts, holes, chases, and other openings in new and existing construction, and give the other interested contractors proper notification with regard to same.
- B. Cutting, fitting, repairing, patching, etc., required whether it be in existing construction, new work in place or executing the initial installation, must be done by craftsmen skilled in their respective trades. Repair cut surfaces to match adjacent surfaces.

1.11 SUBSTITUTIONS

- A. Mill tests, chemical analysis, manufacturer's specifications, and such other information as is available shall be submitted as proof of quality when presenting substitute materials for Owner's approval. If the Contractor proposes the construction method other than that shown or specified, complete drawings and engineering notes shall accompany the request. The Contractor shall reimburse the Architect for architectural and engineering service furnished, time required for checking the proposed change, and drafting time required for preparing as built drawings made necessary by substitutions.

1.12 STABILITY

- A. Members shall be rigid and securely anchored. Members subject to vibration or racking shall be attached with through bolts or cinch bolts. Connections shall be adequate to withstand all strains to which they normally would be subjected.

1.13 TRUENESS

- A. Surfaces and joints of all materials fabricated on or off the site into a single article or composition, or into an assembly of units, shall be uniform, true, plumb, level, properly curved or pitched as required and free from defects and blemishes.

1.14 COORDINATION

- A. The Contractor shall coordinate his/her work with that of the other contractors and shall cooperate with them to the fullest extent. He/she shall order all materials promptly so that they will be available when needed and not delay the installation of items by other contractors.

1.15 THE PRIME (GENERAL) CONTRACTOR

- A. The Prime (General) Contractor shall give ample notice of his/her and other contractor's intended operations including current progress schedules, directing their activities on the job to assure orderly procedures with the interests of the Owner's obligations to the public in mind.

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PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 78 00
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 CLEANING

- A. When the project is completed, the General Contractor shall clean all site and building areas affected by this work, removing all rubbish and excess materials, no matter by whom it is left. Dust accumulations shall be totally removed from all interior surfaces. See General Conditions and individual Specification Sections for further clean-up requirements.

1.02 SUBMITTALS

- A. The following submittals shall accompany the Contractor's final Application for Payment. Submittals shall be submitted in duplicate unless otherwise specified in the Sections indicated.
 - 1. 07 19 00 Water Repellent Warranty
 - 2. 07 92 00 Silicone Joint Sealer Warranty
 - 3. 08 14 16 Wood Door Warranty
 - 4. 08 43 13 Aluminum Frame and Door Warranty
 - 5. 08 80 00 Glazing Warranty
 - 6. 09 51 00 Acoustical Ceiling Tile System Warranty
 - 7. 12 52 00 Window Shades Warranty
 - 8. Divisions 21 thru 28 Various Mechanical and Electrical Warranties as noted

1.03 INSPECTION CERTIFICATES

- A. Inspection certificates issued by regulatory agencies shall be submitted to the Architect/Engineer before final payment.

1.04 TESTING REPORTS

- A. Testing reports shall be submitted to the Architect/Engineer before final payment, and shall include the following:
 - 1. Performance Tests
 - 2. Water System Disinfection Reports
 - 3. Air Balancing Reports

1.05 COORDINATE

- A. Coordinate with requirements of Commissioning as outlined in various sections throughout the project manual.

1.06 RECEIPTS FOR TESTING COSTS

- A. Receipt for testing costs as specified in Section 01 40 00, Quality Control Services, shall be submitted to the Architect/Engineer before final payment.

1.07 PROJECT RECORD DRAWINGS

- A. Project Record Drawings shall be delivered to the Architect/Engineer before final payment in accordance with the General Conditions of the Contract. Record drawings shall be a copy of the Contract Drawings, properly marked to reflect changes made during construction, and with undamaged edges.
- B. These drawings shall be the Contractor's separate field set on which he/she has accurately marked changes that were made during construction.

1.08 OPERATION AND MAINTENANCE MANUALS AND REPAIR KITS

- A. Operation and Maintenance Manuals and Repair kits shall be submitted to the Architect/Engineer in duplicate before final payment or earlier when specified. Data to be included is as follows:
 - 1. Water Repellent Maintenance Data
 - 2. Hardware Maintenance Data
 - 3. Acoustic Ceiling Tile Maintenance Data

4. Carpet Maintenance Data and Repair Kits
 5. Visual Display Board Maintenance Data and Kits
 6. Mechanical and Electrical Operating and Maintenance Data, Parts Lists, Lubrication Schedules, Diagrams and Accessory Schedules
- B. Operation and Maintenance Manuals shall be bound in plastic or vinyl-covered 3-ring binders (Submit one copy). The binders shall be large enough to accommodate all materials and shall be marked with tabs to identify the contents. In addition to the hard copies Operation and Maintenance Manuals shall also be submitted in PDF form by approved external storage media or digital file transfer.

1.09 INSTRUCTIONS FOR THE OWNER

- A. On completion of the project, the Contractor shall demonstrate the proper operation and maintenance procedures for all mechanical, electrical and operating general construction items prior to final acceptance by the Owner. Such demonstration sessions shall be video-recorded by the Contractor at his/her expense. One copy of each video-recording shall be in DVD format, and turned over to the Owner.

1.10 EXTRA STOCK

- A. Extra Stock shall be delivered to the Owner before final payment, and shall include the following:
1. Paint
 2. Carpet
 3. Tile
 4. Vinyl Base
 5. Mechanical/Electrical Items as may be noted in Divisions 22 thru 28 and on the Drawings

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

DIVISION 02 – NOT USED

DIVISION 03 – CONCRETE

**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete formwork.
- B. Floors, slabs on grade and footings.
- C. Concrete reinforcement.
- D. Joint devices associated with concrete work.

1.02 RELATED REQUIREMENTS

- A. Section 03 35 11 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials 2010 (Reapproved 2015).
- B. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide 2022.
- C. ACI 301 - Specifications for Concrete Construction 2020.
- D. ACI 302.1R - Guide to Concrete Floor and Slab Construction 2015.
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete 2000 (Reapproved 2009).
- F. ACI 306R - Guide to Cold Weather Concreting 2016.
- G. ACI 308R - Guide to External Curing of Concrete 2016.
- H. ACI 318 - Building Code Requirements for Structural Concrete 2019 (Reapproved 2022).
- I. ACI 347R - Guide to Formwork for Concrete 2014 (Reapproved 2021).
- J. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.
- L. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars 2022.
- M. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2018.
- N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens 2021.
- O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2022a.
- P. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.
- Q. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
- R. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method 2016.
- S. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).
- T. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete 2017a.
- U. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019, with Editorial Revision (2022).
- V. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete 2022.

- W. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing 2017.
- X. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2018.
- Y. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) 2018.
- Z. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars 2021.
- AA. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers 2020.
- BB. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric) 2014.
- CC. 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.
- DD. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs 2017.
- EE. COE CRD-C 572 - Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop 1974.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
- C. Samples: Submit samples of underslab vapor retarder to be used.
- D. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 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. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Type: Deformed billet-steel bars.
 - 2. Finish: Unfinished, unless otherwise indicated.
 - 3. Finish: Epoxy coated in accordance with ASTM A775/A775M, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain type.
 - 1. Mesh Size and Wire Gage: As indicated on drawings.
- C. 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 stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C260/C260M.
- C. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; Permeance of less than 0.01 perms after mandatory conditioning tests per ASTM E1745 (7.1.1-7.1.5) 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.
 1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 2. Products:
 - a. Stego Industries, LLC: www.stegoindustries.com.
 - b. W. R. Meadows, Inc; PERMINATOR Class A - 10 mils (0.25 mm): www.wrmeadows.com/#sle.
 - c. Interplast Group; Barrier-Bac VB-350.
 - d. Insulation Solutions; Viper Vaporcheck II Vapor Barrier 15-mil (Class A) .
 - e. Griffolyn 15 by Reef Industries
 - f. Fortifiber Building Systems Group; Noistop 15.

2.06 BONDING AND JOINTING PRODUCTS

- A. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 1. Material: Closed-cell, non-absorbent, compressible polymer foam in sheet form.
 2. Products:
 - a. W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip: www.wrmeadows.com/#sle.
 - b. Sonneborn Dugussa Building Systems; Sonoflex F Polyethylene Foam Joint Filler.
- B. 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.

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 for preparing and reporting proposed mix designs.

- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- C. Normal Weight Concrete:
 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 pounds per square inch.
 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 3. Water-Cement Ratio: Maximum .45 percent by weight.
 4. Total Air Content: Max 3 percent, determined in accordance with ASTM C173/C173M.
 5. Maximum Slump: 4 inches.
 6. Maximum Aggregate Size: 3/4 inch.
- D. Concrete mix for polished areas as identified on Room Finish Schedule shall be the thickness recommended by the polishing company and contain a mixture of sand and gravel which shall be reviewed during the shop drawing process. The rebar size shall accommodate the overall thickness required to have a polished finish at the completion of the project and the control joints as indicated on the drawings. The process shall be similar to the below and as recommended by the manufacturer to maintain and achieve a polished floor:

50 Grit Metal Bond Diamonds- Edgework completed with propane powered edger. 50 Grit Metal Bond Diamond- 4 passes with 785lb. head pressure propane powered machine	Autoscrub 100 100
200 Grit Metal Bond Diamonds- 2 passes with propane powered machine Autoscrub to clean floor using concrete cleaner as recommended by manufacturer	200 Grit Metal Bond Diamonds- Edgework completed 200 Grit Metal Bond Diamonds- 2 passes with propane powered machine Autoscrub to clean floor using concrete cleaner as recommended by manufacturer
100 Grit Resin Bond Diamonds- Edgework completed 100 Grit Resin Bond Diamonds- 2 passes with propane powered machine Autoscrub to clean floor using concrete cleaner as recommended by manufacturer Edgework completed 200 Grit Resin Bond Diamonds- 2 passes with propane powered machine Autoscrub to clean floor using concrete cleaner as recommended by manufacturer	100 Grit Resin Bond Diamonds- Edgework 100 Grit Resin Bond Diamonds- 2 passes Autoscrub to clean floor using concrete 200 Grit Resin Bond Diamonds- 200 Grit Resin Bond Autoscrub to clean Detailed floor

cleanup in preparation for polished concrete and Dry Shield Densifier. Use a Microfilm (penetrating sealer) for required applications and burnish with high speed propane burnisher with a black pad as required for receiving final polished finish as recommended by manufacturer and/or indicated. Process for polished concrete shall be similar to that indicated above which may vary from manufacturer's recommended process. This shall be reviewed and approved by Owner(s) and Architect.

2.08 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C94/C94M.
- C. 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.

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 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
 - 1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
- B. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- C. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
- D. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- D. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- E. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 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 columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
- D. 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.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. An independent testing agency, as specified in Section 01 40 00, will inspect finished slabs for compliance with specified tolerances.
- B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
 - 1. Exposed to View and Foot Traffic: F(F) of 35; F(L) of 25, on-grade only.
 - 2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
 - 3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
 - 4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.
- C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.

- D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than $F(F) 13/F(L) 10$.
- E. 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.

3.07 CONCRETE FINISHING

- A. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
 - 1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
 - 2. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
 - a. Chemical Hardener: See Section 03 35 11.

3.08 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. 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. Surfaces Not in Contact with Forms:
 - 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
 - 2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water-fog spray or saturated burlap.
 - a. Spraying: Spray water over floor slab areas and maintain wet.
 - b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
 - 3. Final Curing: Begin after initial curing but before surface is dry.
 - a. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- 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. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.
- E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.10 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect 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. 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 for each individual area.

3.11 PROTECTION

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

END OF SECTION

**SECTION 03 35 20
POLISHED CONCRETE FLOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Products and procedures for diamond polishing concrete floors using multi-step wet/dry mechanical process, and accessories indicated, specified, or required to complete polishing procedure.
- B. Accessories.
- C. Joint fillers for joints in polished slabs.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Prepared concrete floors ready to receive finish.
- B. Section 07 92 00 - Joint Sealants.

1.03 REFERENCE STANDARDS

- A. Concrete Polishing Association of America standards.
- B. ACI 301 - Specifications for Concrete Construction 2020.
- C. ACI 302.1R - Guide to Concrete Floor and Slab Construction 2015.
- D. ACI 360R - Guide to Design of Slabs-on-Ground 2010, with Errata (2016).
- E. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete 2019.
- F. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019, with Editorial Revision (2022).
- G. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers 2020.
- H. ASTM E430 - Standard Test Methods for Measurement of Gloss of High-Gloss Surfaces -11.
- I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2022.
- J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.
- K. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

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

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on concrete hardener and sealer, including information on compatibility of different products and limitations and manufacturer's instructions. Include information on all accessory products listed within this specification.
- C. Samples (Aggregate): Submit samples of aggregate size and color for verification.
- D. Maintenance Data: For inclusion in maintenance manual per Section 01 77 00.
 - 1. Include manufacturer's instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
 - 2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

- E. Warranty: See Section 01 77 00 - Closeout Procedures for additional warranty requirements.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with Concrete Polishing Association of America (CPAA).
 - 1. Maintain one copy on project site.
- B. Floor Finisher:
 - 1. Installer Qualifications: An installer with five (5) years experience with work of similar scope and quality.
 - 2. Installer/applicator shall be thoroughly trained and experienced in the use of concrete finishing equipment.
- C. Obtain materials from same source throughout project.
- D. Static Coefficient of Friction: Achieve not less than 0.5 for level floor surfaces as determined by quality control testing according to NFSI 101-A.
- E. Areas to receive concrete polish shall be closed to traffic during finishing operation, including application of sealer coat.

1.07 MOCK-UP

- A. Field Mock-up for Aesthetic Purposes: Before performing work of this Section, provide field mock-up to verify selections made under submittals and to demonstrate aesthetic effects of polishing. Approval does not constitute approval of deviations from Contract Documents, unless such deviations are specifically approved by Architect in writing.
- B. Construct mock-up area under conditions similar to those that will exist during actual placement, 10 feet long by 10 feet wide, with coatings applied and metal accent strips added if applicable.
- C. Grind, hone, and polish mock up floor area for each finish approved under sample submittals; include edges and joints. Fill joint with specified joint filler.
- D. Use same personnel, including supervisors, which will perform work.
- E. Install products and materials according to specified requirements.
- F. Work shall be representative of those to be expected for finished work.
- G. Finish various components to show maximum variation that will exist in work.
- H. Approval is for following aesthetic qualities:
 - 1. Compliance with approved submittals.
 - 2. Uniformity of exposed aggregate for each type of mix design.
 - 3. Uniformity of sheen.
- I. Obtain Architect's approval before starting work on Project.
- J. Protect approved field mock-ups from elements with weather resistant covering.
- K. Maintain field mock-ups during construction in an undisturbed condition as a standard for judging completed work and locate where directed.
- L. Do not demolish, alter, or remove field mock-ups until acceptable to Owner and Architect.

1.08 DELIVERY, STORAGE, AND HANDLING

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

1.09 PROJECT CONDITIONS

- A. Conduct floor testing (per manufacturer's instructions if required) prior to beginning work.
- B. Coordinate the work with concrete floor placement and concrete floor curing.

1.10 FIELD CONDITIONS

- A. Maintain light level equivalent to minimum 200 W light source, placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.
- B. Maintain ambient temperature of 50 degrees F minimum.
- C. Damage and Stain Prevention: Take precautions to prevent damage and staining of concrete surfaces to be polished.
 - 1. Prohibit vehicle parking over concrete surfaces to be polished.
 - 2. Prohibit pipe cutting operations over concrete surfaces to be polished.
 - 3. Prohibit storage of any items over concrete surfaces to be polished for not less than 28 days after concrete placement.
 - 4. Prohibit ferrous metals storage over concrete surfaces to be polished.
 - 5. Protect from petroleum, oil, hydraulic fluid, or other liquid dripping from equipment working over concrete surfaces to be polished.
 - 6. Protect from acids and acidic detergents contacting concrete surfaces to be polished.
 - 7. Protect from painting activities over concrete surfaces to be polished.
- D. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting liquid applied product application.
- E. Provide ventilation sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.11 WARRANTY

- A. Submit under provisions of Section 01 77 00.
- B. Warranty: The surface of the polished concrete will be hardened, dust proof and water-repellant for a period of Ten (10) years beginning at date of Substantial Completion. If the surface fails to so perform, the applicator will reapply polished floor system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Concrete Floor Finishes-Basis of Design:
 - 1. Scofield Systems; Scofield Interior Polished Concrete System: www.scofield.com.
- B. Other Acceptable Manufacturers:
 - 1. Prosoco; Product Consolideck LS. www.prosoco.com.
 - 2. Advanced Floor Products, Incorporated; Product: Retro-Plate 99.

2.02 ACCESSORY MATERIALS

- A. Finish Coat: Stain and chemical inhibitor/hardener.
 - 1. Scofield Formula One Finish coat.
 - 2. Consolideck LSGuard.
 - 3. RetroPlate 99 Sealer.
- B. Joint Fillers: Polyurea polymer liquid of 100% solids content meeting ACI 302.1R-04, ACI 360R and Portland Cement Association (Concrete Floors on Ground, Fourth Edition 2008).
 - 1. Product: Spal-Pro RS 88 by Metzger/McGuire or approved equal.
 - 2. Fill ALL (isolation, control and construction) joints in polished concrete slabs unless otherwise noted.
 - a. At polished slabs that are not being dyed, apply joint filler prior to beginning grinding.
 - 3. Color: As selected by Architect from full range of available colors.
 - 4. Apply per manufacturer's instructions

2.03 POLISHING EQUIPMENT

- A. Grinding Machine: Floor grinding machine with 3-4 head with counter rotating variable speed and minimum 800 lbs. down pressure.
- B. Duct Extraction System: System with pre-separator and squeegee attachments with minimum flow rate of 300 cu. ft/min.
- C. Grinding Heads:
 - 1. Metal bonded 16, 25, 40, 60, 80, 150 and 300 grits.
 - 2. Resin bonded, phenolic diamonds, 100, 200, 400, 800, 1500 and 3000 grits.
- D. Grinding Pads for Edges:
 - 1. 40, 60, 100 and 200 grits.
 - 2. 200, 400, 800, 1500 and 3000 grits.
- E. Hand grinder with dust extraction equipment and pads.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that floor flatness meets specified requirements.
- C. Cleaning New Concrete Surfaces:
 - 1. Prepare and clean concrete surfaces.
 - 2. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, paint splatter, and other contaminants incompatible with liquid applied products and polishing.
- D. Conduct the following tests on all slabs to be polished. Provide polishing system manufacturer and Architect with report indicating results. Manufacturer must approve results before installation begins.
 - 1. Alkalinity:
 - a. Test Method: Measure pH according to method indicated in ASTM F710.
 - b. Acceptable Results: pH between 8 and 10.
 - 2. Moisture Vapor Transmission Rate:
 - a. Test Method: Perform anhydrous calcium chloride test according to ASTM F1869.
 - b. Acceptable Results: Not more than 5 pounds per 1000 square feet in 24 hours.
 - 3. Relative Humidity:
 - a. Test Method: Perform relative humidity test using in situ probes according to ASTM F2170.
 - b. Acceptable Results: Not more than 75 percent.

3.02 POLISHED CONCRETE APPLICATION

- A. Sequence of Polishing: Perform polishing before partition studs are erected.
- B. Begin grinding in one direction using sufficient size grit pad. Grind the concrete floor with sequential passes of 16, 25, 40, 60, 80 and/or 150 grit pad (each pass perpendicular to the previous) removing construction debris and floor slab imperfections to achieve a uniform scratch pattern and matching the approved mock up for concrete aggregate exposure.
- C. Fill construction joints with approved joint filler per manufacturer's recommendations.
- D. Treating Surface Imperfections:
 - 1. Mix patching compound and grout material with dust created by grinding operations to match color of adjacent concrete surface.
 - 2. Fill surface imperfections including, but not limited to, holes, surface damage, small and micro cracks, air holes, pop-outs, and voids.

3. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not reasonably noticeable when viewed from 10 feet away under lighting conditions that will be present after construction.
- E. Apply densifier impregnator with a stiff, long bristled broom in the concentration and rate recommended by the manufacturer. Using a broom work material into floor for a minimum of 10 minutes. Squeegee the floor to remove any remaining material without leaving squeegee marks or puddles. Allow to cure for a minimum of 12 hours.
- F. Polishing:
 1. Use polishing equipment with resin bonded polishing and burnishing pads.
 2. Begin polishing in one direction starting with 300 grit pad.
 3. Make sequential passes with each pass perpendicular to previous pass using finer grit pad with each pass, up to the grit required to achieve the sheen level approved on the mock up.
 4. Achieve maximum refinement with each pass before proceeding to finer grit pads.
 5. Auto scrub or vacuum floor using squeegee vacuum attachment after each pass.
 6. Continue polishing until gloss appearance, as measured according to ASTM E430, matches approved field mock-ups.
- G. Grind the main floor area to within 2-3 inches of walls, if occurring, with metal bonded diamond grits of 150 and 300. Grind 90 degrees from each previous grind to remove all scratches from the previous grit. Vacuum the floor thoroughly after each grind using a squeegee vacuum attachment.
- H. Grind the edges with 40, 60, 120 and 220 grit grinding pads to remove all scratches from the previous grit. Vacuum the floor thoroughly after each grind using a squeegee vacuum attachment.
- I. Polish with successive passes of finer resin bond grinding pads to the specified shine level.
- J. Apply finish coat at rate per manufacturer's instructions.
- K. Use a high speed (2000-3000 rpm) burnishing machine and hogs hair burnishing pad to buff the surface to a high shine.

3.03 TOLERANCES

- A. Coordinate slab installation with slab installer to ensure tolerances are achieved as stated below.
- B. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E1155, within 48 hours after slab installation.
- C. Finish concrete to achieve the following tolerances:
 1. Exposed to View and Foot Traffic: Ff 50 and Fl 30.
- D. Correct the slab surface if tolerances are less than specified.

3.04 CLEANING

- A. Keep work area clean and free of debris at all times.
- B. Remove slurry and dust from adjoining surfaces as necessary.
- C. Dispose of material containers in accordance with state and local codes.
- D. Protect finished work until fully cured per manufacturer's recommendations.

3.05 DEFINITIONS

- A. Aggregate Exposure (Grind):
 1. Class A - Cream Finish: Remove very little surface and polish portland cement paste resulting in little or no aggregate exposure.
 2. Class B - Fine Aggregate (Salt and Pepper) Finish: Remove not more than 1/16 inch of concrete surface by grinding and polishing resulting in majority of exposure displaying fine

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- aggregate with no, or small amount of, medium aggregate at random locations.
3. Class C - Medium Aggregate Finish: Remove not more than 1/8 inch of concrete surface by grinding and polishing resulting in majority of exposure displaying medium aggregate with no, or small amount of, large aggregate at random locations.
 4. Class D - Large Aggregate Finish: Remove not more than 1/4 inch of concrete surface by grinding and polishing resulting in majority of exposure displaying large aggregate with no, or small amount of, fine aggregate at random locations.
- B. Reflective Clarity and Sheen (Polish):
1. Level 1 - Flat, Low Gloss Appearance:
 - a. Procedure: Not less than 4 step process with full refinement of each diamond pad up to 100 grit resin bonded pad with one application of densifier.
 - b. Gloss Reading: Not less than 40 according to ASTM E430 before polish guard application.
 2. Level 2 - Satin, Medium Gloss Appearance:
 - a. Procedure: Not less than 5 step process with full refinement of each diamond pad up to 400 grit resin bonded pad with one application of densifier.
 - b. Gloss Reading: Not less than 55 according to ASTM E430 before polish guard application.
 3. Level 3 - Semi-Polished, High Gloss Appearance:
 - a. Procedure: Not less than 6 steps with full refinement of each diamond pad from 800 up to 1500 grit resin bonded pad with one application of densifier.
 - b. Gloss Reading: Not less than 60 according to ASTM E430 before polish guard application.
 4. Level 4 - Highly Polished, Very High Gloss Appearance:
 - a. Procedure: Not less than 7 steps with full refinement of each diamond pad from 1500 up to 3000 grit resin bonded pad with one application of densifier.
 - b. Gloss Reading: Not less than 70 according to ASTM E430 before polish guard application.

3.06 SCHEDULE

- A. Aggregate Exposure Class.
1. Depth of surface cut (Grind):
 - a. Class C - Medium Aggregate Finish.
 2. Shine Level (Polish):
 - a. Level 3 - Semi-Polished
 3. Polished concrete finish coat:
 - a. Apply two coats of SCOFIELD Finish Coat in all locations.

3.07 PROTECTION

- A. Covering: After completion of polishing, protect polished floors from subsequent construction activities with protective covering.

END OF SECTION

DIVISION 04 – MASONRY

**SECTION 04 20 00
UNIT MASONRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Loose steel lintels and Fabricated steel items.
- B. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
- C. Section 07 25 00 - Weather Barriers: Water-resistive barriers or air barriers applied to the exterior face of the backing sheathing or masonry.
- D. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- E. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.
- F. Section 13 34 19 - Metal Building Systems: Coordination between systems.

1.03 REFERENCE STANDARDS

- A. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement 2022.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2022.
- F. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile 2021.
- G. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2022.
- H. ASTM C91/C91M - Standard Specification for Masonry Cement 2023.
- I. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units 2017.
- J. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- K. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
- L. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
- M. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a, with Editorial Revision.
- N. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
- O. ASTM C476 - Standard Specification for Grout for Masonry 2022.
- P. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing 2017.
- Q. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.
- R. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Masonry Conference: Prior to the installation of masonry and associated work, and after approval of required job mock-up, the General Contractor shall arrange a Pre-masonry conference at the site at a pre-arranged time approved by the Architect/Engineer. The conference shall include in attendance the masonry subcontractor and his/her jobsite foreperson, and the Architect/Engineer. The Contractor shall record discussions and agreements that are made, which are not specifically addressed in the Contract Documents, and shall furnish a copy to all involved participants.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit two samples of facing brick and mortar units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

- A. All work shall comply with the latest standards of the Brick Institute of America (BIA) and Portland Cement Association (PCA).
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- C. Fire Performance Characteristics: Where fire-resistance ratings are indicated for walls containing unit masonry work, provide materials and construction which have been determined by testing according to ASTM E119 as acceptable to the authority having jurisdiction. Minimum equivalent thicknesses (volume of masonry unit minus volume of cores divided by face area) of masonry units for fire-resistant walls and partitions shall be as follows:

<u>Course Aggregate</u>	<u>4-Hour</u>	<u>3-Hour</u>	<u>2-Hour</u>	<u>1-Hour</u>
Expanded Slag or Domic	4.7	4.0	3.2	2.1
Expanded Clay or Shale	5.7	4.8	3.8	2.6
Limestone, Cinders, Unexpanded Slag	5.9	5.0	4.0	2.7
Calcareous Gravel	6.2	5.3	4.2	2.8
Siliceous Gravel	6.7	5.7	4.5	3.0

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Masonry units shall be delivered, unloaded and handled in a manner to adequately protect exposed corners, edges and faces from chipping, cracking and other damage. Such chipped and otherwise damaged units shall not be utilized in exposed wall areas, but may be selected for utilization in concealed wall areas, if damaged characteristics are minor and do not effect the structural integrity of the wall.
- B. Delivery of mortar materials other than aggregate and water shall be in sealed and labeled packages.
- C. Masonry units shall be stored off the ground on pallets or in some manner that will prevent absorption of moisture from the ground and the soiling of masonry units. Concrete masonry units shall be protected from becoming wet from rain, snow and capillary action. All masonry units shall be so protected when the temperature is below 40F.
- D. Reinforcing shall be stored off the ground and shall be free of loose rust and other coatings that will reduce bond.

- E. General storage of materials shall be in a manner to prevent deterioration and intrusion of foreign material. Material that has become unsuitable for good construction shall not be used and shall be immediately removed from the site.

1.08 JOB CONDITIONS

- A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at the end of each day's work. Extend cover a minimum of 24-inches down both sides and hold cover securely in place. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24-inches down face next to unconstructed wythe and hold cover in place.
- B. Environmental Conditions: During cold and hot weather, masonry materials shall be stored, erected, and protected to meet the requirements of the Brick Institute of America Technical Note 1 Revised dated June, 2006, Technical Note 11A Revised dated September 1988, and National Concrete Masonry Association TEK 3-1C dated 2002.
- C. Cold Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply to cold-weather construction requirement contained in ACI 530.1/ASCE 6/TMS 602. Comply with the following requirements:
 - 1. Construction: When the ambient temperature is within the limits indicated, use the following procedures:
 - a. 40-32 deg F: Heat mixing water or sand to produce mortar temperatures between 40 and 120 deg F.
 - b. 32-25 deg F: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F. Heat grout materials to produce grout temperatures between 70 and 120 deg F. Maintain mortar above freezing until used in masonry. Maintain grout temperature above 70 deg F at time of placement.
 - c. 25-20 deg F: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F. Heat grout materials to produce grout temperatures between 70 and 120 deg F. Maintain mortar above freezing until used in masonry. Maintain grout temperature above 70 deg F at time of placement. Heat masonry units to 40 deg F if grouting. Use heat on both sides of walls under construction.
 - d. 20 deg F and Below: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F. Heat grout materials to produce grout temperatures between 70 and 120 deg F. Maintain mortar above freezing until used in masonry. Maintain grout temperature above 70 deg F at time of placement. Heat masonry units to 40 deg F. Provide enclosures and use heat on both sides of walls under construction to maintain temperatures above 32 deg F within the enclosures.
 - 2. Protection: When the mean daily temperature is within the limits indicated, provide the following protection:
 - a. 40-25 deg F: Cover masonry with a weather-resistive membrane for 48 hours after construction.
 - b. 25-20 deg F: Cover masonry with insulating blankets or provide enclosure and heat for 48 hours after construction to prevent freezing. Install wind breaks when wind velocity exceeds 15 mph.
 - c. 20 deg F and Below: Provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 48 hours after construction.
 - 3. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above, but not less than 7 days after completion of cleaning.
- D. Do not lay masonry units which are wet or frozen.
- E. Remove ice and snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
- F. Remove all masonry determined to be damaged by freezing conditions.

- G. Hot Weather Requirements: Protect unit masonry work when temperatures and humidity conditions produce excessive evaporation of water. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and above. Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

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, lintels, headers, end and jamb blocks, bond beams, and other detailed conditions.
 - a. Provide reinforced concrete masonry lintels fabricated from precast load-bearing units.
 - b. Provide 1" radius bullnose corners where indicated on the plan and details. It shall be the mason's responsibility to work with the General Contractor in order to establish a time to have an on-site meeting to review all square and bullnose corner locations. Attendees of this meeting shall at a minimum include the Mason, General Contractor, Architect and Owner. Any locations constructed with incorrect corner conditions will need to be removed and replaced at the Contractor's expense.
 3. Load-Bearing Units: ASTM C90, normal weight.
 - a. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 Mpa).
 - b. Weight Classification: All units shall be manufactured with standard weight aggregate. (125 lbs. per cu. ft. or more, oven dry weight of concrete.)
 - c. Exposed Faces: Manufacturer's standard color and texture unless otherwise indicated.
 4. Non-Loadbearing Units: ASTM C129.

2.02 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type S.
 1. Pre-mixed with retarder additives, not allowed.
- B. Portland Cement: ASTM C150/C150M, Type I (Type III - High Early Strength may be used for cold weather construction) . Provide natural gray color cement for all standard CMU. Colored mortar shall be used for all exposed brickwork, burnished masonry, and precast masonry.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Mortar Aggregate: ASTM C144.
- E. Grout Aggregate: ASTM C404.
- F. Water: Clean and potable.
- G. Air-entraining add-mixtures shall not be used. Air content shall not exceed 8-percent.
- H. Anti-Freeze Compounds: Not permitted.
- I. Calcium chloride shall not be used in mortar.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
1. Heckman Building Products, Inc.; Product - 213 with 282 Masonry Ties.
 2. Hohmann & Barnard, Inc; HB 213 Veneer Anchor: www.h-b.com/#sle.
 3. WIRE-BOND; RJ-711 www.wirebond.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; galvanized.
- C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Ladder.
 - 2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B.
 - 3. Size: 0.1875 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.
- D. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
 - 1. Concrete frame: Dovetail anchors of bent steel strap, nominal 1 inch width x 0.024 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 2. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
- E. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

2.04 ACCESSORIES

- A. Compressible Fillers:
 - 1. Compressible filler to be used in masonry expansion joints (3/4-inch or wider) behind caulking and backer rod shall be "Sonoflex F" manufactured by Sonneborn Contech, Inc. Thickness shall be as required to fill the joint in an uncompressed state.
 - 2. Compressible fillers to be used at exterior masonry control joints shall be preformed "Neo-Seal IV" as manufactured by Williams Products, Inc.
 - 3. Compressible filler to be used where masonry walls abut or surround concealed columns, shall be 5008-3 Column Boxboard manufactured by Williams Products Company. Thickness shall be 1/2-inch unless noted otherwise on the Drawings.
 - 4. Polyurethane foam for use at existing cavity walls where noted on the Drawings shall be a 2-part spray applied product, Froth-Pak 12 by Dow Chemical Company.
- B. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt used as a bond breaker at control joints in concrete block at exterior walls.
- C. Metal lath shall be 2.5-pound galvanized steel diamond mesh lath, and shall be installed to close off bottom of cores which are to be filled with grout.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.05 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Masonry below grade and in contact with earth: Type S.
 - 2. Exterior, loadbearing masonry: Type S.
 - 3. Exterior, non-loadbearing masonry: Type S.
 - 4. Interior, loadbearing masonry: Type S.
 - 5. Interior, non-loadbearing masonry: Type N (Type S may be used at the Contractor's option).
- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- C. Grout for Reinforced Masonry: shall be concrete with sand-gravel aggregate and with a minimum 28-day compressive strength of 3000 psi. Grout for cores of reinforced masonry shall have a slump of 8 inches to 10 inches as tested according to ASTM C143/C143M. Grout shall have a minimum cement content of 658 lbs. per cubic yard. Where required, grout shall be plastic, suitable for pumping without separation of constituents

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

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

3.04 GENERAL

- A. Cutting of masonry units shall be avoided if possible. If cutting of exposed brick and concrete masonry units is necessary, it shall be done with a carborundum wheel, with all junctions and joints carefully and accurately fitted. No piece shorter than 4-inches shall be used at any vertical corner or jamb unless shown otherwise on the Drawings.
- B. Wetting of Masonry Units: Brick having absorption rates (according to ASTM C 67) in excess of 30 grams/sq. in./minute shall be wetted from 3 to 4 hours before laying. All units shall be uniformly wetted and nearly saturated so the absorption rate does not exceed the above amount, but shall be surface dry without free water on surfaces when laid in the wall. During freezing weather, units that require wetting shall be sprinkled with warm water just before laying. (For units with surface temperatures above 32 degrees F, wet with water heated to above 70 degrees F. For units with surface temperatures below 32 degrees F, wet with water heated to above 130 degrees F.)
- C. Do not wet concrete masonry units.
- D. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets.
- E. Laying Up Masonry: Masonry shall be laid up true and plumb, with special units (corners, jamb blocks, headers, fillers, closers, fitters, etc.) as required to form corners, returns, openings, and offsets, and maintain a proper bond throughout the length of wall.
- F. Stopping and Resuming Work: Rack back 1/2-masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if specified to be wetted), and remove loose masonry units and mortar prior to laying fresh masonry.
- G. Protection of Work: During erection, cover top of walls with waterproof sheeting at end of each days' work. Cover partially complete structures when work is not in progress. Extend cover a minimum of 24-inches down both sides and hold cover securely in place.

3.05 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.06 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints. Bed webs in mortar starting course on footings and foundation walls and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or to be filled with concrete or grout. For starting courses on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Joints: Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not otherwise indicated, lay walls with 3/8-inch joints.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Interlock intersections and external corners.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where walls are concealed by other finish materials, walls are concealed in chases or above ceilings, resilient base is scheduled, cavity insulation vapor barrier adhesive is applied, or bitumen dampproofing is applied.
- I. Collar (vertical longitudinal) joints between facing and backing wythes or solid back-up material, except cavities, shall be completely filled with mortar by back parging either the facing or backing wythe and shoving units tight.
- J. Staining: Prevent grout, mortar and soil from staining the face of masonry to be left exposed or painted. Remove immediately grout and mortar in contact with such masonry. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
- K. Protect sills, ledges and projections from droppings of mortar.
- L. Isolate masonry partitions from vertical structural framing members with a control joint.

3.07 TOOLING AND POINTING

- A. Tooling and Pointing: Joints shall be struck flush and after mortar has partially set but is still sufficiently plastic to bond, joints shall be tooled with a tool which compacts mortar and presses excess mortar out of the joint rather than dragging it out. All joints shall be made with a straight, clean line. Exercise special care to avoid getting mortar on faces of brick which will be exposed.
- B. Rake joints back 3/4-inch at interior control joints in preparation for backer rod and caulking to be installed under Section 07 92 00.
- C. Pointing:
 - 1. Joints which are not tight at the time of tooling shall be raked out, pointed, and then tooled
 - 2. During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point-up all joints at corners, openings, and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealing compounds.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL AND SINGLE WYTHE MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 24 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.

- D. Lap joint reinforcement ends minimum 6 inches.
- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 24 inches horizontally and 16 inches vertically.

3.09 MASONRY WORK ADJACENT TO STRUCTURAL MEMBERS

- A. Anchoring Masonry to Structural Members: Provide an open space not less than 1/2-inch in width between masonry and structural members, unless otherwise shown. Keep open space free of mortar and other rigid materials. Place continuous compressible filler at all column sides adjacent to masonry construction as detailed on the Drawings maintaining the total space completely free of mortar and debris. Also place compressible fillers where non-bearing masonry abuts beam, joists or deck and at other locations shown on the Drawings or specified earlier in this Section.

3.10 GROUTED COMPONENTS

- A. Lap splices minimum 24 bar diameters.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

3.11 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Form expansion joint as detailed on drawings to form continuous vertical breaks from top to bottom of wall junctures. Expansion joints shall be straight and plumb, uniform in width, and totally filled with expansion joint filler as specified and other materials shown on the Drawings. Place expansion joint flashing lengths into wall as erected at locations indicated on the Drawings. Overlap lengths minimum of 4-inches in direction of flow.
- D. See Section 07 92 00 - Joint Sealants.

3.12 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, window frames, anchor bolts, plates, and sleeves and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Fill space between hollow metal frames and masonry solidly with mortar of Portland cement/sand grout mixed to be as stiff as possible without interfering with proper workability and solid filing of jambs. Additives and mixtures which could cause internal rusting in frames shall be strictly prohibited.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.13 MISCELLANEOUS MASONRY INSTALLATION REQUIREMENTS

- A. Openings and chases for heating, plumbing, and electrical ducts, pipes and conduits shall be built into masonry walls. Cutting of units to accommodate work of others shall be performed by masonry mechanics. Chases shall be kept free from mortar and debris.
- B. Fill cores of concrete masonry units of each course, as they are laid up, with sand at special sound isolation walls and partitions noted on the Drawings to receive sand fill. Protect top of unfinished walls and partitions to prevent sand from becoming moist.
- C. Install bond breaker at locations as shown on the Drawings in relation to other construction to allow separation for required movements.

- D. Miscellaneous Grouting: Unless otherwise shown on the Drawings, fill cores of concrete masonry units solid with grout at pilasters and piers, at 2 courses below bearing plates, at beam and lintel bearing and where required to secure anchors and bolts, grout fill all jambs at metal frames, and elsewhere as shown on the Drawings. Also, the cores shall be grouted full at courses which support at least 4 courses of concrete masonry units and roof loads, if the face shells of this lower course do not line up with the face shells of the course immediately above. Install metal lath in horizontal joint below cores to be filled solid with grout.
- E. Do not apply concentrated loads for at least 3 days after completion of erection of masonry walls and columns.

3.14 SPECIAL INSTALLATION REQUIREMENTS - REINFORCED MASONRY

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, and bars with reduced cross-section due to excessive rusting and other causes.
- B. Position reinforcement accurately at the spacing shown. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of no less than the nominal bar diameter of 1-inch (whichever is greater). For columns, piers and pilasters, provide a clear distance between vertical bars as shown, but not less than 1-1/2 times the nominal bar diameter or 1-1/2-inches, whichever is greater. Provide lateral ties as shown.
- C. Laying Masonry:
 - 1. Masonry shall have vertical alignment to provide minimum 2-inch by 3-inch clear continuous unobstructed cores.
 - 2. Top bed joints may be sloped down toward the center of wall to minimize the amount of mortar forced into grout spaces. Fins which project into cores to be grouted shall be removed.
- D. Placing Reinforcing:
 - 1. Horizontal and vertical reinforcing shall be accurately positioned as shown on the Drawings and rigidly secured against displacement. Reinforcing bars shall be straight, except for bends around corners and where bends or hooks are detailed on the Drawings.
 - 2. Foundation dowels that do not line up with cores shall not be sloped more than one horizontal in 6 vertical. Dowels shall be grouted into a core in vertical alignment, even though it is in an adjacent core to vertical wall reinforcing.
 - 3. Vertical reinforcing bars shall extend a minimum of 40-bar diameters above top course.
 - 4. High-lift grouting shall not be permitted.
 - 5. Bars shall be lapped a minimum of 40-bar diameters at splices and spaced at least one-bar diameter apart or wired together. Splices in adjacent horizontal bars shall be staggered.
 - 6. Reinforcing bars shall be completely embedded in grout.
- E. Grout:
 - 1. Grouting shall be done, wherever possible, from the inside face of masonry. Extreme care shall be used to prevent grout and mortar from staining the face of masonry to be left exposed or painted. If grout and mortar do contact the face of such masonry, they shall be immediately removed. Protect all sills, ledges, offsets, etc., from droppings of mortar and protect door jambs and corners from damage during construction.
- F. Low-lift grouting of cores which are reinforced shall be made in lifts of heights of 5-feet maximum. Spaces containing reinforcing shall be solidly filled with grout which shall be puddled or vibrated into place.
- G. High lift grouting of cores shall not be permitted.

- H. Cut-Offs: When grouting is stopped for one hour or longer, grout pour shall be stopped 1-1/2-inches below the top masonry course to form a key.

3.15 REPAIR AND POINTING OF MASONRY

- A. Remove and replace masonry units which are loose, chipped, broken, stained and otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point-up all joints at corners, openings, and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.

3.16 TOLERANCES

- A. Tolerances shall meet or exceed those recommended by the Brick Institute of America.

3.17 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.

3.18 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

DIVISION 05 – METALS

**SECTION 05 12 00
STRUCTURAL STEEL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 05 31 00 - Steel Decking: Support framing for small openings in deck.
- B. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual 2017.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges 2022.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- 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 - Standard Specification for Carbon and Alloy Steel Nuts 2021a.
- H. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric) 2021a.
- I. ASTM A992/A992M - Standard Specification for Structural Steel Shapes 2022.
- J. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2022.
- K. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions 2019.
- L. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength 2020.
- M. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
- N. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).
- O. SSPC-SP 3 - Power Tool Cleaning 2018.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - 2. Connections not detailed.
 - 3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Fabricator's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.
- D. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- E. Design connections not detailed on 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.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
- D. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M Class C.
- E. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
- F. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.
- G. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
- H. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Fabricate connections for bolt, nut, and washer connectors.

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, in contact with concrete, or high strength bolted.

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.
- 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

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permanent bracing.

- C. Field weld components indicated on shop drawings.
- D. Do not field cut or alter structural members without approval of Architect.
- E. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- F. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

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 will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

END OF SECTION

**SECTION 05 31 00
STEEL DECKING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Composite floor deck.
- B. Supplementary framing for openings up to and including 18 inches.
- C. Bearing plates and angles.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).
- D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel 2018, with Errata (2022).
- E. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems 2016.
- F. ICC-ES AC70 - Acceptance Criteria for Fasteners Power Driven into Concrete, Steel and Masonry Elements 2016.
- G. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks 2007.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
- B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- C. Certificates: Certify that products furnished meet or exceed specified requirements.

1.05 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. Nucor-Vulcraft Group: www.vulcraft.com/#sle.

2.02 STEEL DECK

- A. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
 - 2. Minimum Base Metal Thickness: 18 gauge, [] inch.
 - 3. Nominal Height: 1-1/2 inches.
 - 4. Profile: Fluted; SDI WR.
 - 5. Side Joints: Lock seam.
 - 6. End Joints: Lapped, welded.

2.03 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.
- 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 (DM) design method for roof deck and floor deck applications and ICC-ES AC43.
- 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 SDI (DM) design method for roof deck and floor deck applications and ICC-ES AC43.

2.04 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gauge, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.
- B. Floor Drain Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On steel supports provide minimum 1-1/2 inch bearing.
- C. 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 specified.
 - 1. Welding: Use fusion welds through weld washers.
- D. Clinch lock seam side laps.
- E. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.
- F. Weld deck in accordance with AWS D1.3/D1.3M.
- G. 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 fusion weld to deck at each flute.
- H. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- I. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION

**SECTION 05 40 00
COLD-FORMED METAL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formed steel stud interior wall framing.

1.02 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2020).
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
- D. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members 2018, with Editorial Revision.
- E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.
- F. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
- C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
 - 1. Describe method for securing studs to tracks and for bolted framing connections.
 - 2. Design data:
 - a. Shop drawings signed and sealed by a professional structural engineer.
- E. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention .

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing:
 - 1. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 2. Marino: www.marinoware.com/#sle.
- B. Framing Connectors and Accessories:
 - 1. Same manufacturer as metal framing.

2.02 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
- B. Design Requirements: Provide completed framing system having the following characteristics:
 - 1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100.
 - 2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
 - 3. Design Loads: In accordance with applicable codes.
 - 4. Live load deflection meeting the following, unless otherwise indicated:
 - a. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
 - 5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 - 6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS

- A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
 - 1. Gauge and Depth: As required to meet specified performance levels.
 - 2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
- B. Framing Connectors: Factory-made, formed steel sheet.
 - 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gauge, 0.1345 inch, and factory punched holes and slots.
 - 2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 - 3. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

2.04 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated.

2.05 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.

3.03 INSTALLATION OF WALL SHEATHING

- A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.

END OF SECTION

**SECTION 05 50 00
METAL FABRICATIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.
- C. Section 09 91 13 - Exterior Painting: Paint finish.
- D. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2020.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
- E. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes 2019a.
- 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 B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes 2012.
- I. ASTM B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric) 2012.
- J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- K. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1.05 QUALITY ASSURANCE

- A. Field Measurement: Take field measurements prior to preparation of shop drawings and fabrication, where possible.
- B. Shop Fabrications: Fabricate, fit, and assemble miscellaneous metal items in the shop. Work that cannot be permanently shop-assembled shall be completely assembled, marked, and disassembled before shipment to ensure proper assembly in the field.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. General: For metal work which will be exposed to view, use only materials which are smooth and free of all surface blemishes.
- B. Steel Sections: ASTM A36/A36M.
- C. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- D. Plates: ASTM A283/A283M.
- E. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- F. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
- G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
- D. Bolts, Nuts, and Washers: Stainless steel.

2.03 MATERIALS - GROUT

- A. Grout materials for setting posts in sleeves shall be Bonsal Anchor Cement manufactured by W.R. Bonsal Company or approved equal.

2.04 MATERIALS - FASTENERS

- A. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.
- B. Provide bolts and fastening devices as required to set miscellaneous and ornamental metal items in place.

2.05 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds at exterior locations.
 - 1. Miscellaneous metal items exposed on the interior shall be intermittently welded, ground smooth, and filled with sanded body putty; or at the Contractor's option, they may be continuously welded and ground smooth.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to a 1/32-inch radius. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work with exposed faces flat, smooth and free of deformation and distortion.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- G. Cut, reinforce, drill and tap miscellaneous metal work as required to receive hardware and similar items.

- H. Weather Exposure: Fabricate joints which will be exposed to the weather in a manner to exclude water and/or provide weep holes where water may accumulate through condensation or other means.

2.06 FABRICATED ITEMS

- A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking and masonry; prime paint finish.
- B. Steel Angles: Provided for metal deck support at all roof openings greater than 12-inches by 12-inches in size. Angles shall extend to adjacent joists and shall be installed on all 4 sides except where openings are immediately adjacent to joists. Angles shall be 3-inch by 3-inch by 1/4-inch unless noted otherwise on the Drawings.
- C. Lintels: As detailed; prime paint finish.
 - 1. Lintels shall have a minimum 8-inch bearing unless otherwise noted.
 - 2. All surfaces of exterior lintels shall be prepared and hot-dipped galvanized after fabrication.

2.07 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
 - 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: Two coats.
- E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.
- F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.08 FINISHES - ALUMINUM

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.
- D. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

END OF SECTION

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire retardant treated wood materials.
- B. Communications and electrical room mounting boards.
- C. Concealed wood blocking, nailers, and supports.
- D. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series) 2012 (Reaffirmed 2021).
- B. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
- C. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts 2021a.
- D. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- F. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples 2021.
- G. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs 2022.
- H. ASTM F594 - Standard Specification for Stainless Steel Nuts 2022.
- I. AWPA U1 - Use Category System: User Specification for Treated Wood 2022.
- J. PS 1 - Structural Plywood 2019.
- K. PS 2 - Performance Standard for Wood Structural Panels 2018.
- L. PS 20 - American Softwood Lumber Standard 2021.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide technical data on each type of process and factory-fabricated product.
- C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.
- D. Research/Evaluation Reports: For the following, showing compliance with the building code in effect for the Project:
 - 1. Power-driven fasteners.
 - 2. Powder-actuated fasteners.
 - 3. Expansion anchors
 - 4. Metal framing anchors.

1.05 QUALITY ASSURANCE

- A. New Products: Only new lumber shall be utilized throughout the project.

1.06 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, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 3. Where nominal sizes are indicated, provide actual sizes required by PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
 - 5. Treated wood will not be allowed, except at sill plate conditions.

2.02 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Top Plates and Headers Framing (2 by 6 through 4 by 16):
 - 1. Machine stress-rated (MSR) as follows:
 - a. Fb-single; minimum extreme fiber stress in bending: 1350 psi.
 - b. E (minimum modulus of elasticity): 1,400,000 psi.
 - 2. Species: Douglas Fir-Larch.
- E. Other Framing Not Listed Above: Any species and grade with a modulus of elasticity of at least 1,400,000 psi and an extreme fiber stress in bending of at least 875 psi for 2-inch thick nominal thickness for single-member use.
- F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. For items of dimension lumber size, provide Construction, Stud or No. 2 grade SPF lumber with 19 percent maximum moisture content.
 - 2. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
 - a. Spruce-pine-fir (south) or Spruce-pine-fir, Construction or No. 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.

2.03 EXPOSED BOARDS

- A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.
- B. Moisture Content: S-dry (19 percent maximum).
- C. Surfacing: S4S.
- D. Grade: No. 1, 1 Common, or Select.

2.04 CONSTRUCTION PANELS

- A. Wall Sheathing: PS 2 type.
 - 1. Bond Classification: Exposure 1.
 - 2. Grade: Structural I Sheathing.
 - 3. Span Rating: 24.
 - 4. Performance Category: 3/4 PERF CAT.
 - 5. Edge Profile: Square edge.
 - 6. Firetreated.
- B. 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.
- C. 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.

2.05 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in an area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153.
- B. Nails, Brads, and Staples: ASTM F1667 .
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 .
- F. Bolts: Steel bolts complying with ASTM A307 , Grade A, Property Class 4.6; with ASTM A563 Hex nuts and, where indicated, flat washers.
- G. Headed Anchor Bolts at Sill Plates: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594 , Alloy Group 1 or 2.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six (6) times the load imposed when installed in unit masonry assemblies and equal to four (4) times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633 , Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.06 METAL FRAMING ANCHORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alpine Engineered Products, Inc.
 - 2. Cleveland Steel Specialty Co.
 - 3. Simpson Strong-Tie Co., Inc.
 - 4. USP Structural Connectors.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by the manufacturer that meet or exceed those indicated. The manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

- C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation.

2.07 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: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
- 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 treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit.
- B. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. Table 2304.9.1, "Fastening Schedule", in the 2006 International Building Code.
 - 4. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; pre-drill as required.
 - 5. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.
- D. At sill plate conditions, provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2-inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

- E. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- F. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Toilet accessories.
 - 6. Wall-mounted door stops.
 - 7. Marker boards and tackboards.
 - 8. Projection screens.
 - 9. Wall and ceiling mounted projectors.
 - 10. Wall mounted A/V displays.
 - 11. Fire extinguisher cabinets.

3.04 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.

END OF SECTION

**SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Hardware.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.

1.03 REFERENCE STANDARDS

- A. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.04 SUBMITTALS

- A. See Section 01 30 00 - 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.
- C. Samples: Submit the following samples to the Architect/Engineer in accord with 01 30 00 - Administrative Requirements.
 - 1. Plastic Laminate: One piece of each specified; 2-inches by 2-1/2-inches minimum.
 - 2. PVC Edge Banding: One piece of each specified; 6-inch long strip.
 - 3. Solid Surfacing and Quartz: Set of two pieces of each color specified; 2-inches by 2-inches.
 - 4. Cabinet Liner: One of each specified; 6-inches by 6-inches.
 - 5. Hardware: Pulls; one of each specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.
- B. Do not deliver casework until painting, wet work, and similar operations, which could damage or deteriorate woodwork, have been completed in installation areas.
- C. Scheduling: Fabricator shall advise Contractor of temperature and humidity requirements for finish carpentry installation areas. Do not install interior finish carpentry until required temperature and relative humidity conditions have been stabilized and will be maintained in installation areas.
- D. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.06 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 LUMBER - GENERAL

- A. Factory-mark each piece of lumber and plywood with grading agency identification information; except omit marking from surfaces to receive transparent finish.
- B. Cabinets shall be constructed per Section 400 of AWI Quality Standards, 1997 edition, and shall be Custom Grade overlay construction (without reveals) for plastic laminate and wood casework unless indicated otherwise.

- C. Softwood Moisture Content: Softwood shall be seasoned lumber having a moisture content from time of manufacture until time of installation not greater than the values required by the applicable grading rules of the appropriate grading and inspecting agency.
- D. Hardwood Moisture Content: Hardwood shall be kiln dried lumber having a moisture content from time of manufacture until time of installation within the ranges required in the Architectural Woodwork Institute "Quality Standards".
- E. Wood Moisture Content: Provide kiln-dried lumber with an average moisture content range of 6-percent to 11-percent for interior work. Lumber at time of installation shall not exceed 5-percent to 10-percent for interior wood (except pressure treated wood).
- F. Lumber for Painted Finish: At Contractor's option, use pieces which are either glued-up lumber or made of solid lumber stock.
- G. Hardwood Edges: All exposed hardwood edges shall be eased slightly to approximately a 1/32-inch radius unless noted otherwise. Exercise care to avoid pre-easing edges which will abut other ease edges at unmitered corners.

2.02 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.

2.03 WOOD-BASED COMPONENTS

- A. Concealed miscellaneous solid wood for blocking, furring, nailers and similar applications as required shall be Standard or Better, any species, unless designated otherwise on the Drawings.
- B. Hardboard: shall be tempered.
 - 1. Thickness: 1/4-inch thick unless noted otherwise.
 - 2. Manufacturers:
 - a. Boise Cascade; www.bc.com.
 - b. Georgia-Pacific; www.gp.com.
 - c. Masonite Corporation; www.masonite.com.
- C. Particle Board:
 - 1. Density: 45-48 pounds per cubic foot.
 - 2. Thickness: 3/4-inch, unless otherwise shown or specified.
 - 3. Manufacturers:
 - a. Georgia-Pacific; www.gp.com.
 - b. Weyerhaeuser Company; www.weyerhaeuser.com
- D. Cabinet Liner for use on cabinet interiors where shown on the Drawings and specified hereinafter shall be of balanced panel construction composed of 9 to 11 mils thick thermosetting polyester over-laminated to both faces of particleboard substrate as previously specified, and shall be Pluswood. Melamine or 1/32-inch plastic laminate may be used at the Contractor's option, with Architect's approval.
- E. Nails for Architectural Casework Materials: As follows:

Stock up to 1/2-inch thick	4d finishing or casing nails
Stock 1/2- to 3/4-inch thick	6d finishing or casing nails
Stock 3/4- to 1-inch thick	8d finishing or casing nails
Stock 1- to 1-1/4-inch thick	16d finishing or casing nails

2.04 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation: www.formica.com/#sle.

- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
 - 1. Color: (PLAM-1) Formica, Terril, Flat.
- C. Thickness of plastic laminate shall be 1/16-inch where applied to countertops, backsplashes and endsplashes, and 1/32-inch elsewhere.
- D. Exposed tops less than 72-inches above the floor, ends, backs, fronts, doors, drawer fronts, knee spaces, face rails, open shelving, countertops, file cabinet openings and other locations specified or shown on the Drawings shall receive plastic laminate and shall be balanced with plastic laminate cabinet liner at semi-exposed locations and backer sheet at concealed locations.
- E. Plastic laminate placement shall be as shown on the Drawings.
- F. Interior surfaces of cabinet doors, unless noted otherwise, shall be the same plastic laminate as on the door exteriors.

2.05 COUNTERTOPS

- A. All countertops which abut walls shall be fabricated long for scribing in the field except where shown otherwise on the Drawings. Wall cleats supporting countertops at walls shall be 3/4-inch by 2-inch paint-grade hardwood. Recess back from front face of countertop 4 inches unless noted otherwise of the Drawings. Paint to match wall. All loose joints and field joints shall be jointed with hardwood splines and loose joint (or concealed) fasteners.
- B. Solid surfacing shall be 1/2-inch thick material (unless noted otherwise on the Drawings), shall be manufactured by Corian, and shall have eased edges as detailed on the Drawings.
 - 1. Color: (STN-3) Silver Birch.
- C. Simulated Stone shall be 1/2-inch thick material (unless noted otherwise on the Drawings).
 - 1. Color: (STN-1) Cambria, Luxury Series, Brittanica.
 - 2. Color: (STN-2) Cambria, Snowdon White.

2.06 ACCESSORIES

- A. Adhesive: Type recommended by AWI/AWMAC to suit application.
- B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Thickness: 3mm.
 - 2. Color: As selected by Architect from manufacturer's standard range.
 - 3. Manufacturers:
 - a. Doellken North America; www.doellken.com.
 - b. Rehau; www.rehau.com.
- C. Sealant, for sealing between wall surfaces and splashes or countertops, shall be one of the following:
 - 1. Dow Corning Corp.; 999, clear.
 - 2. General Electric Co.; SCC-1201, clear.
- D. Sealer for hardboard and drawer bodies shall be clear satin varnish (2 coats) manufactured by any of the approved manufacturers listed in Section 09 90 00.
- E. 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.
- F. Grommets: Standard plastic grommets for cut-outs, in color Metallic Silver 23.
 - 1. Manufacturer:
 - a. Doug Mockett & Company; Model No. EDP.

- G. Sealer for hardboard and drawer bodies shall be clear satin varnish (2-coats) manufactured by any of the approved manufacturer's listed in Section 09 90 00.
 - 1. Manufacturer:
 - a. Guilford of Maine; Panel 2100-FR701.

2.07 MISCELLANEOUS REQUIREMENTS

- A. All surfaces including countertops and backsplashes receiving plastic laminate shall be balanced with plastic laminate where exposed, or plastic laminate backer sheet where not exposed.
- B. Where architectural casework abut walls and ceilings, provide a maximum 3/4-inch scribe to match adjacent plastic laminate or hardwood. Hold face of scribe back 1-1/4-inch from the outer face of doors.
- C. All shelving shall be 1-inch thick material, with edging as specified above.
- D. Cabinets that hold equipment and those which do not extend to the floor shall be fabricated by gluing and screwing all joints and additional means necessary to provide extra strong joints to carry the load.
- E. Drawers shall be 1/2-inch solid hardwood assembled with lock-shoulder corner joint or full furniture dovetail joints. Bottom shall be 1/4-inch thick tempered Duron fully captured, except at file drawers (where file followers are specified) the bottom shall be 1/2-inch thick plywood fully captured, with 1/4-inch tempered hardboard layer on top of drawer bottom to bring it up flush with the file follower. Drawers shall be shop-sealed with 2 coats of sanding sealer prior to installation of drawer hardware.

2.08 HARDWARE

- A. Hardware: BHMA A156.9, types as scheduled for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, brushed chrome finish, for nominal 1 inch spacing adjustments.
 - 1. Product: No. 255 with 256 clips manufactured by K & V.
 - 2. Product No. 346 NP manufactured by K & V or equal.
 - 3. Provide 4 clips per shelf.
 - 4. Pin fits into 1/4-inch holes.
- C. Drawer and Door Pulls: "U" shaped wire pull, solid brass in US26D brushed chrome finish, 3 1/2 inch centers.
 - 1. Product: Series 4480 Model No. 4483-1/2 manufactured by Stanley Hardware.
 - 2. Pulls: Provide two pulls on drawer fronts exceeding 30-inches in width and one pull on each door.
- D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with brushed chrome finish.
 - 1. Product: DCN3-26D manufactured by Olympus.
 - 2. Furnish five master keys to the Owner.
 - 3. Key locks alike for each room. Each room shall be keyed differently from each other
- E. Door Catches: Magnetic.
 - 1. One per door less than 48-inches in height and 2 per door 48-inches in height or over. Catches shall be the manufacturers standard. Samples shall be submitted to the Architect/Engineer for approval. Finish shall be chrome or almond that matches liner.
- F. Automatic Door Catches for inactive leaf of locked pairs of doors:
 - 1. Spring changing bolts will not be accepted.
 - 2. Manufacturer:
 - a. H.B. Ives; Elbow Catch #2, heavy duty or approved equal.

- G. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Mounting: Side mounted.
 - 3. Manufacturers:
 - a. For all drawers over 8-inches high, and for all drawers wider than 24-inches:
 - 1) Accuride International, Inc; Model 3640: www accuride.com/#sle.
 - b. Drawer slides for all other drawers:
 - 1) Blum 430E.
 - c. Manufacturer's standard glides are acceptable on standard drawers as long as the following minimum requirements are met:
 - 1) 100-pound rating
 - 2) epoxy coating
 - 3) in-stop/out/stop, out keeper
 - 4) nylon ball-bearing rollers
 - 5) side away adjustable cam
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Hinges: Concealed (fully mortised) self-closing type, with plastic caps.
 - 1. Manufacturers:
 - a. Grass America Inc; Model No. 1203: www.grassusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Doors 48-inches or less: 1-pair.
 - 3. Doors 48- to 72-inches: 1-1/2 pair.
 - 4. Doors over 72-inches: 2 pair.
 - 5. Provide Grass clear plastic bumper pads in the same quantity as the hinges.

2.09 FABRICATION

- A. General: Architectural Casework shall conform to the design and details shown on the Drawings and shall meet the requirements for cabinets as defined in Section 400 of the Architectural Woodwork Institute Quality Standards for Custom Grade overlay construction (unless otherwise shown on the Drawings) plastic laminate and wood casework.
- B. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements, verify dimensions, and review equipment shop drawings as required for an accurate fit.
- C. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings. However, items shall be fabricated in largest units possible, with minimal field joints and assembly. Proposed field joint locations shall be shown on the shop drawings.
- D. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- E. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- F. All countertops, unless noted otherwise, shall be 1-layer of 3/4-inch thick particleboard and 1-layer of 1/2-inch thick particleboard. Plastic laminate shall be utilized to cover all exposed portions of the countertop, backsplashes and endsplashes. Edges shall be hardwood and shall be as shown on the Drawings.
- G. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

- H. Inner faces of doors and inner faces of finished ends shall be plastic laminate or hardwood plywood as shown on the Drawings.
- I. Concealed and semi-exposed framing shall be of soft wood.
- J. Where finished end or base cabinet has side splash shown, the end and splash shall be one-piece 3/4-inch thick particleboard with plastic laminate at all exposed faces, and hardwood edging (size as shown of the Drawings).
- K. Provide cutouts for plumbing fixtures, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure cabinets and counter bases to floor using appropriate angles and anchorages.

3.03 ADJUSTING

- A. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

**SECTION 07 05 53
FIRE AND SMOKE ASSEMBLY IDENTIFICATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting: Paint finish.

1.03 REFERNECE STANDARDS

- A. ICC (IBC) - International Building Code; 2012.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.
- C. Schedule: Completely define scope of proposed marking, and indicate location of affected walls and partitions, and number of markings.
- D. Samples: Submit two samples of each type of marking proposed for use, of size similar to that required for project, illustrating font, wording, and method of application.

PART 2 PRODUCTS

2.01 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

- A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC).
- B. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl or paper sign with factory applied adhesive backing.
- C. Applied Fire and Smoke Assembly Identification: Identification markings applied to partition with paint and a code compliant stencil. See Section 09 91 23 for products.
- D. Languages: Provide sign markings in English.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 PREPARATION

- A. See Section 09 90 00 for substrate preparation for painted markings.

3.03 INSTALLATION

- A. Locate markings as required by ICC (IBC).
- B. Install adhered markings in accordance with manufacturer's instructions.
- C. Install applied markings in accordance with Section 09 90 00.
- D. Install neatly, with horizontal edges level.
- E. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION

**SECTION 07 11 13
BITUMINOUS DAMPPROOFING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Bituminous dampproofing.
 - 1. At structural steel columns and base plates where concealed by concrete and extending below grade.
 - 2. At other similar locations as may be shown on the Drawings at steel surfaces.

1.02 REFERENCE STANDARDS

- A. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal 1997 (Reapproved 2018).
- B. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing 2013.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide properties of primer, bitumen, and mastics.

1.04 QUALITY ASSURANCE

- A. General: For each type of work, obtain primary materials from a single manufacturer, to the greatest extent possible. Provide secondary materials only as recommended by the manufacturer of the primary materials.
- B. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.05 FIELD CONDITIONS

- A. Temperature and Weather: Unless otherwise permitted by the dampproofing manufacturer's recommendations, dampproofing shall not be applied when temperatures are below 50-degrees F, during rainy weather, when rain is forecast within 24 hours, or when freezing temperatures are forecast within 12 hours.
- B. Protect dampproofing from rain and moisture during initial set.
- C. Protect other work from spillage of dampproofing materials and prevent materials from penetrating and clogging drains and conductors.
- D. Scheduling: Do not proceed with dampproofing work until blocking, nailers, piping, conduit and other projections through the substrate have been installed, and parging placed and cured.

PART 2 PRODUCTS

2.01 BITUMINOUS DAMPPROOFING

- A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
 - 1. Composition - Vertical Application: ASTM D1227 Type III or ASTM D1187/D1187M Type I.
 - 2. Composition - Horizontal and Low-Slope Application: ASTM D1227 Type II or III.
 - 3. VOC Content: Not more than permitted by local, State, and federal regulations.
 - 4. Applied Thickness: 1/16 inch, minimum, wet film.
 - 5. Products:
 - a. Master Builder Solutions by BASF; MasterSeal 615: www.master-builder-solutions.basf.us.

- b. W. R. Meadows, Inc; Sealmastic Emulsion Type II (brush/spray-grade):
www.wrmeadows.com/#sle.
- B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

- A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.
- B. Foundation Walls: Patch disturbed areas of existing dampproofing with two additional coats of dampproofing of the same generic type.
- C. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- D. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- E. Apply bitumen by brush or spray application.
- F. Apply bitumen in two coats, continuous and uniform, at a rate of 25 sq ft/gal per coat to a minimum dry-film thickness of not less than 30 mils. Dampproofing shall be applied evenly to form a continuous unbroken film, free from pinholes so that surfaces present a uniform black appearance..
- G. Extend vertical dampproofing 12-inches onto intersecting walls and footings, but do not extend onto surfaces which will be exposed to view when the project is completed.
- H. Seal items watertight with mastic, that project through dampproofing surface.
- I. Backfilling: Unless a longer curing time is recommended by the dampproofing material manufacturer, backfilling shall be executed at least 24 hours and not more than 7 days after dampproofing work is complete. Care shall be taken during backfilling as not to rupture, damage, or displace the dampproofing.

END OF SECTION

**SECTION 07 19 00
WATER REPELLENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water repellents applied to exterior masonry surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 04 20 00 - Unit Masonry.

1.03 REFERENCE STANDARDS

- A. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete 2021.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings 2005 (Reapproved 2018).
- C. ASTM D5095 - Standard Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments 1991 (Reapproved 2022).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience
- B. Single Source Responsibility: Both water-repellent coating and graffiti-resistant coating to be by the same manufacturer. Where both coatings are applied to the same surface, apply within the time limit specified by the coating manufacturer.
 - 1. When both water repellent and graffiti-resistant coatings are applied to the same surface, be sure only manufacturers that provide both types of coatings are specified and that their products are compatible with each other.

1.06 MOCK-UP

- A. Apply water repellent according to the rates and methods recommended by the manufacturer to half of the approved brick and cast stone unit mock-ups. Water repellent work shall not proceed until the sample applications have been approved by the Owner and Architect.

1.07 FIELD CONDITIONS

- A. Protect liquid materials from freezing.
- B. Do not apply water repellent when ambient temperature is lower than 50 degrees F or higher than 100 degrees F.
- C. Follow the manufacturer's printed instructions relative to other application limitations and specific requirements of temperature and wall dryness before masonry surface application begins.
- D. Sequencing: Application of water repellent shall not proceed until all caulking, painting and sealing has been applied.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

- B. Water Repellent: Submit 2 copies of a warranty, signed by the manufacturer, describing an agreement to furnish new water repellent material at no cost to the Owner for wall areas which become non-water-repellent due to a deterioration of the original application within a period of 5 years following the completion of the water repellent work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acrylic Water Repellents:
 - 1. BASF Construction Chemicals; MasterProtect Series:
www.buildingsystems.basf.com/#sle.
- B. Silane, Siloxane, Silane-Siloxane Blend, and Siliconate Water Repellents:
 - 1. PROSOCO, Inc; Sure Klean Weather Seal Blok-Guard & Graffiti Control:
www.prosoco.com/#sle.

2.02 MATERIALS

- A. Water Repellent: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
 - 1. Applications: Vertical surfaces and non-traffic horizontal surfaces.
 - 2. Number of Coats: Two.
 - 3. VOC Content: Less than 20 g/L, when tested in accordance with ASTM D3960 or ASTM D5095.
 - 4. Water-based siloxane, silane, or blend that reacts chemically with concrete and masonry.
 - a. Manufacturers:
 - 1) PROSOCO, Inc; Sure Klean Weather Blok-Guard & Graffiti Control II:
www.prosoco.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify joint sealants are installed and cured.
- C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

3.02 PREPARATION

- A. Protection of Adjacent Work:
 - 1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
 - 2. Protect adjacent surfaces not intended to receive water repellent.
- B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.
- C. Do not start work until masonry mortar substrate is cured a minimum of 60 days.
- D. Remove loose particles and foreign matter.
- E. Remove oil and foreign substances with a chemical solvent that will not affect water repellent.
- F. Scrub and rinse surfaces with water and let dry.
- G. Allow surfaces to dry completely to degree recommended by water repellent manufacturer before starting coating work.

3.03 APPLICATION

- A. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.
- B. Apply at rate recommended by manufacturer, continuously over entire surface.

- C. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.

END OF SECTION

**SECTION 07 21 00
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Batt insulation and vapor retarder in exterior wall construction.
- B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

- A. Section 04 20 00 - Unit Masonry: Masonry walls enclosing insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- C. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect insulation from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with the manufacturer's recommendations for handling, storage, and protection during installation.
- B. Do not expose plastic insulation to sunlight, except to the extent necessary for the period of installation and concealment.
- C. Protect plastic insulation against ignition at all times. Do not deliver plastic insulating materials to project site ahead of time. Complete installation and concealment of plastic materials as rapidly as possible in each area of work.

1.06 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- 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: 450 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 4. Formaldehyde Content: Zero.
 - 5. Thermal Resistance: R-value of R-11. At 6-inch stud walls, use unfaced R-19 batts.
 - 6. Products:
 - a. CertainTeed Corporation: www.certainteed.com/#sle.

- b. Johns Manville: www.jm.com/#sle.
 - c. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Mineral Fiber Batt Insulation: 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. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 - 2. Products:
 - a. Thermafiber, Inc; SAFB: www.thermafiber.com/#sle.

2.02 ACCESSORIES

- A. Continuous Air Barrier and Vapor Retarder: At all exterior walls where Batt Insulation is provided, that area shall be encapsulated by a vapor barrier. Install per manufacturer's recommended standards.
 - 1. Product: MemBrain by Certainteed Corporation.
- B. Tape: Polyethylene self-adhering type, mesh reinforced, 2 inch wide.
- C. Insulation Fasteners: Appropriate for purpose intended.
 - 1. Length as required for thickness of insulation material and penetration of deck substrate.
- D. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.
- E. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Push down and in vertical spaces to assure avoidance of future settling.
- F. Maintain all required minimum clearances between insulation and fans, lights, or other heat producing equipment items.
- G. Install with factory-applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.
- H. Staple or nail facing flanges in place at maximum 6 inches on center.
- I. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
- J. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.03 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

**SECTION 07 21 19
FOAMED-IN-PLACE INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foamed-in-place insulation.
 - 1. In exterior framed walls.
 - 2. In exterior wall crevices.
 - 3. At junctions of dissimilar wall and roof materials.

1.02 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics 2019.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- D. 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).

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, insulation properties, and preparation requirements.
- C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection as required by ABAA QAP.
- D. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience, and approved by manufacturer.
- B. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
 - 1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
 - 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 MOCK-UP

- A. Install one representative area of insulation (approximately 14 feet long by 14 feet high); include insulation wall construction, window and frame, and door frame in mock-up.
- B. Mock-up may remain as part of the Work.

1.07 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

2.01 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 Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
 - 3. Closed Cell Content: At least 90 percent.
 - 4. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
 - 5. Manufacturers:
 - a. BASF Corporation; SPRAYTITE 178: www.spf.basf.com/#sle.
 - b. Certainteed; CertiaSpray Closed Cell Foam: www.certainteed.com.
 - c. Demilec LLC; HEATLOK HFO High Lift: www.demilec.com/#sle.
 - d. Dow: www.dow.com.
 - e. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACCESSORIES

- A. Primer: As required by insulation manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify work within construction spaces or crevices is complete prior to insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Apply to achieve a thermal resistance R-value of 13 minimum.
- D. Patch damaged areas.
- E. At exterior stud walls with structural steel beams, fill the cavity between the steel and the exterior sheathing full. Coordinate with General Contractor to drill openings in and patch portions of the exterior sheathing board, as required, to provide access to fill the cavity full.
- F. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
- G. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 PROTECTION

- A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

**SECTION 07 26 00
VAPOR BARRIERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vapor barriers.

1.02 REFERENCE STANDARDS

- A. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications 2016.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.

1.04 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 VAPOR BARRIERS

- A. Vapor Barrier Sheet: Polyethylene sheeting complying with ASTM D4397, clear colored.
 - 1. Thickness: 6 mil, 0.006 inch, nominal.
 - 2. Seam and Perimeter Tape: Polyethylene self-adhering type, mesh reinforced, 2 inches wide; compatible with sheet material.

2.02 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Vapor Barrier and Adjacent Substrates: As indicated, complying with vapor barrier manufacturer's installation instructions.
- B. Vapor Barrier Tape: Coated polyester film with acrylic adhesive backing; pressure sensitive.

PART 3 EXECUTION

3.01 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Vapor Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.

END OF SECTION

**SECTION 07 84 00
FIRESTOPPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not.

1.02 RELATED REQUIREMENTS

- A. Section 07 05 53 - Fire and Smoke Assembly Identification.
- B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems 2015 (Reapproved 2019).
- D. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus 2020.
- E. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies 2013 (Reapproved 2017).
- F. FM 4991 - Approval Standard of Firestop Contractors 2013.
- G. FM (AG) - FM Approval Guide current edition.
- H. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.
- I. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.
- J. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's qualification statement.
- E. Installer's qualification statement.

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:
 - 1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
 - 2. Verification of minimum three years documented experience installing work of this type.
 - 3. Verification of at least five satisfactorily completed projects of comparable size and type.
 - 4. Licensed by local authorities having jurisdiction (AHJ).

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 MANUFACTURERS

- A. Basis of Design Manufacturer:
 - 1. 3M Fire Protection Products; CP 25WB: www.3m.com/firestop/#sle.
 - a. Accessories: MPS-2 and MMP-4S putty and other accessories as manufactured by 3M.
- B. Acceptable Firestopping Manufacturers:
 - 1. Hilti, Inc: www.us.hilti.com/#sle.
 - 2. Johns Manville: www.jm.com.
 - 3. RectorSeal, a CSW Industrials Company: www.rectorseal.com/firestop-solutions/#sle.
 - 4. Specified Technologies Inc: www.stifirestop.com/#sle.
 - 5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 6. USG: www.usg.com.

2.02 MATERIALS

- A. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- B. Fire Ratings: Refer to drawings for required systems and ratings.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
- B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
- C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.04 FIRESTOPPING SYSTEMS

- A. Firestopping:
 - 1. Fire Ratings: Use system that is listed by FM (AG) or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.
- B. Fire Safing Insulation:
 - 1. Mineral wool insulation for head of wall conditions, prefabricated to fit the trapezoidal flutes typical of metal deck.
 - a. Product: Thermafiber TopStop, Mineral Wood Insulation by Owens Corning or approved equal. See Section 01 60 00 - Materials & Methods.
 - 2. Mineral wool insulation for use at construction joints and penetrations.
 - a. Product: Thermafiber Safing, Mineral Wood Insulation by Owens Corning or approved equal. See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

- A. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

**SECTION 07 92 00
JOINT SEALANTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 08 80 00 - Glazing: Glazing sealants and accessories.
- B. Section 09 30 00 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.
- C. Section 13 34 19 - Metal Building Systems.

1.03 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants 2018 (Reapproved 2022).
- C. ASTM C834 - Standard Specification for Latex Sealants 2017.
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2022.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- H. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2022.
- I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.
- J. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

1.04 SUBMITTALS

- A. See Section 01 30 00 - 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. Certification by manufacturer indicating that product complies with specification requirements.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection. Samples shall be strips of actual caulking. Paper samples shall not be acceptable.
- D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Allow sufficient time for testing to avoid delaying the work.
 - 4. Deliver to manufacturer sufficient samples for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 - 6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.06 WARRANTY

- A. See Section 01 78 00 - 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.
 - 1. Urethane Sealants: Five years.
 - 2. Silicone Sealants: Twenty years.

1.07 JOB CONDITIONS

- A. Weather and Temperature: Sealants shall be installed on dry days preferably with temperatures between 40F and 55F, but in no case shall sealants be installed when temperatures are below 40F or above 90F.
- B. Protection: Special care shall be exercised to prevent damage to adjacent work during installation of sealants.
- C. Sequencing:
 - 1. Install sealant adjacent to painted and stained surfaces before adjacent surfaces receive their final coat of paint or stain.
 - 2. Install sealants after brickwork and concrete is washed down and before water repellent treatment is applied.
 - 3. Caulking shall not begin until all samples have been approved and until a meeting has been held at the construction site between the Architect/Engineer and the caulking subcontractor to discuss miscellaneous caulking requirements and workmanship.

PART 2 PRODUCTS

2.01 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. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - 1) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
- c. 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. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
 - 2. Type S-6 - Joints within and at perimeter of Exterior Insulation Finish System.
- 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. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 - 3. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 - 4. Interior Expansion Joints at Exterior Walls.
- D. Interior Wet Areas: restrooms, kitchens, and food service areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.02 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 61 16.

2.03 NONSAG JOINT SEALANTS

- 1. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
- 2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
- 3. Manufacturers:
 - a. Dow Chemical Company; DOWSIL 790 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - b. Dow Chemical Company; DOWSIL 791 Silicone Weatherproofing Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - c. Pecora Corporation: www.pecora.com/#sle.
 - d. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
 - e. Tremco Commercial Sealants & Waterproofing; Spectrem 3: www.tremcosealants.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- B. 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. Dow Corning Corporation; 786 Mildew Resistant.

- b. General Electric; Sanitary 1700 Sealant.
- c. Tremco, Inc.; Tremsil 200: www.tremcosealants.com.
- d. Substitutions: See Section 01 60 00 - Product Requirements.
- 3. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
- 4. Manufacturers:
 - a. Pecora Corporation; Dynatrol II: www.pecora.com/#sle.
 - b. Sika Corporation; Sikaflex-2c NS: www.usa-sika.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing; Vulkem 116: www.tremcosealants.com/#sle.
 - d. Tremco Commercial Sealants & Waterproofing; Dymeric 511: www.tremcosealants.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- C. 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. Manufacturers:
 - a. Pecora Corporation; NR-200 Urexpan: www.pecora.com.
 - b. Sika Corporation; Sikaflex-2c NS: www.usa-sika.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing; THC-900: www.tremcosealants.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use. Acoustical Sealant for use at penetrations through walls and at the tops of walls.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Manufacturers:
 - a. BASF; MasterSeal NP 520: www.master-builders-solutions.basf.us.
 - b. Pecora Corporation; AC-20: www.pecora.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound: www.tremcosealants.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Firestopping Sealant: For use at penetrations through fire rated walls and tops of such walls, ASTM E814.
 - 1. Basis of Design Manufacturer:
 - a. 3M; CP 25WB: www.3m.com.
 - 1) Accessories: MPS-2 and MMP-4S putty and other accessories as manufactured by 3M.
 - 2. Other Acceptable Manufacturers:
 - a. Bio Fireshield; Biotherm and Biostop: www.biofireshield.com.
 - b. Johns Manville.
 - c. Rectorseal.
 - d. Tremco.
 - e. USG.
 - f. Substitutions: See Section 01 60 00 - Product Requirements .

2.04 SELF-LEVELING SEALANTS

- 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. Manufacturers:
 - a. Sika Corporation; Sikaflex-2c SL: www.usa-sika.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Self-Leveling Polyurethane Sealant for Horizontal Expansion Joints: ASTM C920, Grade P, Uses T, M and O; multi-component; explicitly approved by manufacturer for horizontal

expansion joints.

1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 30 to 35, Shore A, when tested in accordance with ASTM C661.
3. Manufacturers:
 - a. W.R. Meadows, Inc.; Gardox:
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

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. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 3. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
 5. Manufacturers:
 - a. BASF: www.basf.com.
 - b. Nomaco, Inc: www.nomaco.com/#sle.
 - c. W.R. Meadows: www.wrmeadows.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Overlay Extrusion for Glazing System Joint Protection: Rubber profiled extrusions placed over joints in glazing system and provided with watertight seal.
 1. Profile: As required to match existing metal glazing cap requirements.
- C. Preformed Extruded Silicone Joint Seal: Pre-cured low-modulus silicone extrusion, in sizes to fit applications indicated on drawings, combined with a neutral-curing liquid silicone sealant for bonding joint seal to substrates.
 1. Thickness: 0.78 inch, with ridges along outside bottom edges for bonding area.
- D. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- E. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- F. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- G. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

- A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

DIVISION 08 – OPENINGS

**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 90 00 - Painting: Field painting.
- D. Section 13 34 19 - Metal Building Systems.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2022.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- H. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.
- I. ASTM C476 - Standard Specification for Grout for Masonry 2022.
- J. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames 2016.
- K. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- 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 Receipt, Storage and Installation of Hollow Metal Doors and Frames 2017.
- P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
- Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.
- R. UL (DIR) - Online Certifications Directory Current Edition.

- S. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Supplier of Hollow Metal Doors and Frames shall be responsible for all coordination and preparation of hardware and hollow metal doors and frames as they relate to each other.
- B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies whose fire resistance characteristics have been determined per ASTM E 152 and which are labeled and listed by UL, Factory Mutual, Warnock Hersey, or other testing and inspecting organizations acceptable to the authorities having jurisdiction.
- C. Hardware Templates: Templates shall be furnished to the fabricator by the hardware manufacturer. The fabricator shall drill and tap all holes, and make all cutouts and reinforcement in frames and doors to receive hardware in a neat and proper manner.
- D. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Inspect hollow metal work upon delivery for damage or manufacturing defects. Minor damages and defects may be repaired provided items are equal in all respects to new work and acceptable to the Architect. Rejected work shall be replaced with new items.
- C. Delivery and Storage: Doors shall be shipped individually packed. Frames shall be shipped with angle spreaders at door opening bottoms. Doors and frames shall be stored on the building site, in an upright position, under cover, on wood sills or floors, in a manner that will prevent rust or damage. Ventilate canvas or plastic covers to avoid humidity build-up.
- D. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - 4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - 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. Door Edge Profile: Manufacturers standard for application indicated.
 - 4. Typical Door Face Sheets: Flush.
 - 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Flush.
 - 6. 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.
- 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. 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 and 3 - Style and Rail.
 - d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - 1) 14 gage at stile and rail doors.
 - 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 - 3. Door Thickness: 1-3/4 inches, nominal.
 - 4. Door Finish: Factory primed and field finished.
- B. Interior Doors, Non-Fire Rated:
- 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 gauge, 0.053 inch, minimum.
 - 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 - 3. Door Thickness: 1-3/4 inches, nominal.
 - 4. Door Finish: Factory primed and field finished.
- C. Fire-Rated 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 gauge, 0.053 inch, minimum.
 - 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - 3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - a. Attach fire rating label to each fire rated unit.

4. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
5. Door Thickness: 1-3/4 inches, nominal.
6. Door Finish: Factory primed and field finished.

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: Full profile/continuously welded type.
 1. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
 2. Weatherstripping: Separate, see Section 08 71 00.
- 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: Full profile/continuously welded type.
 1. Fire Rating: Same as door, labeled.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00, factory installed.
- B. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.07 FABRICATION

- A. Fabricate metal doors and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Grind and fill all visible projection welds as required to make welded areas smooth, flush and invisible on exposed faces. No visible grind marks from fabrication will be allowed. The level of surface grinding prior to prime painting shall be as sufficient so that all grinding is invisible on exposed faces regardless of the sheen of the painted finish. The Owner reserves the right to reject any surface where visible grinding marks are found after final finish regardless of whether surface preparation was done according to manufacturer's standard practices or SDI standards.
- B. Light Openings in doors shall be fabricated with integral formed fixed square corner profile steel exterior stop on all opening edges and with removable interior square corner profile formed steel loose stops secured with evenly spaced oval head countersunk metal screws. Fit removable stops flush with the door edge and with tight butt joints at the corners. Aluminum and pressed steel overlay protecting profile lite opening frames are not acceptable. No deviations from these requirements will be allowed.

- C. Undercut doors 3/4-inch to clear carpet where carpet is indicated in the Room Finish Schedule. Pay particular attention to varying heights of different thresholds when setting door undercuts.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 08 71 00.
- F. Comply with glazing installation requirements of Section 08 80 00.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

3.03 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION

**SECTION 08 14 16
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.

1.03 REFERENCE STANDARDS

- A. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
- B. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- C. WDMA I.S. 1A - Interior Architectural Wood Flush Doors 2021, with Errata.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Samples: Submit two samples of door veneer, 6 inches by 6 inches in size illustrating wood grain, stain color, and sheen.
- E. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Obtain doors from a single manufacturer to ensure uniformity in quality of appearances and construction, unless otherwise indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Wood doors shall not be delivered until the building or storage area is enclosed and sufficiently dry so that doors will not be damaged by excessive changes in moisture content.
- D. Identify each door as to type and location.
- E. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 78 00 - 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. Eggers Industries: www.eggersindustries.com/#sle.
2. Graham Wood Doors: www.grahamdoors.com/#sle.
3. Lynden Door: www.lyndendoor.com.
4. Marshfield DoorSystems, Inc: www.marshfielddoors.com/#sle.
5. VT Industries, Inc.; www.vtindustries.com.
6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS

- A. Doors:
 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
 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 UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 3. Wood veneer facing with factory transparent finish.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particle board core (PC) or structural composite lumber core (SCLC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 1. Vertical Edges: Same species as face veneer.
- B. Facing Adhesive: Type II - water resistant.

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 locations required by WDMA for hardware reinforcement.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
 1. Transparent:
 - a. System - TR-6, Catalyzed Polyurethane.
 - b. Stain: As selected by Architect.
 - c. Sheen: Satin.
- B. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 08 11 13.
- B. Glazing: See Section 08 80 00.
- C. Glazing Stops: Wood, of same species as door facing, mitered corners; prepared for countersink style tamper proof screws.
 - 1. Provide square edge profile primed steel 2-piece glass kit frames for labeled doors.
- D. Door Hardware: See Section 08 71 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Fit door to frame for proper fit and machine for hardware using templates supplied by the Hardware Supplier.
- D. Use machine tools to cut or drill for hardware.
- E. Coordinate installation of doors with installation of frames and hardware.
- F. Coordinate installation of glazing.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION

**SECTION 08 31 00
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted access units.

1.02 SUBMITTALS

- A. See Section 01 30 00 - 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 in Wet Areas:
 - 1. Location: As indicated on drawings.
 - 2. Size: 18 by 18 inches.

2.02 WALL MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. FF Systems, Inc: www.ffsystemsinc.com/#sle.
 - a. Tile Applications: FF Systems; System F3.
- B. Wall Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Material: Aluminum extrusions with gypsum board inlay.
 - 2. Style: Recessed door panel for infill with wall/ceiling finish.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - 3. Door Style: Single thickness with rolled or turned in edges.
 - 4. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 5/8 inch back from wall face.
 - 5. Aluminum Finish: Natural brushed.
 - 6. Hardware:
 - a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - b. Latch/Lock: Tamperproof tool-operated cam latch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Unit to be installed at 5'-0" above finish floor.
- C. Install frames plumb and level in openings, and secure units rigidly in place.
- D. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

**SECTION 08 36 13
SECTIONAL DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Overhead sectional doors, electrically operated.
 - 1. Overhead sectional door is existing under Phase 1 and included for information only.
 - 2. Operator and Controls are **to be provided under Phase 2 contract.**
- B. Operating hardware and supports.
- C. Electrical controls.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 83 - Wiring Connections.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- C. DASMA 102 - American National Standard Specifications for Sectional Doors 2018.
- D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2008 (Reaffirmed 2020).
- E. NEMA MG 1 - Motors and Generators 2021.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL (DIR) - Online Certifications Directory Current Edition.
- I. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - 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. Operation Data: Include normal operation, troubleshooting, and adjusting.

1.05 QUALITY ASSURANCE

- A. Provide each sectional overhead door as a complete unit produced by one manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, hardware, operators and installation accessories, to suit openings and head room allowable.
- B. Inserts and Anchorages: Furnish inserts and anchoring devices which must be built into masonry for installation of units. Provide setting drawings, templates, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.
- C. Wind Loading: Design and reinforce sectional overhead doors to withstand a 20 lb. per sq. ft. wind loading pressure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sectional Doors:

1. C.H.I. Overhead Doors; Model 3285 Micro-Grooved Sandwich Steel Insulated Doors: www.chiohd.com/#sle.
2. Overhead Door Co.; Series 595: www.overheaddoor.com.
3. Raynor Garage Doors; Model TC 200: www.raynor.com.
4. Wayne-Dalton, a Division of Overhead Door Corporation; Thermospan Model 200-20: www.wayne-dalton.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 STEEL DOORS

- A. Steel Doors: Flush steel, insulated; high lift operating style with track and hardware; complying with DASMA 102, Commercial application.
 1. Door Nominal Thickness: 2 inches thick.
 2. Exterior Finish: Factory finished with acrylic baked enamel; color as selected from manufacturers standard line.
 3. Interior Finish: Factory finished with acrylic baked enamel; color as selected from manufacturers standard line.
 4. Glazed Lights: Three glazed lights per panel, one row; set in place with resilient glazing channel.
 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 24 gage, 0.0239 inch minimum thickness, flat profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; expanded polystyrene (EPS) insulation.
- C. Glazing: Fully tempered glass; single pane; clear; 1/8 inch overall thickness.

2.03 COMPONENTS

- A. Track: Provide manufacturer's standard galvanized steel track system sized for door size and weight, and designed for clearance shown. Provide complete track assembly including brackets, bracing and reinforcing.
- B. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.
- C. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
- D. Head Weatherstripping: EPDM rubber seal, one piece full length.
- E. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

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.
- C. Insulation: Expanded polystyrene (EPS), bonded to facing.

2.05 ELECTRIC OPERATION

- A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by UL (DIR) or testing agency acceptable to authorities having jurisdiction.
 1. Provide interlock switches on motor operated units.
- B. Electric Operators:
 1. Mounting: Side mounted on cross head shaft.
 2. Motor Enclosure:
 - a. Exterior Doors: NEMA MG 1, Type 4; open drip proof.
 - b. Interior Doors: NEMA MG 1, Type 1; open drip proof.

3. Motor Rating: 1/3 hp; continuous duty.
 4. Motor Voltage: 120 volts, single phase, 60 Hz.
 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 6. Controller Enclosure: NEMA 250, Type 1.
 7. Opening Speed: 12 inches per second.
 8. Brake: Adjustable friction clutch type, activated by motor controller.
 9. Manual override in case of power failure.
 10. Refer to Section 26 05 83 for electrical connections.
- C. 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.
- D. 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 electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.
- E. Disconnect Switch: Factory mount disconnect switch in control panel.
- F. Electric Operator: Side mounted on cross head shaft, adjustable safety friction clutch; brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware.
- G. Safety Edge: Located at bottom of sectional door panel, full width; electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object; hollow neoprene covered to provide weatherstrip seal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

- A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.

3.03 INSTALLATION

- A. Install door unit assembly in accordance with manufacturer's instructions.
- B. Anchor assembly to wall construction and building framing without distortion or stress.
- C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- D. Fit and align door assembly including hardware.
- E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.
- F. Install perimeter trim.

3.04 TOLERANCES

- A. Maximum Variation from Plumb: 1/16 inch.
- B. Maximum Variation from Level: 1/16 inch.

- C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.
- D. Maintain dimensional tolerances and alignment with adjacent work.

3.05 ADJUSTING

- A. Adjust door assembly for smooth operation and full contact with weatherstripping.

3.06 CLEANING

- A. Clean doors and frames.
- B. Remove temporary labels and visible markings.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.
- B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION

**SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- B. Section 08 80 00 - Glazing: Glass and glazing accessories.
- C. Section 13 34 19 - Metal Building Systems.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems 2015.
- C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections 2009.
- D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- G. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.
- H. 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).
- I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. All frame details which will incorporate glazing shall be coordinated with the glass manufacturer to assure that all details, methods of frame weepage, materials and methods of installation are in accordance with the glass manufacturer's requirements.
- C. All hardware preparation, reinforcing and other requirements shall be coordinated with the hardware supplier to assure proper operation and fit of all doors and hardware items.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.

- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit two samples of 4-inch long extrusions illustrating finished aluminum surface, glass, glazing materials.
- E. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.08 MOCK UP

- A. Install on representative aluminum frame condition for Owner/Architect approval prior to installing the remaining locations.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide 10 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 10 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 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Center-Set Style, Thermally-Broken:
 - 1. Basis of Design: Kawneer North America; Trifab VG 451T: www.kawneer.com.
 - 2. Vertical Mullion Dimensions: 2-1/4 inches wide by 4-1/2 inches deep.
- B. Center-Set Style, Not Thermally-Broken (Interior Aluminum Frames):
 - 1. Basis of Design: Kawneer North America; Trifab II 450.
 - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
- C. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 - 1. EFCO, a Pella Company; S430: www.efcocorp.com/#sle.
 - 2. Manko Window Systems, Inc.; 2450 Series: www.mankowindows.com.
 - 3. Tubelite Inc.; T14000 Series: www.tubeliteinc.com.

2.02 BASIS OF DESIGN -- SWINGING DOORS

- A. Wide Stile, Insulating Glazing, Thermally-Broken:
 - 1. Basis of Design: Kawneer North America; Model 500: www.kawneer.com.
 - 2. Thickness: 1-3/4 inches.
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 - 1. EFCO, a Pella Company: www.efcocorp.com/#sle.

2. Manko Window Systems, Inc.: www.mankowindows.com.
3. Tubelite Inc.: www.tubeliteinc.com.

2.03 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Finish: Superior performing organic coatings.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 2. Finish Color: As selected by Architect from manufacturer's standard line.
 3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 4. Fabrication: To the greatest possible extent, complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.
 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 6. 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.
 7. 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.
 8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 10. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.

2.04 PERFORMANCE REQUIREMENTS

- A. 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.
- B. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
- C. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
- D. Overall U-value Including Glazing: 0.45 Btu/(hr sq ft deg F), maximum.

2.05 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Manufacturer's standard blade-type stops.
- B. Glazing: As specified in Section 08 80 00.
- C. Swing Doors: Glazed aluminum.
 1. Thickness: 1-3/4 inches.

2. Top Rail: 8 inches wide.
3. Vertical Stiles: 5 inches wide.
4. Midrail: 6 inches with center 36 inches from the bottom of the door.
5. Bottom Rail: 10 inches wide.
6. Glazing Stops: Manufacturer's standard blade-type stops.
7. Finish: Same as storefront.

2.06 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
 1. Do not use exposed fasteners except where unavoidable. Exposed fasteners shall match finish of frame members.
- C. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
- D. Concealed Flashings: Galvanized steel, 26 gauge, 0.0179 inch minimum base metal thickness.
- E. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- F. Glazing Accessories: As specified in Section 08 80 00.
- G. Caulking materials for internal frame joints, fasteners, etc., shall be of a color to most closely match the aluminum framing, and of the types recommended by the frame manufacturer. Caulking which is totally concealed may be of any color selected by the manufacturer.
- H. All caulking of frame perimeters shall comply with the requirements, materials and colors specified in Section 07 92 00, and shall be included under this Section.
- I. Mullion column cover, where indicated on drawings shall be clear anodized aluminum 0.08 thickness material.

2.07 FINISHES

- A. Superior Performing Organic Coatings 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 aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
 1. Manufacturers:
 - a. PPG Metal Coatings; Duranar: www.ppgmetalcoatings.com/#sle.
 - b. Sherwin-Williams Company; SHER-NAR 5000: oem.sherwin-williams.com/#sle.
 - c. Valspar; Fluropon: www.valsparcoilextrusion.com/#sle.
 - d. Kawneer; Permafluor: www.kawneer.com.
- B. Color: As selected from manufacturer's standard colors.

2.08 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Coordinate installation of security components at exterior doors. Coordinate as required with the door hardware supplier, the electrical sub-contractor and the Owner's security system provider. When there are electrical door hardware items being installed, the aluminum frame supplier shall provide boxes of the appropriate size to protect the hardware devices from damage and also to allow room for wire termination and installation of the electrified hardware items.
- C. Other Door Hardware: As specified in Section 08 71 00.
- D. Weather-stripping:
 1. Meeting stiles on pairs of doors shall be equipped with an adjustable astragal utilizing wool pile with polymeric fin.

2. The door weathering on a single acting offset pivot or butt hung door and frame (single or pairs) shall be comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.
- E. Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Anchor securely in place, separating aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. At points where members are attached to structure, use nylon or neoprene washers or other non-metallic materials for separation to allow for movement due to thermal range between aluminum unit and structure.
- E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- F. Provide thermal isolation where components penetrate or disrupt building insulation.
- G. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- H. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Drill frames and doors and install hardware items with bolted connections, complying with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible. Check and adjust as required to maintain a tight fit against all weatherstripping.
- K. Install glass in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

- A. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 1. Perform a minimum of two tests in each designated area . Test not less than 2% minimum of each window system. Field verify exact location of testing with Architect in

the field.

2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

3.05 ADJUSTING

- A. Adjust operating hardware for smooth operation.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies.
 - 3. ANSI/UL 294 – Access Control System Units.
 - 4. ULC-S319 - Electronic Access Control Systems.
 - 5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.

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2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

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2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

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1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Seven years for heavy duty cylindrical (bored) locks and latches.
 - 2. Five years for exit hardware.
 - 3. Fifteen years for manual overhead door closer bodies.
 - 4. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 - 4. Hinge Options: Comply with the following:

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- a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

- a. Hager Companies (HA).
- b. Ives (IV).
- c. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
- d. Stanley Hardware (ST).

- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

- a. Hager Companies (HA).
- b. Ives (IV).
- c. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
- d. Stanley Hardware (ST).

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

- a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) – EL-CEPT Series.
- b. Securitron (SU) - EL-CEPT Series.
- c. Von Duprin (VD) - EPT-10 Series.

- B. Provide mortar guard enclosure on steel frames installed at masonry openings for each electrical hinge specified.

2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

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1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 2. Furnish dust proof strikes for bottom bolts.
 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 5. Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
 5. Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).

2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
 1. Manufacturers:
 - a. Schlage (SC).
 - b. No Substitution.
- C. Cylinders: Original manufacturer cylinders complying with the following:
 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.

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2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 5. Keyway: Match Facility Restricted Keyway.
- D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- E. Security Cylinders: ANSI/BHMA A156.5, Grade 1, patterned security cylinders and keys able to be used together under the same facility master or grandmaster key system.
1. New security key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
 2. Manufacturers:
 - a. Schlage (SC) – Primus Everest S145 Keyway
- F. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified patented cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents.
1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
 2. Manufacturers:
 - a. Schlage (SC) – Everest S145 Keyway
 - b. No Substitution.
- G. Keying System: Each type of lock and cylinders to be factory keyed.
1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 2. Keying by Keymaster's of Greater Omaha 3422 Leavenworth Street Omaha Ne 68105 402-346-7108.
 3. New System: Key locks to a new key system as directed by the Owner.
- H. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).
 3. Construction Keys (where required): Ten (10).
- I. Construction Keying: Provide construction master keyed cylinders.
- J. Key Registration List (Bitting List):

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1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.7 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed.
1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
 2. Locks are to be non-handed and fully field reversible.
 3. Manufacturers:
 - a. Schlage (SC) – ND Series.
 - b. No Substitution.

2.8 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:

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1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 ELECTRIC STRIKES

- A. Standard Electric Strikes: Electric strikes tested to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Manufacturers:
 - a. Von Duprin (VD) - 6200/6400 Series.

- B. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes tested to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.

1. Manufacturers:
 - a. HES (HS) - 9400/9500/9600/9700/9800 Series.
 - b. Von Duprin (VD) - VD3146/6200/6300 Series.

2.10 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

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3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 5. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.
 6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
 - a. Von Duprin (VD) - 33A/99 Series.
 - b. No Substitution.

2.11 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:

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1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.
1. Manufacturers:
 - a. LCN Closers (LC) – 4040XP Series.
 - b. No Substitution.

2.12 ELECTROHYDRAULIC DOOR OPERATORS

- A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
- B. Standard: Certified ANSI/BHMA A156.19.
- C. Performance Requirements:

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1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
 2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.
- D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.
- E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.
- F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
- G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
- H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. LCN Closers (LC) - 4640 Series w/ Touchless Wall Switch MS-41-D by BEA.

2.13 ARCHITECTURAL TRIM

- A. Door Protective Trim
1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.

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4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).

2.14 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 1. Manufacturers:
 - a. dormakaba (DO).
 - b. Rixson Door Controls (RF).
 - c. Sargent Manufacturing (SA).

2.15 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and

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provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. National Guard Products (NG).
 - 2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
 - 3. Reese Enterprises, Inc. (RE).
 - 4. Zero (ZE).

2.16 ELECTRONIC ACCESSORIES

- A. Request-to-Exit Motion Sensor: Request-to-Exit Sensors motion detectors specifically designed for detecting exiting through a door from the secure area to a non-secure area. Include built-in timers (up to 60 second adjustable timing), door monitor with sounder alert, internal vertical pointability coverage, 12VDC or 24VDC power and selectable relay trigger with fail safe/fail secure modes.
 - 1. Manufacturers:
 - a. Alarm Controls (AK) - SREX Series.
 - b. Securitron (SU) - XMS Series.
- B. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

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1. Manufacturers:

- a. Securitron (SU) - DPS Series.

- C. Linear Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw plus 50% for the specified electrified hardware and access control equipment.

1. Manufacturers:

- a. Von Duprin (VD) - PS.

2.17 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.18 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

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3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Power Operator products and accessories are required to be installed through current members of the manufacturer's "Power Operator Preferred Installer" program.
- D. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

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3.4 FIELD QUALITY CONTROL

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handing and sizing all products.
 - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
- B. Manufacturer's Abbreviations:

- 1. MK - McKinney

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2. PE - Pemko
3. VD - Von Duprin
4. RO - Rockwood
5. SC - Schlage
6. HS - HES
7. GJ - Glynn-Johnson
8. LC - LCN Closers
9. OT - Other
10. SU - Securitron

Hardware Sets

Set: 1.0

Doors: 105, 106

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Push Plate	70C 4" x 16"	US32D	RO
1 Pull Plate	BF 110 x 70C 4" x 16"	US32D	RO
1 Door Closer (reg arm, pull side)	4040XP REG	689	LC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO
1 Wall Stop	406	US32D	RO

Set: 2.0

Doors: 112C, 113C

1 Hardware	All Hardware by Door Supplier		00
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Set: 3.0

Doors: 124, 127

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Cylindrical Lock (office)	ND53- T- J RHO CMK	626	SC
1 Everest FSIC Core	23-030 Everest	626	SC
1 Wall Stop	409	US32D	RO

Set: 4.0

Doors: 115, 116, 117

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
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BCDM No: 5396-00

DOOR HARDWARE
08 71 00 - 20

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1 Exit Device (rim, classroom)	99L x 996L-06 lever	US26D	VD
1 FSIC Cylinder Housing (rim)	20-057	626	SC
1 Everest FSIC Core	23-030 Everest	626	SC
1 Door Closer (hd arm w/ stop, push side)	4040XP SCUSH	689	LC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO

Set: 5.0

Doors: 125, 129B

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Cylindrical Lock (classroom)	ND70- T- J RHO CMK	626	SC
1 Everest FSIC Core	23-030 Everest	626	SC
1 Door Closer (reg arm, pull side)	4040XP REG	689	LC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO
1 Wall Stop	406	US32D	RO

Set: 6.0

Doors: 121, 129A

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Cylindrical Lock (classroom)	ND70- T- J RHO CMK	626	SC
1 Everest FSIC Core	23-030 Everest	626	SC
1 Overhead Stop (surface)	900S	US32D	GJ
1 Door Closer (reg arm, pull side)	4040XP REG	689	LC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO

Set: 7.0

Doors: 111

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Cylindrical Lock (classroom)	ND70- T- J RHO CMK	626	SC
1 Everest FSIC Core	23-030 Everest	626	SC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO
1 Gasketing	S88BL (head and jambs)		PE
1 Wall Stop	406	US32D	RO

Set: 8.0

Doors: 103

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
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BCDM No: 5396-00

DOOR HARDWARE
08 71 00 - 21

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1 Cylindrical Lock (storeroom)	ND80- T- J RHO CMK	626	SC
1 Everest FSIC Core	23-030 Everest	626	SC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO
1 Wall Stop	406	US32D	RO

Set: 9.0

Doors: 102

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Cylindrical Lock (storeroom)	ND80- T- J RHO CMK	626	SC
1 Everest FSIC Core	23-030 Everest	626	SC
1 Overhead Stop (surface)	900S	US32D	GJ
1 Door Closer (reg arm, pull side)	4040XP REG	689	LC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO

Set: 10.0

Doors: 119

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Cylindrical Lock (storeroom)	ND80- T- J RHO CMK	626	SC
1 Everest FSIC Core	23-030 Everest	626	SC
1 Door Closer (hd arm w/ stop, push side)	4040XP SCUSH	689	LC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO
1 Gasketing	S88BL (head and jambs)		PE

Set: 11.0

Doors: 101A, 107A, 126A

1 Continuous Hinge	KCFM xx-HD1	AL	PE
1 Exit Device (rim, classroom)	99L x 996L-06 lever	US26D	VD
1 Primus FSIC Cylinder Housing (rim)	20-079	626	SC
1 Primus / Everest FSIC Core	20-740 Primus / Everest	626	SC
1 Door Closer (hd arm w/ stop, push side)	4040XP SCUSH	689	LC
1 Drop Plate	4040XP-18PA	689	LC
1 Blade Stop Spacer	4040XP-61	689	LC
1 Threshold	171A		PE
1 Sweep w/ drip	345ANB x TKSP8		PE
1 Weatherstripping	Weatherstripping by Door and Frame Supplier		00
1 Rain Guard	346C x TKSP8 (door width + 4")		PE

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DOOR HARDWARE
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OPPD Training Building Phase 2

Set: 12.0

Doors: 130A

1 Continuous Hinge	KCFMxx-HD1 x PT (ept prep)	AL	PE
1 Electric Power Transfer	EPT10	SP28	VD
1 Exit Device (rim, classroom, elec latch retraction)	QEL RX 99L x 996L-06 lever	US26D	VD
1 Primus FSIC Cylinder Housing (rim)	20-079	626	SC
1 Primus / Everest FSIC Core	20-740 Primus / Everest	626	SC
1 Overhead Stop (concealed)	100S	US32D	GJ
1 Automatic Door Operator	4642 x 2ea touchless Wall Switches MS-41-D as manufactured by BEA (verify locations)	689	LC
1 Threshold	171A		PE
1 Sweep w/ drip	345ANB x TKSP8		PE
1 Weatherstripping	Weatherstripping by Door and Frame Supplier		00
1 Rain Guard	346C x TKSP8 (door width + 4")		PE
1 Power Supply	PS902-2RS-FA-KL		VD

Set: 13.0

Doors: 112B, 113B

3 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1 Cylindrical Lock (storeroom)	ND80- T- J RHO CMK	626	SC
1 Primus / Everest FSIC Core	20-740 Primus / Everest	626	SC
1 Electric Strike (fail secure)	6211	630	VD
1 Door Closer (hd arm w/ stop, push side)	4040XP SCUSH	689	LC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO
1 Threshold	171A		PE
1 Sweep w/ drip	345ANB x TKSP8		PE
1 Weatherstripping	303AS x TKSP8 (head and jambs)		PE
1 Rain Guard	346C x TKSP8 (door width + 4")		PE
1 Card Reader	Card Reader by Security Contractor		OT
1 Door Position Switch	DPS-x-BK		SU
1 Motion Sensor	XMS		SU
1 Power Supply	Power Supply by Security Contractor		OT
1 Latch Protector	321	US32D	RO

Set: 14.0

OPPD Training Building Phase 2

Doors: 108, 109, 202

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Cylindrical Lock (storeroom)	ND80- T- J RHO CMK	626	SC
1 Primus / Everest FSIC Core	20-740 Primus / Everest	626	SC
1 Electric Strike (fail secure)	6211	630	VD
1 Overhead Stop (surface)	900S	US32D	GJ
1 Door Closer (reg arm, pull side)	4040XP REG	689	LC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO
1 Card Reader	Card Reader by Security Contractor		OT
1 Door Position Switch	DPS-x-BK		SU
1 Motion Sensor	XMS		SU
1 Power Supply	Power Supply by Security Contractor		OT

Set: 15.0

Doors: 110, 112A

6 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Electric Power Transfer	EPT10	SP28	VD
2 Manual Flush Bolt	555	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Cylindrical Lock (fail secure)	RX ND80EU- T- J RHO CMK	626	SC
1 Primus / Everest FSIC Core	20-740 Primus / Everest	626	SC
1 Overhead Stop (concealed)	100S	US32D	GJ
1 Door Closer (reg arm, pull side)	4040XP REG	689	LC
2 Kick Plate	K1050 10" x 1" LDW B4E CSK	US32D	RO
1 Gasketing	S88BL (head and jambs)		PE
1 Wall Stop	406	US32D	RO
1 Astragal Strip	S772BL		PE
1 Astragal	Astragal by Door Supplier		00
1 Card Reader	Card Reader by Security Contractor		OT
2 Door Position Switch	DPS-x-BK		SU
1 Motion Sensor	XMS		SU
1 Power Supply	Power Supply by Security Contractor		OT

Set: 16.0

Doors: 113A

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Cylindrical Lock (storeroom)	ND80- T- J RHO CMK	626	SC

BCDM No: 5396-00

DOOR HARDWARE
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OPPD Training Building Phase 2

1 Primus / Everest FSIC Core	20-740 Primus / Everest	626	SC
1 Electric Strike (fail secure)	6211	630	VD
1 Overhead Stop (concealed)	100S	US32D	GJ
1 Door Closer (reg arm, pull side)	4040XP REG	689	LC
1 Kick Plate	K1050 10" x 1" LDW B4E CSK	US32D	RO
1 Gasketing	S88BL (head and jambs)		PE
1 Card Reader	Card Reader by Security Contractor		OT
1 Door Position Switch	DPS-x-BK		SU
1 Motion Sensor	XMS		SU
1 Power Supply	Power Supply by Security Contractor		OT

Set: 17.0

Doors: 201

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Cylindrical Lock (storeroom)	ND80- T- J RHO CMK	626	SC
1 Primus / Everest FSIC Core	20-740 Primus / Everest	626	SC
1 Electric Strike (fail secure)	6211	630	VD
1 Door Closer (hd arm w/ stop, push side)	4040XP SCUSH	689	LC
1 Kick Plate	K1050 10" x 2" LDW B4E CSK	US32D	RO
1 Gasketing	S88BL (head and jambs)		PE
1 Card Reader	Card Reader by Security Contractor		OT
1 Door Position Switch	DPS-x-BK		SU
1 Motion Sensor	XMS		SU
1 Power Supply	Power Supply by Security Contractor		OT

Set: 18.0

Doors: 101B, 107B, 126B

1 Continuous Hinge	KCFM xx-HD1	AL	PE
1 Exit Device (rim, nightlatch)	99NL x 990NL pull	US26D	VD
1 Primus FSIC Cylinder Housing (rim)	20-079	626	SC
1 Primus / Everest FSIC Core	20-740 Primus / Everest	626	SC
1 Electric Strike (fail secure)	9600	630	HS
1 Door Closer (hd arm, push side)	4040XP EDA	689	LC
1 Drop Plate	4040XP-18PA	689	LC
1 Blade Stop Spacer	4040XP-61	689	LC
1 Wall Stop	406	US32D	RO
1 Card Reader	Card Reader by Security Contractor		OT
1 Door Position Switch	DPS-x-BK		SU

OPPD Training Building Phase 2

1 Motion Sensor	XMS		SU
1 Power Supply	Power Supply by Security Contractor		OT

Set: 19.0

Doors: 130B

1 Continuous Hinge	KCFMxx-HD1 x PT (ept prep)	AL	PE
1 Electric Power Transfer	EPT10	SP28	VD
1 Exit Device (rim, nightlatch, elec latch retraction)	QEL RX 99NL x 990NL pull	US26D	VD
1 Primus FSIC Cylinder Housing (rim)	20-079	626	SC
1 Primus / Everest FSIC Core	20-740 Primus / Everest	626	SC
1 Automatic Door Operator	4642 x 2ea touchless Wall Switches MS-41-D as manufactured by BEA (verify locations)	689	LC
1 Wall Stop	406	US32D	RO
1 Card Reader	Card Reader by Security Contractor		OT
1 Door Position Switch	DPS-x-BK		SU
1 Motion Sensor	XMS		SU
1 Power Supply	PS902-2RS-FA-KL		VD

END OF SECTION

**SECTION 08 80 00
GLAZING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.
- B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- C. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.
- D. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.
- E. Section 10 28 00 - Toilet, Bath, and Laundry Accessories: Mirrors.

1.03 REFERENCE STANDARDS

- A. ASTM C1036 - Standard Specification for Flat Glass 2021.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- C. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- D. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021a.
- E. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.
- F. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2019.
- G. GANA (SM) - GANA Sealant Manual 2008.
- H. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2020.
- I. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2020.
- J. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2023.

1.04 SUBMITTALS

- A. See Section 01 30 00 - 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 two samples 12 by 12 inch in size of glass units.
- E. Certificate: Certify that products of this section meet or exceed specified requirements.

1.05 COORDINATION

- A. The glazing subcontractor shall coordinate his/her requirements with the steel frame subcontractors to assure that frames are provided with required bite, edge, and face clearance.

1.06 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: All areas of glazing shall comply with all applicable codes, including but not limited to the International Building Code, 2015 Edition. In case of conflict between that regulation and these Drawings and Specifications, the requirements of the regulatory agency shall govern.
- B. Glass Standards: Glass installations shall meet the requirements of ASTM C 1036. Heat-treated glass shall meet the requirements of ASTM C 1048. Safety glass shall meet the requirements of Standard CPSC 16 CFR 1201.
- C. Glass material containing bubbles, scratches, or other glass shall be removed immediately upon notice.
- D. Manufacturer's Label: Each piece of glass shall bear the manufacturer's label.

1.07 STORAGE AND HANDLING

- A. Stack glazing sheets at 5 to 7 degrees from vertical. Separate sheets with interweaving of protection paper and cushion top and bottom edges with felt. Cover to protect material from wind-blown water or run-off, but provide for ventilation and circulation of cool, dry air. Maintain temperature above dew point. Protect glazing material from welding, sandblasting, and other potentially damaging operations before and after installation.
- B. Handle glazing sheets to prevent damage to edges and corners.

1.08 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Warranty on Hermetic Seals: Provide insulating glass manufacturer's written warranty, agreeing to, within specified warranty period, furnish FOB project site, replacement units for insulating glass units which have defective hermetic seals (excluding that due to glass breakage); defined to include intrusion of moisture or dirt, internal condensation at temperatures above -20F, and other visual evidence of seal failure or performance failure; provided manufacturer's instructions for handling, installation, protection, and maintenance have been adhered to during warranty period. If this warranty is not honored by the glass manufacturer because of defective installation procedures or other actions of the glazing subcontractor, that subcontractor shall be liable for the terms of that warranty for a period of 5 years after the date of Substantial Completion.
- C. Warranty period is 10 years after seal date permanently imprinted on unit, but not less than 9 years after date of Substantial Completion.
- D. All glass shall be warranted for 10 years against breakage due to defects in materials, workmanship or installation with all such glass immediately removed and replaced with matching new material at no additional cost to the Owner upon notification by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. Guardian Glass, LLC: www.guardianglass.com/#sle.
 - 2. Pilkington North America Inc: www.pilkington.com/na/#sle.
 - 3. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 3. 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.
- 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.

2.04 INSULATING GLASS UNITS

- A. Manufacturers:
1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
 2. Guardian Glass, LLC: www.guardianglass.com/#sle.
 3. Insulite Glass Co.: www.insuliteglass.com.
 4. ITI Glass: www.itiglass.com.
 5. Oldcastle Building Envelope: www.obe.com.
 6. Pilkington North America Inc: www.pilkington.com/na/#sle. Pilkington North America Inc: www.pilkington.com/na/#sle.
 7. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle.
 8. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
 9. Substitutions: See Section 01 60 00 - 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. Spacer Color: Aluminum.
 4. Edge Seal:
 - a. Single-Sealed System: Provide silicone sealant as seal applied around perimeter.
 5. Color: Grey.
 6. Purge interpane space with dry air, hermetically sealed.
- C. Type CTIG - Clear Tempered Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with air.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch thick.
 - a. Tint: Clear.
 - b. Coating: VNE-63, on #2 surface.
 4. Inboard Lite: Fully tempered float glass, 1/4 inch thick.
 - a. Tint: Clear.

5. Total Thickness: 1 inch.
6. Thermal Transmittance (U-Value), .29 Winter and .26 Summer, nominal.
7. Visible Light Transmittance (VLT): 62 percent, nominal.
8. Shading Coefficient: .33, nominal.
9. Solar Heat Gain Coefficient (SHGC): .29, nominal.

2.05 GLAZING UNITS

- A. Type CTG - Clear Tempered Glass: Non-fire-rated.
 1. Applications:
 - a. Glazed lites in doors, except fire doors.
 - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on drawings.
 2. Glass Type: Fully tempered safety glass as specified.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.

2.06 GLAZING SEALANTS

- A. Glazing Sealant for the exterior perimeter of all glass panes where they abut frame members (unless recommended otherwise by the glass manufacturer) shall be the following type and manufacturer:
 1. General Electric Company; SCS2000 SilPruf.
- B. Other glazing sealants shall be of the type and manufacture recommended by the glazing manufacturer for the type of glass and application.
- C. Sealant Backer Rod: To be compressible continuous length rod stock of closed cell polyethylene foam for use as back-up of butt joint sealants as shown on the Drawings. Color shall be manufacturer's standard. Backer rod shall be of the diameter as recommended by the Fabricator/Installer and shall be one of the following or as otherwise recommended by the Fabricator/Installer:
 1. BASF; MasterSeal 920: www.basf.com.
 2. W.R. Meadows, Inc.; Kool-Rod: www.wrmeadows.com.
- D. Joint Primer/Sealer: To be the type of joint/sealer recommended by the sealant manufacturer for the joint surfaces to be primed, bonded, and sealed.

2.07 ACCESSORIES

- A. Setting Blocks: Neoprene or EPDM, 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 x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene or EPDM, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound; 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.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 STANDARDS AND PERFORMANCE

- A. Watertight and airtight window and door installation of each glass product is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating doors), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.
- B. Protect all glass from edge damage during handling and installation, and subsequent operation of glazed components of the work. During installation, discard units with significant edge damage or other imperfections.
- C. Glazing channel dimensions as shown are intended to provide for necessary bite on glass, minimum edge clearance, and adequate sealant thicknesses, with reasonable tolerance. Adjust as required by job conditions at time of installation.
- D. Comply with combined recommendations and technical reports by manufacturers of glass and glazing products as used in each glazing channel, and with recommendations of Flat Glass Marketing Association "Glazing Manual," except where more stringent requirements are indicated.
- E. Install insulating glass units to comply with recommendations by Sealed Insulating Glass Manufacturers Association, except as otherwise specifically indicated or recommended by glass and sealant manufacturers.

3.03 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry immediately before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.
- D. Coordinate with painter to assure that all metal frames have received their first coat of paint before glazing is started.

3.04 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.
- F. Continuous glazing tape shall be installed at both faces of all glass. Exterior glazing shall be sealed at the full perimeter of each pane with silicone sealant where the glass abuts the metal frames.
- G. Make silicone joints where interior glass abuts glass and wall materials without frames.
- H. Install setting blocks of proper size and spacing, for glass sizes larger than 50 united inches, except where pre-shimmed tapes are used for glazing. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

- I. Install tempered glass sheets in frame openings with manufacturer's identification seal placed in the lower right hand corner of each lite opening.
- J. Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from the glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.
- K. Clean and trim excess glazing materials from glass and stops or frames promptly after installation, and eliminate stains and discolorations.

3.05 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

DIVISION 09 – FINISHES

**SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Gypsum sheathing.
- F. Cementitious backing board.
- G. Gypsum wallboard.
- H. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Structural steel stud framing.
- B. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2020).
- B. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members 2012.
- C. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
- D. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units 2019.
- E. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire 2019.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
- G. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.
- H. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).
- I. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board 2004 (Reapproved 2020).
- J. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- K. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- L. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- M. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- N. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2022.

- O. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.
- P. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.
- Q. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel 2017.
- R. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units 2022.
- S. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- T. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels 2019, with Editorial Revision (2020).
- U. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.
- V. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.
- W. GA-216 - Application and Finishing of Gypsum Panel Products 2021.
- X. UL (FRD) - Fire Resistance Directory Current Edition.
- Y. SSMA - Steel Stud Manufacturers Association Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where gypsum wallboard systems with fire-resistance ratings are indicated or are required to comply with governing regulations, provide materials and installations identical with applicable assemblies which have been tested for fire resistance per ASTM E119 by a testing and inspection agency acceptable to authorities having jurisdiction. Products used in the assembly shall carry a classification label from a testing laboratory acceptable to the authority having jurisdiction.
- B. Allowable Tolerances: On faces of work exposed in occupied spaces, including stairwells (if any), limit offsets between planes of board faces to 1/8-inch, and limit variations from plumb and location (including warp and bow) not to exceed 1/4-inch in 8'-0".
- C. Install gypsum board on walls, partitions and furring to within 1/8-inch of floor to provide full backing for resilient base.

1.06 DELIVERY STORAGE AND HANDLING

- A. Delivery: Gypsum wallboard shall not be delivered to the project site until immediately before application is to begin. All gypsum drywall materials shall be delivered in original packages, containers or bundles bearing brand name and identification nomenclature.
- B. Storage: Gypsum wallboard boards shall be stored inside under cover and stacked flat in a manner to keep material flat, dry, protected from weather, direct sunlight, surface contamination, traffic or other construction damage. Other materials and accessories shall remain in their original wrappings or containers, sorted flat and protected from damage or bending until ready for actual use.

- C. Handling: Handle gypsum boards in a manner to prevent damage to edges, ends and surfaces. Damaged gypsum boards and accessories shall not be incorporated within the work and shall be immediately removed from the site.
- D. Steel framing and related accessories shall be stored and handled in accord with A.I.S.I. "Code of Standard Practice".

1.07 JOB CONDITIONS

- A. Environmental Requirements, General: Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during, and after application of gypsum board.
- B. Temperature: When outside temperatures are below 55F, maintain continuous interior temperature in the range of 55F to 70F for minimum period of 48 hours prior to, during, and following application of gypsum board, joint and finishing treatment materials or bonding of adhesives.
- C. Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent drying too rapidly.
- D. Protection: Protect all adjacent surfaces and work by suitable means from splatter or overspray from texture surface application.

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. Fire Rated Assemblies: Provide completed assemblies 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. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com/#sle.
 - 2. MBA Metal Framing: www.mbastuds.com.
 - 3. Marino: www.marinoware.com/#sle.
 - 4. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Structural Steel Framing for Application of Gypsum Board: As specified in Section 05 40 00.
- C. Non-structural 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/120 at 5 psf.
 - 1. Framing and Suspension Materials: When 20-gauge and 25-gauge materials are specified below, they shall be fabricated from commercial quality galvanized steel with a minimum yield point of 33,000 psi. 20-gauge material shall have a design thickness of .0312-inch and the 25-gauge material shall have a design thickness of .0188-inch as defined by SSMA (Steel Stud Manufacturers Association).
 - 2. Studs: "C" shaped with flat or formed webs consisting of 25-gauge and 20-gauge galvanized steel, 1-5/8 inch, 3-5/8 inch, 4 inch and 6 inch screw type studs and track or as may otherwise be indicated on the Drawings.
 - a. 25-gauge studs shall be used throughout, except 20-gauge shall be used at the following locations:
 - 1) All interior studs that are over 12-feet total height.
 - 2) All 4-inch and 6-inch interior studs.

- 3) All interior studs which support wall-mounted cabinets and plumbing fixtures.
- 3. Runners: 20-gauge galvanized U shaped, sized to match studs with 1-1/2-inch minimum legs placed at the top of all walls abutting structural members above as indicated on the Drawings.
- 4. Ceiling Channels: C-shaped.
- 5. Furring: Hat-shaped sections, minimum depth of 7/8 inch fabricated from 0.021-inch hot dipped galvanized steel..
- 6. Z-Channel: 2 inches.
- D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
- E. Non-structural Framing Accessories:
 - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- F. Fastenings Shall be as Follows:

Studs to track	3/8-inch drywall, type S, pan head screws
Track to masonry	1/4-inch diameter hooked anchor bolts
Track to concrete floor and furring studs and channel to masonry	Cartridge driven studs or concrete nails
Track to metal deck	Self-tapping screws (toggle bolts required to hang heavy bulkheads in tension)

2.03 SUSPENSION SYSTEM

- A. Grid Suspension System: ASTM C645 , manufacturer's standard grid suspension system composed of main beams and cross furring members which interlock to form a modular supporting network.
- B. Wire for Hangers and Ties: ASTM A641/A641M , soft, Class 1 zinc coated (galvanized).
 - 1. Hanger Wire: No. 11 gauge galvanized wire.
 - 2. Tie Wire: No. 16 gauge galvanized wire.
- C. Runner Channels: 20 gauge galvanized channels. Size shall be 1-1/2-inches deep by 19/32-inch wide. Also, provide 25-gauge studs for ceiling/bulkhead suspension where shown on the Drawings.
- D. Furring Channels: 25 gauge electrogalvanized steel.
 - 1. Products:
 - a. Same manufacturers as other framing materials.
- E. Furring Channel Clips: For clipping to furring channels shall be of galvanized wire and of the same manufacturer as the furring channels.
- F. At the Contractor's Option: In lieu of the above specified tie wire, runner channels, furring channels and furring channel clips, provide pre-engineered suspension system including main tees and cross channels manufactured by United States Gypsum Company, or equal system by any other manufacturer listed above, or Drywall Grid System or Shortspan Drywall Grid (as appropriate to the location as manufactured by Armstrong).

2.04 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. USG Corporation: www.usg.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 3. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 4. 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 the interior face of all exterior walls as noted on Sheet G1-0.
 5. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 6. Mold Resistant Paper Faced Products:
 - a. National Gypsum Company; Gold Bond XP Gypsum Board: www.nationalgypsum.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 7. Glass Mat Faced Products:
 - a. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough.
- C. Backing Board For Wet Areas:
1. Application: For use at all areas where wall tile is shown or scheduled (see wall types) to be installed over stud walls.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 5/8 inch.
 - b. Products:
 - 1) National Gypsum Company; PermaBase Cement Board: www.nationalgypsum.com/#sle.
 - 2) USG Corporation; Durock Interior Cement Board: www.usg.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.

2.05 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 2 inch.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
 1. Corner Beads: Low profile, for 90 degree outside corners.
 - a. Products:
 - 1) ClarkDietrich: www.clarkdietrich.com/#sle.
 2. Corner Beads at High Traffic Areas: Low profile, for 90 degree outside corners.
 - a. Products:

- 1) Pittcon Industries Inc.; SO-HSN-90 High Strength Corner:
3. Expansion Joints:
 - a. Type: 1/4-inch by 7/16-inch deep V-shaped metal with factory-installed protective tape.
 - b. Products:
 - 1) ClarkDietrick; 093 Zinc Control Joint (ZNCJ): www.clarkdietrich.com.
- D. Wall Protection Board: Board shall be installed on all walls abutting mop sinks to a height of 4'-0" above the rim of the sink unless noted otherwise on the Drawings. Provide and install all moldings, end caps, nylon fasteners and other accessories of matching color as required for a complete installation. Coordinate to provide continuous joint sealants along floor line/base at all wall protection board locations.
 1. Color: Selected from manufacturer's standards.
 2. Product:
 - a. Crane Composites; Glasbord Wall Panels with Surfaseal Finish: www.cranecomposites.com.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 1. Tape: 2 inch wide, creased paper tape for joints and corners.
- F. 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.
- G. 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.
- H. Screws shall be 1-inch, Type S, drywall screws for securing gypsum board to metal studs and 1-1/4-inch, Type W drywall screws for securing gypsum board to wood furring. Longer screws, as recommended by the gypsum board manufacturer, shall be utilized to secure the exposed layer of gypsum board to the framing and suspension systems through the concealed layer at double layer walls, ceilings and bulkheads, and to attach and secure accessories. Provide other screws as recommended by the manufacturer for attachment of tile backer board to metal studs.
- I. Fasteners for Glass-Mat Gypsum Sheathing Board: 1-5/8" (41 mm), No. 8 (4.2 mm diameter) wafer-head steel drill screws complying with ASTM C 954, with an organic-polymer coating or other corrosion-protective coating having a salt-spray resistance of more than 500 hours per ASTM B117.
- J. Nails for Attachment to Wood Members: Annular ring nails, 1-1/2-inches long, GWB 54, ASTM C514.
- K. Adhesive for direct lamination of gypsum board panels at double layer walls, ceilings and bulkheads, and direct lamination of gypsum board to other substrates shall be selected as recommended by the gypsum board manufacturer for the specific applications and as approved by the Architect/Engineer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Studs: Space studs at 16 inches on center.
 1. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of

- stud connections; do not leave studs unattached to track.
2. Align track at floor, top of masonry walls, frames and overhead structure as indicated on the Drawings. Secure base track at 24-inch centers and at ends with power-driven fasteners as specified above. Head track to be held within the down turn legs of special formed 20-gauged galvanized steel slip runner track welded or secured to bottom side of structure above for lateral support with deflection allowance of 1/2-inch or as indicated on the Drawings. Bulkhead or other similar construction which is to be hung under tension shall have head track secured to structure at 16-inch centers minimum. Butt weld or splice track at joints.
 3. Set studs at partition ends, corners, and intersections, at jambs of openings and at 16-inch centers in between unless shown otherwise on Drawings. Seat studs squarely into track and plumb or align. Secure studs to track as required.
 4. If the partition is of such height that the studs must be spliced, do so by installing 2 horizontal runner channels back-to-back (one for the top of the lower wall and one for the bottom of the upper wall). Fasten the runner channels to each other and then install 3-5/8-inch metal stud diagonal knee braces at 8-foot maximum centers from on face of the studs to the structure.
 5. Install horizontal stiffener channels through studs at cut-out locations at maximum 6-foot centers in partitions which do not have GWB installed in both faces.
 6. Install knee braces for metal frames and for walls which terminate above the ceiling as required to provide lateral support.
- C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- D. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
- E. Blocking: Install wood blocking for support of:
1. Framed openings.
 2. Wall-mounted cabinets.
 3. Plumbing fixtures.
 4. Toilet partitions.
 5. Toilet accessories.
 6. Wall-mounted door hardware.
 7. Other items as indicated

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 1. Place one bead continuously on substrate before installation of perimeter framing members.
 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board of maximum practical length with long dimensions at right angles to furring, cross channels, and studs, with ends and edges occurring over firm bearing.
- C. Double-Layer Non-Rated: The finish layer shall be installed with screws spaced as specified above, and with adhesive as recommended by the manufacturer. All joints of the second

(finish) layer shall be staggered for a minimum of 16-inches from the joints of the base layer. All screws for the finish layer shall be driven through the base layer into the framing above.

- D. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- E. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- F. Openings: End joints may occur not closer than 8-inches from either side of openings in walls. No joint shall align with edges of openings, and joints above openings shall be centered over openings.
- G. Fastenings: Panels shall be held in firm contact with the support member while the nails and screws are being driven. Fastenings shall proceed from the central portion of the board toward ends and edges. Fastenings shall proceed from the central portion of the board toward ends and edges. Fastenings shall be driven home with the heads slightly below the surface of the board. Care shall be taken to avoid breaking the paper face. Improperly driven fastenings shall be removed. Space screws at 15-inch centers and locate 3/8-inch to 1/2-inch from edges of panels. At double layer walls and bulkheads, install finish layer with longer screws and adhesive as noted above for ceilings.
- H. Checking Fasteners: After installation, pound on walls and ceilings to detect loose fastenings and push on board adjacent to fasteners to see if there is movement. If loose fasteners are detected, drive them tight. Whenever fastenings have punctured paper, hold board tight against framing and install another fastener properly, approximately 1-1/2-inches from fastener head which punctured paper, and remove faulty fastener. When fastenings wallboard to second side of a partition, check the opposite side for fasteners loosened by pounding and drive them tight again.

3.05 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
 - 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 3. Level 3: Walls to receive textured wall finish.
 - 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 5. Level 1: Ceiling plenum areas above finished ceilings, whether or not accessible in the completed construction.
 - 6. Level 0: Temporary partitions.
 - 7. Level 0: Surfaces indicated to be finished in later stage of project.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Taping: A uniformly thin layer of joint compound, approximately 4-inches wide, shall be applied over the joint. Tape shall be centered over the joint and embedded into the compound, leaving sufficient joint compound under the tape to provide proper bond. Wall angles, corners, returns and inside corner angles shall be reinforced with tape to conform to the angle and embedded into the compound. Taping and finishing shall be required for all below ceiling line exposed joints, and all joints behind tackwall surfaces. Taping only without finishing will be required for all fire rated partitions above the ceiling line, and for all gypsum board which covers steel structure members at return air plenum.
 - 2. Joint compound combinations to be utilized at gypsum board locations shall be as follows (note: use portland based product at cement board locations):

- a. Embedding and First Coat: Ready-mixed or job-mixed, drying-type, all-purpose or taping compound.
 - b. Fill (Second) Coat: Ready-mixed or job-mixed, drying-type, all-purpose or topping compound.
 - c. Finish (Third) Coat: Ready-mixed or job-mixed, drying-type, all-purpose or topping compound.
3. Finishing Joints: After compound is thoroughly dry, the tape shall be covered with a coat of joint compound or taping compound spread over the tape approximately 3-inches on each side of the tape and feathered out at the edge. After thoroughly dry, another coat of joint compound or taping compound shall be applied with a slight, uniform crown over the joint. This coat shall be smooth and the edges feathered approximately 3-inches beyond the preceding coat.
 4. Finishing Corners: All inside corners shall be coated with at least one coat of joint compound or topping compound with the edges feathered out. Flanges of wallboard corner bead shall be concealed by at least 2 coats of compound. The first coat shall be joint compound, and the second coat may be joint compound or topping compound feathered out approximately 9-inches on both sides of the exposed metal nose.
 5. Finish Nail or Screw Heads and Dimples: Apply three coats of joint compound or taping compound to all exposed gypsum board surfaces below the ceiling, and concealed behind tackwall locations. This may be applied as each coat is applied to the joints. Allow 24 hours drying time between coats, sanding between if necessary. Caution shall be used to avoid roughing of wallboard paper.
- D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

**SECTION 09 30 00
TILING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for wall applications.
- B. Metal trim.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium) 2019.
- B. ANSI A108/A118/A136.1 - Specifications for the Installation of Ceramic Tile 2020.
- C. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation 2019.
- D. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers. Coordinate with Architect.

1.05 SUBMITTALS

- A. See Section 01 30 00 - 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. Samples: Submit samples of each type and color of tile, base, trim and grout color required to the Architect/Engineer.
- D. Manufacturer's Certification: Tile shall be Quality Certified by the Tile Council of America, Inc., to equal or exceed the standard grade requirements of TCA 137.1. The Certification Mark of the Tile Council of America shall appear on each label or carton of tile.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 10 square feet of each of each 12"x24" porcelain tile (T-1 and T-2)

1.06 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of ten years of documented experience and must submit 3 project references where like kind specified tile has been installed.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store materials in original containers with seals unbroken and labels intact until the time of use.
- B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 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.
- C. Protect work form environmental conditions and construction activities during and after installation in accordance with manufacturer's printed recommendations.

1.09 SETTING PRODUCTS SYSTEM WARRANTY

- A. Provide 5 Year System Warranty from manufacturer of waterproofing/anti-fracture membrane, mortar, grout, and sealant. Contractor must use only products called for under manufacturer's warranty and install per manufacturer's instructions.

PART 2 PRODUCTS

2.01 TILE

- A. Porcelain Tile Type (T-1): ANSI A137.1, , and as follows:
 - 1. Through-body Colored Porcelain; Style: Santino.
 - 2. Color: Bianco, SN06.
 - 3. Distributer:
 - a. Daltile; Madison Schwartz: madison.schwatz@daltile.com.
 - 4. Size: 12x24 inches, 2/3 offset.
 - 5. Grout joint of 1/8 inch is recommended.
- B. Porcelain Tile Type (T-2): ANSI A137.1, , and as follows:
 - 1. Through-body Colored Porcelain; Style: Santino.
 - 2. Color: Grigio, SN08.
 - 3. Distributer:
 - a. Daltile; Madison Schwartz: madison.schwatz@daltile.com.
 - 4. Size: 12x24 inches, 2/3 offset.
 - 5. Grout joint of 1/8 inch is recommended.

2.02 TRIM AND ACCESSORIES

- A. Metal Trim: Brushed stainless steel, dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Metal Edge Trim at all vertical outside corners of porcelain wall tile and base tile and exposed top edges of porcelain wall tile shall be Quadec by Schluter Systems. Use longest lengths available to avoid multiple pieces per corner. When piecing lengths together is necessary, edges touching each other shall be smooth, factory edges to ensure tight seam.
 - 2. Applications:
 - a. Open edges of wall tile.
 - b. Wall corners, outside and inside.
 - c. Floor to wall joints.
 - 3. Manufacturers:
 - a. Schluter-Systems: www.schluter.com/#sle.

2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. Bostik Inc: www.bostik-us.com/#sle.
 - 2. Bonsal American, Inc.: www.prospec.com.
 - 3. Custom Building Products: www.custombuildingproducts.com/#sle.
 - 4. LATICRETE International, Inc: www.laticrete.com/#sle.
- C. Basis of Design Thinset:

1. LATICRETE International, Inc; 253 Gold: www.laticrete.com/#sle.

2.04 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 3. Color(s): Warm Gray 93.
 4. Products:
 - a. Mapei Corp.: www.mapei.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

3.03 INSTALLATION - GENERAL

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated on the drawings. Do not interrupt tile pattern through openings. Align joints when adjoining tiles on floor, base, walls and trim are the same size. Layout tile work and center tile fields in both directions in each space on each wall area. Adjust to minimize tile cutting. Maintain 1/8-inch joints at porcelain tile, unless recommended otherwise by tile manufacturer(s).
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Install metal trim in accordance with manufacturer's instructions.
- F. Sound tile after setting. Replace hollow sounding units.
- G. Keep control and expansion joints free of mortar, grout, and adhesive.
- H. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints. Use epoxy grout at floors and base in restrooms. Grout tile according to the grout manufacturer's printed instructions.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 CLEANING

- A. Clean tile and grout surfaces per manufacturers' recommended procedures.

3.05 PROTECTION

- A. When recommended by the tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors.
- B. Protect installed tile work with Kraft paper or other heavy covering during the construction period to prevent damage and wear.
- C. Prior to final inspection, remove protective coverings and rinse protective cleaner from surfaces.

END OF SECTION

**SECTION 09 51 00
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 RELATED REQUIREMENTS

- A. Section 23 37 00 - Air Outlets and Inlets: Air diffusion devices in ceiling.
- B. Section 26 51 00 - Interior Lighting: Light fixtures in ceiling system.
- C. Section 28 46 00 - Fire Detection and Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2022.
- B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2022.
- C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2019.
- D. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 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.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit two samples 6" by 6" inch in size illustrating material and finish of acoustical units.
- D. Samples: Submit two samples each, 6 inches long, of suspension system main runner and perimeter molding.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Provide one additional unopened carton of each type and size of acoustical tiles on the project.

1.06 QUALITY ASSURANCE

- A. Subcontract the installation of acoustical ceilings to an experienced firm which is acceptable to the manufacturer of the acoustical units and suspension system.
- B. Warranty: Provide manufacturer's minimum 15 year system warranty for all acoustical ceiling tile and grid against sagging, shrinking and delamination, and resistance to the growth of mold / mildew and bacteria.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Material shall be delivered to the project in the original packages, with seals unbroken and with the manufacturer's name and brand stamped clearly thereon. No seconds or remnants shall be used. No materials shall be delivered or stored in the building until all glazing has been

completed and all exterior openings closed in. All wet work, including concrete, masonry, plastering, etc., shall be completed and dried out.

1.08 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, or as required in Manufacturer's Installation Instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc: www.armstrong.com/#sle.
- B. Suspension Systems:
 - 1. Armstrong World Industries, Inc: www.armstrong.com/#sle.
 - 2. CertainTeed Corporation: www.certainteed.com/#sle.

2.02 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Tiles ATC-1: Painted mineral fiber, with the following characteristics:
 - 1. Classification: ASTM E1264 Type III.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
 - 2. Size: 24 by 24 inches.
 - 3. Thickness: 3/4 inch.
 - 4. Light Reflectance: 83-85 percent, determined in accordance with ASTM E1264.
 - 5. NRC: 70 determined in accordance with ASTM E1264.
 - 6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 - 7. Panel Edge: Square.
 - 8. Color: White.
 - 9. Acceptable Substitutions:
 - a. CertainTeed Corporation; Fine Fissured High NRC, HHF-457: www.certainteed.com/#sle.
 - b. USG Corporation; Radar High-NRC Acoustical Panels 22421: www.usg.com/ceilings/#sle.

2.03 SUSPENSION SYSTEM(S)

- A. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required. Sections shall be thickness and strength to support the ceiling assembly indicated on the Drawings, with a maximum deflection of 1/360 of the span. Size attachment devices for 5 times the design load indicated in ASTM C635/C635M, Table 1, direct hung.
- B. Exposed Suspension System for all ATC: Hot-dipped galvanized steel grid with aluminum cap.
 - 1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 - 2. Profile: Tee; 15/16 inch face width.
 - 3. Finish: Baked enamel.
 - 4. Color: White.
 - 5. Products:
 - a. Armstrong World Industries, Inc; Armstrong Suprafine Exposed Tee: www.armstrong.com/#sle.

2.04 ACCESSORIES

- A. Support Channels: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire unless heavier gauge is recommended by the manufacturer for the loads specified.
- C. Accessories: Provide prefinished 15/16-inch by 15/16-inch by 0.20 gauge hemmed edge wall angle molding and corners. All accessories shall be pre-finished to match Tee Grid System finish. Provide hold-down clips where indicated, and other special accessories as required for a complete installation. Accessories shall be supplied by the same manufacturer as the grid system.
- D. Perimeter Moldings: Same metal and finish as grid.
- E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work. Notify the Contractor and the Architect in writing of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.
- B. Verify that layout of hangers will not interfere with the location of the electrical fixtures, and other items which penetrate ceiling. Examine the Electrical and Mechanical Drawings to coordinate this work. Examine the Reflected Ceiling Plan and various ceiling edge treatment details on the Drawings for exact coordination of relationships to the various building lines, surfaces and conditions.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C 636/C 636M and ASTM C 636/C 636M and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
- E. Install suspension system with hanger support coming from building structure only. Install hangers by looping and wire-tying directly to structures or with concrete nails or drive pins into solid structure members, toggles into hollow areas, or eye screws as appropriate to comply with ASTM C 636. Attachment to ducts, conduit and other similar support will not be permitted. Space hangers not more than 4-feet on center as recommended by grid manufacturer along each member. Extra hanger wires shall be required as recommended by the grid manufacturer where grilles and troffers are installed parallel to main runners.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Do not eccentrically load system or induce rotation of runners.
- I. Install edge moldings, corners, special corners, reveal moldings and 2-inch by 2-inch expansion wall angles of the type indicated to coordinate with the grid system at edges of each acoustical ceiling area as noted on the reflected ceiling plan, and at locations where edge of units would otherwise be exposed after completion of work. Secure wall angle molding to building construction by fastening through holes made not more than 3-inches from end of molding and

6-inches on center. All moldings shall be standard wall angle moldings specified except where shown otherwise on the Drawings.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
- F. Install hold-down clips on each panel where noted on the Drawings and in areas where required by governing regulations for fire-resistance ratings. Space as recommended by the panel manufacturer, unless otherwise indicated or required. Comply with fire rating requirements.
- G. Upon completion of the installation, all soiled, deformed, discolored and otherwise damaged tile surfaces shall be cleaned or replaced. Completed acoustical ceiling system installation shall neither be altered nor disturbed by any other trade without specific prior approval from the Prime Contractor and Ceiling Subcontractor. Prior to Substantial Completion, the total acoustical ceiling system installation shall be inspected by the Contractor, adjusting all units and accessories for complete and proper placement and alignment. All soiled and otherwise damaged acoustic tile units and accessories shall be replaced with new items if minor finish damage cannot be successfully cleaned or repaired to original condition status completely free of damage or soil evidence to the satisfaction of the Architect/Engineer.

END OF SECTION

**SECTION 09 65 00
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient base.

1.02 REFERENCE STANDARDS

- A. ASTM F1861 - Standard Specification for Resilient Wall Base 2021.

1.03 SUBMITTALS

- A. See Section 01 30 00 - 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. Verification Samples: Submit two samples, 2 by 2 inch in size illustrating color and pattern for each resilient flooring product specified.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Wall Base: 10 linear feet of each type and color.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F, or as recommended by manufacturers of resilient flooring products.
- D. Protect roll materials from damage by storing on end.

1.05 FIELD CONDITIONS

- A. 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 RESILIENT BASE

- A. Vinyl Base (VB): ASTM F1861, Type TV, vinyl, thermoplastic; top set Style B, Cove.
 - 1. Manufacturers:
 - a. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Height: 4 inch.
 - 3. Thickness: 0.125 inch.
 - 4. Finish: Satin.
 - 5. Length: Roll.
 - 6. Color: Burnt Umber 63.

2.02 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Spread only enough adhesive to permit installation of materials before initial set.
 - 2. Fit joints and butt seams tightly.
 - 3. Set flooring in place, press with heavy roller to attain full adhesion.

3.03 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.04 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

END OF SECTION

**SECTION 09 68 13
TILE CARPETING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.
- B. Section 09 65 00 - Resilient Flooring.

1.03 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Shop Drawings: Indicate layout of joints, direction of carpet pile, and location of edge moldings.
- 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. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 3 percent of total installed of each color and pattern installed. Extra carpet shall be new, clean, unused carpet material in full factory width, carefully wrapped, sealed and identified as to carpet type designation, as extra stock for each manufacturer, pattern, color and dye lot. Extra carpet shall be provided immediately before installation begins, and shall be of the same dye lot of that which is installed.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

- A. Deliver carpet to jobsite in the original mill wrappings with each roll having its register number properly marked on each bale. Each pattern, type and color of carpet shall be of the same dye lot.
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Tile Carpeting CPT-1: Tufted, manufactured in one color dye lot.
 - 1. Product: Optic Reset manufactured by Mohawk Group.
 - 2. Tile Size: 12 by 36 inch, nominal.
 - 3. Thickness: .107 inch.
 - 4. Color: 979 Silhouette Dark.
 - 5. Pattern: Field of View Dark/GT449.
 - 6. Fiber: Duracolor Tricolor Premium Nylon.

7. Gauge: 1/12 inch.
 8. Stitches: 12.1 per inch.
 9. Dye Method: 100% Solution Dyed.
 10. Primary Backing Material: Polyolefin.
 11. Face Weight: 18 oz/sq yd.
 12. Installation Method: Half Lap.
- B. Tile Carpeting CPT-2: Tufted modular walk-off, manufactured in one color dye lot.
1. Product: First Sep II manufactured by Mohawk Group.
 2. Tile Size: 24 by 24 inch, nominal.
 3. Thickness: 203 inch.
 4. Color: Obsidian 989.
 5. Fiber: Duracolor Premium Nylon.
 6. Gauge: 5/32 inch.
 7. Stitches: 8.5 per inch.
 8. Dye Method: 100% Solution Dyed.
 9. Primary Backing Material: EcoFlex NXT.
 10. Face Weight: 38 oz/sq yd.
 11. Installation Method: Quarter turn.

2.02 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips and Transitions: Schluter Systems, Brushed stainless color. Transition style as required for between carpet tile and polished concrete floor.
- C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect all carpet upon receiving shipment and advise Architect in writing of any condition or defects deemed unacceptable for installation.
- B. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile. The Carpet Subcontractor shall notify the General Contractor, in writing, with copies to the Architect, of conditions which will prevent him/her from producing satisfactory finished work. The installation of carpet shall be an indication of his/her acceptance of the substrates, and he/she will automatically assume the responsibility for any unacceptable finished work caused by substrate conditions. Under this Section, the Carpet Subcontractor shall be responsible for installing fill at depressions, holes, cracks and minor variations, and to transition where adjacent to polished concrete floor.
- C. Vacuum substrate immediately prior to carpet installation. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 1. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C. Blend carpet from different cartons to ensure minimal variation in color match.

- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay out carpet per Drawings.
- F. Bond all modular carpet securely to the substrate in a full bed of "releasable" adhesive, and with self-adhesive backing where specified.
- G. Install in a grid pattern, tightly fitting carpet tiles to each other and to all vertical surfaces. Follow manufacturer's printed instructions regarding maintaining squareness and tightness of the installation.
- H. Carpet tiles less than half-size will not be allowed except where the configuration of the room will not permit larger size tiles. Avoid use of cut tiles in doorways and other high traffic areas to the maximum extent possible.
- I. Locate change of color or pattern between rooms under door centerline.
- J. Trim carpet tile neatly at walls and around interruptions.
- K. Extend carpet under open-bottom and raised-bottom obstructions and under removable flanges of obstructions. Extend carpet into closets, knee spaces and alcoves of rooms indicated to be carpeted. Extend carpet under movable furniture and equipment unless otherwise indicated.
- L. Complete installation of edge strips, concealing exposed edges.
- M. Damaged, defective, wrinkled or shrunken modular carpet tiles, or carpet stained by adhesives shall be removed and replaced.

3.03 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.
- C. Remove all loose pieces of face yarn with sharp scissors.

END OF SECTION

**SECTION 09 72 00
WALL COVERINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Dry Erase wall covering (**EQ-12**).
- B. Tray and trim rails.

1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- B. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics 2020.

1.03 SUBMITTALS

- A. See Section 01 30 00 - 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. Samples: Submit two samples of wall covering, 6 by 9 inch in size illustrating color, finish, and texture.
- E. Samples: Submit one 6 inch sample of each type of trim and tray.
- F. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

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 DRY ERASE 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.
- B. Wall Covering: Fabric-backed vinyl roll stock.
 - 1. Comply with ASTM F793/F793M, Category V, Type II.
 - 2. Roll Width: 60 inches.
 - 3. Backing: Non-woven, synthetic fabric.
 - 4. Color: White.
 - 5. Manufacturers:
 - a. Koroseal/RJF International; Walltalkers Matte-Rite MP60: www.koroseal.com/#sle.

- C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.
- D. Termination Trim: Extruded plastic, clear.
- E. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

2.02 TRIM AND TRAY

- A. Aluminum Tray: Clear satin, anodized aluminum, snap-on marker and eraser tray with clip.
1. Length: See Drawings for length required.
- B. Wallcovering Trim: J Cap (JC12-00), clear satin, anodized aluminum, low profile trim to be installed at the top of the wall covering from corner to corner.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.
- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.
- C. Beginning of installation means acceptance of surface conditions.

3.02 PREPARATION

- A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
- B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- C. Surfaces: Correct defects and clean surfaces that affect work of this section.
- D. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Apply adhesive to wall surface immediately prior to application of wall covering.
- C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- D. Butt edges tightly.
- E. Install termination trim.
- F. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

- A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

- A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

**SECTION 09 90 00
PAINTING**

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. Extent of painting work is shown on Drawings and schedules, and as herein specified.
- B. The work includes painting and finishing of interior and exterior exposed items and surfaces throughout project, except as otherwise indicated.
- C. "PAINT" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.02 WORK NOT INCLUDED

- A. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, miscellaneous metal, hollow metal work and similar items. The same applies for shop-fabricated or factory-built mechanical and electrical equipment and accessories. See list of items later in this Section. However, the presence of a shop-applied primer shall not reduce the number of coats required to be applied in the field as specified under the Paint and Stain Schedule later in this Section. Touch-up of primer on structural and miscellaneous steel items damaged or abraded shall be accomplished under Sections 05 12 00 and 05 50 00. Touch-up of primer on metal doors and frames damaged or abraded surfaces shall be accomplished under Section 08 12 13. The painter shall notify the Contractor if such repair has not been done prior to his/her application of the first coat of paint.
- B. Prefinished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer finishing is specified for such items as (but not limited to) toilet enclosures, acoustic materials, finished mechanical and electrical equipment including cabinet unit heaters, light fixtures, switchgear and distribution cabinets. See list of items later in this Section.
- C. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls and ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces and duct shafts. See list of items later in this Section.
- D. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated. See list of items later in this Section.
- E. Operating Parts and Labels: Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts will not require finish painting, unless otherwise indicated.
- F. Do not paint over code-required labels, such as Underwriters' Laboratories and Factory Mutual, and equipment identification, performance rating, name, and nomenclature plates.
- G. Omit paint, stain, and/or finishing as noted for the following items:
 - 1. Acoustical tile ceilings
 - 2. Drawer bodies at architectural casework (prefinished)
 - 3. Fire alarm panels (prefinished)
 - 4. Fire extinguisher cabinets (as noted in Section 10 44 00)
 - 5. Flashings, gutters and downspouts (prefinished)
 - 6. Operable partition jamb trim (prefinished)
 - 7. Toilet compartments (prefinished)
 - 8. Prefinished wood doors (except as otherwise specified)

1.03 QUALITY ASSURANCE

- A. Acceptable manufacturers are as follows:
 - 1. Benjamin Moore and Company
 - 2. Diamond Vogel Paints (Vogel Paint Manufacturing Company)

3. ICI Paints
 4. Iowa Paint Manufacturing Company, Inc.
 5. Pittsburgh Paints, PPG Industries, Inc.
 6. Pratt and Lambert, Inc.
 7. The Sherwin-Williams Company
 8. Tnemec Company, Inc. (only on products as specified below)
- B. Pre-Painting Conference: Prior to the start of painting and after approval of required shop drawings and samples, the General Contractor shall arrange a Pre-painting Conference at the project site at a pre-arranged time approved by the Architect/Engineer. The conference shall include in attendance the painting subcontractor and his/her jobsite foreperson. The contractor shall record discussions and agreements that are made which are not specifically addressed in the Contract Documents, and shall furnish a copy to all involved participants.

1.04 SUBMITTALS

- A. Manufacturer's Data: Submit copies to the Architect/Engineer in accord with the General Conditions and Section 01 30 00 of the manufacturers' printed specifications and data sheets for each type of paint and other finishing materials proposed to be utilized. These submittals shall be for each paint system (designated PS herein) specified.
- B. Samples: Submit 3 samples of each type of finish and color to the Architect/Engineer in accord with the General Conditions and Section 01 30 00 . Stain samples of ST-1 shall be submitted on 8-inch long piece of wood, matching species and cut specified. Paint samples shall be submitted on 8-1/2-inch by 11-inch Mead Mark I cover paper, coated one side, with paint sprayed or applied with a foam rubber roller. Front of paint samples shall show the paint manufacturer and the trade name of the proposed paint.
- C. Extra Stock: The Painting Contractor shall furnish the Owner with one gallon of **EACH COLOR in EACH PAINT SYSTEM**, sealed and unused, which are used on this project, together with explanation of what each paint system is used for and mixing formula attached thereto. The Painting Contractor shall furnish 2 copies of the mixing formula information to the Prime Contractor in addition to the instructions attached to paint containers for inclusion with the Owner's maintenance manuals.

1.05 DELIVERY, STORAGE AND PROTECTION

- A. Delivery and Storage of Materials: All paints, varnishes, enamels, lacquers, stains, and similar materials must be delivered in the original containers with seals unbroken. All containers must also include the following information:
1. Name of title of material
 2. Federal Specification numbers if applicable
 3. Manufacturer's stock number and date of manufacture
 4. Manufacturer's name
 5. Contents by volume, for major pigment and vehicle constituents
 6. Thinning instructions
 7. Application instructions
 8. Color name and number
- B. Store materials in a single place designated by the Prime Contractor and approved by the Owner and Architect/Engineer. Such storage place shall be kept neat and clean, and all damage thereto or to its surroundings shall be returned to the original or intended condition. Oil rags, waste, etc. shall be removed from the building every night, and every precaution taken to avoid the danger of fire.

1.06 JOB CONDITIONS

- A. Temperature: Surface temperature shall be maintained at a minimum of 50F during application and drying of paints and finishes. Exterior surfaces shall not be painted or finished during rainy or frosty weather nor when they are exposed to a hot sun. See manufacturer's printed instructions for more specific requirements.

- B. Protection: Adjacent work, building finishes and surfaces together with manufactured casework and similar items shall be totally protected with masking tape, drop cloths or other suitable coverings. Manufactured casework, millwork, cabinetwork, food service equipment and similar items shall not be utilized for any construction related purpose or utilized as work surface, scaffolding, plank supports or in any way walked upon.
- C. Sequencing: Frames and doors shall be given their first coat of paint and stain/varnish before glass is installed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. MATERIALS. The Contractor shall have the option of using materials and finishes manufactured by any one of the manufacturers previously listed. Materials used throughout shall be the products of one manufacturer only and shall be first line and top grade materials produced by the manufacturer selected. The mentioning of a specific brand name is done to establish a minimum acceptable standard or quality desired. Actual materials are listed in the Schedule of Finishes. In the case where Tnemec products are specified hereinafter, the above substitution policy for other listed products shall not apply, and only the specified Tnemec products will be acceptable.

PART 3 EXECUTION

3.01 INSPECTION

- A. Condition of Surfaces: The Painting Contractor shall examine all surfaces which are scheduled to receive paint, stain, varnish, or other coatings, and report in writing to the Prime Contractor with copy to the Architect/Engineer, any surfaces which cannot be put into proper condition for finishing by customer cleaning, sanding, puttying, or other similar preparation operations. Application of the first coat shall constitute acceptance of surfaces as fit and proper to receive finish.

3.02 PREPARATION

- A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.
- B. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted. Following completion of painting of each space or area, reinstall removed items.
- C. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.
- D. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block and cement plaster to be painted by removing efflorescence, chalk, dust, dirt, grease, oils and by roughening as required to remove glaze.
- E. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed direction.
- F. Wood: Wood surfaces to be painted shall be cleaned of dirt, oil, or other foreign substances. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat, where finish is paint or enamel.
- G. Wood surfaces to be stained shall be finish sanded to 150 grit or equal, and dusted off.
- H. After application of first coat, putty nail holes, cracks, etc., with putty of a color to match that of the finish. Bring putty flush to the adjoining surface. Sandpaper smooth when dried.

- I. Ferrous Metals: Clean ferrous surfaces which are not galvanized or shop-coated, with S.S.P.C. SP 6 Commercial Blast.
- J. Galvanized Metals: Clean and treat chemically with a compound designed for this purpose, such as "Lithoform", "Stibley", or "Solfo Metallic Coat", in accord with the paint manufacturer's instructions.
- K. Aluminum(where specified to be painted): Thoroughly clean using solvents recommended by the paint manufacturer. Scuff sand surface to provide tooth for bonding.

3.03 APPLICATION

- A. General: All materials shall be applied in accordance with the paint manufacturer's printed instructions, using applicators and techniques best suited for substrate and type of material being applied. Apply all materials under adequate illumination, spread evenly, and flow on smoothly without runs or sags. All coats must be thoroughly dry before applying succeeding coats. The number of coats specified shall not be reduced, even if the item to be painted has been factory primed. Apply materials to provide total color and sheen uniformity on all surfaces.
- B. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind all permanently-fixed equipment and furniture with prime coat only before final installation of equipment.
- C. Spray application of paints will be permitted on wall surfaces and on exposed metal deck, steel joists, and exposed structural roof system areas provided the application is by airless-type spray equipment, and provided the application by spray is followed by a roller on wall surfaces. Roller shall thoroughly work paint into pores for complete surface coverage. Conventional paint spray equipment will be permitted on metal door frames, metal doors, and other metal fabrications. Sprayed surfaces shall be smooth, free of imperfections, and paint runs, and shall be completely covered by each coat.
- D. Undercoats of paint and enamel shall be of the approximate color as the final coat, except primers for accent colors may be white or off-white if recommended by the paint manufacturer to bring out the color depth of the finish color. Between coats, sand enamel finish applied to metal or wood with fine sand paper, clean and tack to produce an even, smooth finish.
- E. Staining and Varnishing: Cover surfaces to be stained with a uniform coat and wipe off if required. Between coats, sand varnish finish applied to wood with fine sandpaper, clean and tack to produce an even, smooth finish.
- F. Factory-Primed and Mill-Primed Surfaces: Use the materials specified in every case for such surfaces and use in accord with the manufacturer's directions for the first or priming coat.
- G. Non-Ferrous Metals: Copper, bronze, chromium plate, nickel, stainless steel, aluminum, and Monel metal shall not be painted or finished except as otherwise specified.

3.04 FIELD QUALITY CONTROL

- A. First Coat Inspection: When a coat of material has been applied, the Painting Subcontractor shall inform the Architect/Engineer so that the work may be inspected and approved. Credit for succeeding coats will not be given unless the preceding coat has been so examined and approved.

3.05 ADJUSTING AND CLEANING

- A. Clean adjacent and other surfaces which are smeared or splattered as a result of the painting. Use a knife blade to clean paint out of control joints in plaster or gypsum board, using care not to scratch or otherwise damage finished surfaces.

3.06 PROTECTION

- A. Protect work of other trades whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

- B. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
- C. Do not paint telecommunications cables. Coordinate paint and cable installation schedule with the telecommunications contractor. Protect cabling from direct painting or over-spray. Cables which have been painted are void of the manufacturer's warranty and will be replaced at this contractor's expense.
- D. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.07 PAINT AND STAIN SCHEDULE

A. EXTERIOR WORK

- 1. FERROUS METAL (All items included in Sections 05 12 00 and 05 50 00)
 - a. Touch up damaged or scratched shop-applied primer
 - 1) Tnemec 135 Primer
 - b. 1 coat, 2.5-3.5 mils (spray, brush or roller)
 - 1) Tnemec Series 750, Semi-gloss
- 2. FERROUS METAL (Steel doors, frames, and other ferrous metal not primed with Tnemec primers)
 - a. 1 coat, 1.5-2.0 mils (spray, brush or roller)
 - 1) Tnemec Series 27 Typoxy (color similar to specified finish color)
 - b. 1 coat, 3.0-4.0 mils (spray, brush or roller)
 - 1) Tnemec Series 1075U Endura-Shield II, Semi-gloss
- 3. CONCRETE BLOCK (CMU)
 - a. 2 coats
 - 1) Tnemec Series 52 Tnemecrete

B. INTERIOR WORK

- 1. INTERIOR SURFACES OF EXTERIOR METAL DOORS AND METAL FRAMES,
 - a. Same as specified above for exterior steel doors and frames.
- 2. FERROUS METAL (Other items, i.e., metal doors, frames, etc.)
 - a. 1 coat
 - 1) Tnemec Series 115 at 2.5-3.0 mils
 - b. 2 coats
 - 1) Tnemec Series 1029 Enduratone
- 3. EXPOSED STRUCTURAL STEEL AND DECK
 - a. 1 coat
 - 1) Tnemec Series: 115 Uni-Bond DF OR Sherwin Williams ProIndustrial 113.70 Waterborne Acrylic Dryfall Flat
- 4. GYPSUM BOARD (CEILINGS)
 - a. 1 coat
 - 1) Sherwin Williams ProMar 200 Zero VOC Interior latex primer
 - b. 2 coats
 - 1) Sherwin Williams ProMar 200 Zero VOC Interior Latex Flat B30-2600 Series
- 5. GYPSUM BOARD (WALLS)
 - a. 1 coat
 - 1) Sherwin Williams ProMar 200 Zero VOC Interior Latex Primer
 - b. 2 coats
 - 1) Sherwin Williams ProMar 200 Zero VOC Interior Latex Eg Shell B20-2600 Series
- 6. GYPSUM BOARD (WALLS EPOXY FINISH) (Apply to all walls of rooms indicated in Room Finish Schedule unless otherwise noted)
 - a. 1 coat

- 1) Sherwin Williams ProMar 200 Zero VOC Interior Latex Primer
 - b. 2 coats
 - 1) Sherwin Williams Pro Industrial Waterbased Catalyzed Epoxy B73-300 Series
- 7. WOOD AND PLYWOOD (PAINTED)
 - a. 1 coat
 - 1) Sherwin Williams ProMar 200 Zero VOC Interior Latex Prime
 - b. 2 coats
 - 1) Sherwin Williams ProMar 200 Zero VOC Interior Semi-Gloss B20-2600 Series
- 8. CONCRETE MASONRY
 - a. 1 coat
 - 1) Sherwin Williams ProMar Interior/ExteriorBlock Filler
 - b. 2 coats
 - 1) Sherwin Williams ProMar 200 Zero VOC Interior Latex Eg Shell B20-260 Series
- 9. HARDWOOD (STAINED)
 - a. 1 coat
 - 1) Sherwin Williams MinWax Wood Finish 250 VOC Compliant Stain
 - b. 3 coats
 - 1) Sherwin Williams Kem Aqua Lacquer, CC-F31, Medium
- 10. GYPSUM BOARD WALLS (to be covered with tackboard for tackwall)
 - a. 1 coat
 - 1) Sherwin Williams PrepRite Classic Interior Latex Eg-Shel
- 11. TACKBOARD FOR TACKWALL
 - a. 1 coat
 - 1) Sherwin Williams PrepRite VOC-ComplyingWall and Wood Primer
- 12. MECHANICAL AND ELECTRICAL ITEMS. New registers, grilles, steel-incased heating units, heating and water pipes, sprinkler piping, electrical conduits, outlet boxes, and panelboard fronts exposed in a finished room (except in Rooms at the Mezzanine / Clerestory level) shall be painted as specified for Metal Work or as specified or required for the surface to be painted. Color shall match color of adjacent wall or ceiling surfaces.
- 13. INSIDE OF NEW DUCTWORK AND PLENUM SPACES exposed to view through registers and grilles shall receive one coat of flat black paint.

3.08 PAINT AND STAIN LOCATION SCHEDULE

- A. THE FOLLOWING LIST of items requiring paint or stain contains the major areas of finish required. The Contractor shall verify the color and type of finish with the Architect/Engineer for any items which obviously require finish but for which a color is not listed hereinafter.
- B. EXTERIOR COLOR PLACEMENT
 - 1. Hollow metal doors and frames, including interior surfaces, unless noted otherwise
As noted on Door and Frame Schedule
- C. INTERIOR COLOR PLACEMENT

1. Hollow metal doors and frames	As noted on Door and Frame Schedule
2. CMU walls	As noted on Room Finish Schedule
3. GWB walls	As noted on Room Finish Schedule
4. GWB ceilings	As noted on Room Finish Schedule
5. GWB bulkheads	PNT-6, U.N.O., see drawings
6. Electrical panels and access doors surfaces	Match adjacent wall and ceiling
7. Handrails, guardrails, brackets and supports	PNT-7
8. Exposed metal deck	As noted on the Drawings
- D. SCHEDULE
 - 1. Paint Color
 - a. PNT-1, color: Sherwin Williams, Eider White, 7014.
 - b. PNT-2, color: Sherwin Williams, Loch Blue, 6502.

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- c. PNT-3, color: Sherwin Williams, Ellie Gray, 7650.
 - d. PNT-4, color: Sherwin Williams, Reynard, 6348.
 - e. PNT-5, color: Sherwin Williams, Serape, 6656.
 - f. PNT-6, color: Sherwin Williams, Snowbound, 7004.
2. Stain Color
- a. ST-1, color: As selected from manufacturer's standard range.

END OF SECTION

DIVISION 10 – SPECIALTIES

**SECTION 10 11 00
VISUAL DISPLAY UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resinous markerboards **(EQ-6)**.
- B. Tackboards **(EQ-20)**.
- C. Horizontal sliding visual display units.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

- A. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling 2018.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
- D. Samples: Submit two samples 2 by 2 inch in size illustrating materials and finish, color and texture of markerboard and trim.
- E. Test Reports: Show compliance to specified surface burning characteristics requirements.
- F. Maintenance Data: Include data on regular cleaning, stain removal .

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide Life of Building warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 VISUAL DISPLAY UNITS

- A. Resinous Markerboards:
 - 1. Resinous Markerboard: Glass-free, magnetic, non-staining, resinous panel, factory finished edges, flexible, shatterproof and optically clear.
 - a. Non-staining shall mean impervious to staining from dry erase, wet erase, and permanent markers.
 - b. Markerboard colorant: Permanent opaque color on back.
 - c. Markerboard weight: 2.5LB/SF.
 - 2. Edge and Corner Detail:
 - a. Crown corner with Brilliance Edge.
 - 3. Size:
 - a. Executive (60" x 48") at Electrical/I & C Lab (Room 112) and Mechanical Lab (Room 113).
 - b. Classic (48" x 48") at Classroom 1 (Room 115) and Classroom 3 (Room 117).
 - c. Mini (39" x 48") at Classroom 2 (Room 116).

4. Color: Standard white.
5. Accessories:
 - a. Manufacturer's Magnetic Accessory Kit: Provide at each markerboard.
 - 1) Magnetic cup.
 - 2) Magnetic eraser.
 - 3) Dry erase markers.
 - 4) Magnets.
- B. Bulletin Board Cabinet: Cabinet with doors and fixed rear panel.
 1. Cabinet:
 - a. Height: 48 inches.
 - b. Length: 6 feet .
 - c. Perimeter trim is 1-1/2" x 3" heavy-gauge rectangular aluminum with satin anodize finish; inside depth is 1-3/4"
 - d. Frame Finish: Anodized, satin.
 - e. Doors: 3/16 inch tempered glass doors.
 - f. Locks: Manufacturer's standard tumbler locks.
 2. Fixed Rear Panel: Self-Healing cork.
 3. Manufacturers:
 - a. Claridge Products and Equipment, Inc; Contemporary Series Bulletin Board Model 2044S: www.claridgeproducts.com/#sle.

2.02 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Float Glass: Provide float-glass-based glazing unless otherwise indicated.
 1. Kind FT - Fully Tempered Type: Comply with ASTM C1048.

2.03 ACCESSORIES

- A. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- B. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame. Chalk tray shall be equal to Claridge Series 1 chalk tray.
- C. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

3.03 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

END OF SECTION

**SECTION 10 21 13.19
PLASTIC TOILET COMPARTMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal screens.
- C. Locker benches **(EQ-9)**.

1.02 REFERENCE STANDARDS

- A. Conform to ANSI A117.1 code for access for the handicapped.

1.03 QUALITY ASSURANCE

- A. Field Measurements: Take field measurements prior to the preparation of shop drawings and fabrication where possible, to ensure proper fitting of work. However, allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay work.
- B. Coordination: Furnish inserts and anchorages which must be built into other work for installation of toilet partitions and related work; coordinate delivery with other work to avoid delay.
- C. Code Compliance: All partitions and pilasters shall comply with the Americans with Disabilities Act and other applicable codes.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- C. Samples: Submit two samples of partition panels, 3 by 3 inch in size illustrating panel finish, color, and sheen.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
 - 1. Scranton Products; Hiny Hiders Partitions: www.scrantonproducts.com/#sle.

2.02 PLASTIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286, floor-mounted headrail-braced.
 - 1. Furnish units with cutouts, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories and grab bars as indicated.
 - 2. Color: Grey
 - 3. Texture: Orange Peel.
- B. Doors:
 - 1. Thickness: 1 inch.
 - 2. Width: 24 inch.
 - 3. Width for Handicapped Use: 36 inch, out-swinging.
 - 4. Height: 55 inch.
- C. Panels:
 - 1. Thickness: 1 inch.
 - 2. Height: 55 inch.

3. Depth: As indicated on drawings.
- D. Pilasters:
 1. Thickness: 1 inch.
 2. Width: As required to fit space; minimum 3 inch.
- E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.03 LOCKER BENCHES

- A. Locker Benches: Stationary type; bench top of solid high density polyethylene (HDPE); black anodized aluminum pedestal pedestals.
 1. Length: 72 inches.
 2. Color to be selected from manufacturer's standard range.
 3. Bench tops shall be 1-1/2 inches thick with all edges rounded to a 1/4 inch radius. Standard bench top size is 9-1/2 inches wide.
 4. Steel pedestals shall be 16-1/4 inches high, secured to bench tops with stainless steel tamper resistant Torx head screws and secured to the floor using lead expansion shields with 2 inches stainless steel Phillips head machine bolts.
 5. Basis of Design:
 - a. Scranton Products; Tufftec Benches: www.scrantonproducts.com/#sle.

2.04 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
- B. Head Rails: Extruded aluminum, anti-grip profile.
- C. Wall and Pilaster Brackets: Stainless steel; continuous type.
- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- E. Hinges: Stainless steel; satin finish.
 1. Pivot hinges, gravity type, adjustable for door close positioning; set to stand open approximately 15 degrees; two per door, three per door at handicap compartments.
 - a. 4-inch heavy duty hinge.
- F. Door Hardware: Stainless steel; satin finish.
 1. Door Latch: Slide 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.
 4. Out-swing door components shall be provided with a building wall-mounted bumper positioned to be from 2-inches to 4-inches above the bottom edge of compartment door, or where the door handle comes in contact with the building wall.
- G. Coat Hook: One per compartment, mounted on door.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.

- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 CLEANING AND PROTECTION

- A. Clean exposed surfaces of partition system using materials and methods recommended by manufacturer and provide protection as necessary to prevent damage during remainder of construction period.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

**SECTION 10 22 39
FOLDING PANEL PARTITIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Top-supported folding panel partitions, horizontal opening.

1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- C. ASTM E413 - Classification for Rating Sound Insulation 2022.
- D. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics 2020.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on partition materials, operation, hardware and accessories, and track switching components.
- C. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, adjacent construction and finish trim, and stacking depth.
- D. Samples for Review: Submit two samples of surface finish, 6 by 6 inches size, illustrating quality, colors selected, texture, and weight.
- E. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until installation.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within five year period after Date of Substantial Completion.
- C. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Folding Panel Partitions - Horizontal Opening:
 - 1. Basis-of-Design: Modernfold; Acousti-Seal 932: www.modernfold.com.
 - 2. Other Acceptable Manufacturers:
 - a. Hufcor, Inc: www.hufcor.com/#sle.
 - b. Moderco, Inc: www.moderco.com/#sle.
 - c. Panelfold, Inc: www.panelfold.com/#sle.

2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

- A. Folding Panel Partitions: Side opening; paired panels; side stacking; manually operated.
- B. Panel Construction:
 - 1. Frame: 18 gage, 0.0478 inch thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
 - 2. Panel Properties:
 - a. Thickness Without Finish: 3 inches.
 - b. Width: Up to 48 inches (1219 mm).
 - c. Weight: 8 1/2 lb/sq ft.
 - 3. Hardware: Manufacturer's standard heavy duty.
 - 4. Trailing panel shall incorporate an "expanding jamb" at the trail edge to make the final closure and seal.
 - 5. Wall jambs: Include manufacturer's standard vinyl wrapped wall jambs at both jambs as shown on the Drawings.
- C. Panel Finishes:
 - 1. Facing: Vinyl coated fabric.
 - 2. Exposed Metal Trim: Dark Bronze anodized finish.
- D. Panel Seals:
 - 1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
 - 2. Acoustic Seals: Flexible acoustic seals at jambs, ceilings, floor seals.
- E. Suspension System:
 - 1. Track: Manufacturer's standard No. 17, 11-gauge steel track with prefinished off-white exposed surface. Provide system as scheduled to properly support operation without damage to track folding unit and adjacent surfaces.
 - a. Additional track assembly for the stack area shall be included as required.
 - 2. Carriers: Top supported ball bearing hanger trolleys capable of negotiating 90 degree turns without the use of switching devices or curves. Top support horizontal rotating "puck" trolleys.
- F. Performance:
 - 1. Acoustic Performance:
 - a. Sound Transmission Class (STC): 50 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.
 - 2. Surface Burning Characteristics of Panel Finish: Flame spread/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
 - 3. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.
 - 4. Deflection: Partition systems shall be capable of operating with up to 1-1/2-inch live roof load deflection.
- G. Accessories:
 - 1. Acoustic Sealant: As recommended by partition manufacturer.

2.03 MATERIALS

- A. Vinyl Coated Fabric: ASTM F793 Category VI, polyvinyl fluoride (PVC) finish for washability and improved flame retardance; color as selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

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

- B. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.

3.02 INSTALLATION

- A. Install partition in accordance with manufacturer's instructions and ASTM E557.
- B. Install acoustic sealant to achieve required acoustic performance.
- C. Coordination: Installation shall not begin until all roofing materials have been installed on the roof and the resulting deflection has taken place. The Prime Contractor shall provide and install overhead support, header enclosure and/or baffling as detailed on the Drawings and defined earlier in this Section. Overhead operable partition track supports or hanger brackets shall be pre-punched or otherwise be prepared by the panel fabricator to receive hanger rods in accord with layout for the job. The Prime Contractor shall provide a smooth and level floor from wall to wall and for minimum 27-inches either side of center line of the partition. All tracks shall be hung, leveled and adjusted before adjacent ceilings or bulkheads are installed. Where possible, hanger rods shall be left accessible above finished ceilings or bulkheads, where attached to structure above, for adjustment in the future.

3.03 ADJUSTING

- A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.
- B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.
- C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING

- A. Clean finish surfaces and partition accessories.

END OF SECTION

**SECTION 10 26 00
WALL AND DOOR PROTECTION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

1.03 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2010 (Reapproved 2018).
- B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents 2021.
- C. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies 2014.
- D. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details.
- D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
 - 1. Submit two sections of corner guards, 6 inches long.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Stock Materials: Two of each kind of minimum 48 inches long unit of covers for corner guards.
- F. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has previously installed wall surface protection systems similar in material, design, and extent to the systems indicated for this Project.
- B. Manufacturer Qualifications: Firm experienced in manufacturing wall surface protection system components that are similar to those required for this Project and that have a record of successful in-service performance.
- C. Single Source Responsibility: Obtain each color, grade finish and type of wall surface protection system component from a single source with resources to provided products of consistent quality in appearance and physical properties without delaying progress of the Work.
- D. Design Criteria: The Drawings indicate the size, profile and dimensional requirements of wall surface protection system components required and are based on the specific types and models indicated. Wall surface protection system components by other manufacturers may be considered provided color options are acceptable and deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards:
 - 1. Basis of Design:
 - a. Construction Specialties, Inc; Acrovyn Solid Color and Chameleon Corner Guards: www.c-sgroup.com/#sle.
 - 2. Acceptable Manufacturers:
 - a. Inpro: www.inprocorp.com/#sle.
 - b. Koroseal Interior Products: www.koroseal.com/#sle.

2.02 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.
- C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.03 PRODUCT TYPES

- A. Corner Guards - Surface Mounted:
 - 1. Material: Polyethylene terephthalate (PET or PETG); PVC-free.
 - 2. Width of Wings: 1-1/2 inches.
 - 3. Corner: Square.
 - 4. Color: As selected from manufacturer's standard colors.
 - 5. Length: One piece 48" long (mounted above 4" base).
 - 6. Accessories: Mounting hardware, and other accessories as required.
 - a. End caps:
 - 1) Match plastic cover color.
 - 2) Field adjustable for close alignment with snap-on plastic covers.
- B. Basis of Design:
 - 1. Construction Specialties, Inc; Acrovyn VA-200N: www.c-sgroup.com/#sle.
- C. Adhesives and Primers: As recommended by manufacturer.
- D. Furnish color match caulk to be used at outside corners underneath corner guards and at top of vinyl base where vinyl base is installed over sheet product.

2.04 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that substrate surfaces for adhered items are clean and smooth.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Install wall surface protection units plumb, level and true to line without distortions. Do not use materials with chips, cracks, voids, stains or other defect that might be visible in the finished work.
- C. Position corner guard 4 inches above finished floor to 52 inches high (48 inch corner guard).

3.03 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

**SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Utility room accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00: Concealed supports for accessories, including in wall framing and plates.
- B. Section 10 21 13.19 - Plastic Toilet Compartments.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- C. ASTM C1036 - Standard Specification for Flat Glass 2021.
- D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. ASI - American Specialties, Inc: www.americanspecialties.com.
 - 2. Bradley Corporation: www.bradleycorp.com.
 - 3. Georgia-Pacific Professional: www.blue-connect.com/#sle.
 - 4. GOJO Industries: www.gojo
 - 5. Bobrick Washroom Equipment Co., Inc.: www.Bobrick.com.

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.
- B. Surface-Mounted Toilet Accessories - General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with full-length stainless steel piano hinge. Provide concealed anchorage wherever possible.
- C. Recessed Toilet Accessories - General: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full-length stainless steel piano hinge. Provide anchorage which is fully concealed when closed.
- D. Stamped Names and Labels: On exposed faces of toilet accessory units are not permitted, except where otherwise indicated; unobtrusive labels on surfaces not exposed to view are acceptable.
- E. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six (6) keys for each accessory to Owner.
- F. Stainless Steel Sheet: ASTM A666, Type 304.

- G. Mirror Glass: Tempered safety glass, ASTM C1048/ASTM C1048; and ASTM C1036/ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required or stainless steel.
 - 1. Mirror shall be secured to hanger(s) with concealed Philips head locking screws located in bottom of frame.
- H. Fasteners, Screws, and Bolts: Shall be of the same material as accessory unit or of galvanized steel where concealed; tamper-proof.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 PREPARATION

- A. Deliver inserts, anchorages, and rough-in frames to site for timely installation.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated. Verify all heights and locations with Owner and Architect in the field.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.
- B. Protective coverings shall remain in place until all construction is complete.

3.05 SCHEDULE

Item #	Model #	Item	Item Description
TA-1	Not Used		
TA-2	BRAD-5241	Paper Holder	Rocking Control Dual Rod 13" W x 1-3/4" H x 4-1/4" D
TA-3	GP-59489	Towel Dispenser	Sofpul Translucent Smoke
TA-4	B-254	Napkin Disposal	Partition-Mounted Disposal
TA-5	GOJO TFX 2750-12	Soap Dispenser	Touch-Free Hand Soap Dispenser Dove Gray
TA-6	B-6806	Grab Bars	6806 (Concealed Mounting)
TA-6A		18" Grab Bar	
TA-6B		36" Grab Bar	
TA-6C		42" Grab Bar	
TA-7	BRAD-9953	Mop and Broom Holder	24"
TA-8	B-290	Mirrors-Tempered Glass	20" x 34"
TA-9	BRAD-7512	Shelf	24" x 12" Shelf
TA-10		Sharps Container	Owner Provided, Contractor Installed

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TA-11		Waste Receptacle	Owner Provided, Contractor Installed
TA-12	BRAD-9119	Robe Hooks	Single Hook

END OF SECTION

**SECTION 10 43 00
EMERGENCY AID SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Automated external defibrillator (AED) cabinets **(EQ-3)**.
- B. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide AED operational features, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Maintenance Data: Include test schedules and recertification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Emergency Aid Cabinets and Accessories:
 - 1. Activar Construction Products Group, Inc. - JL Industries; LifeStart 1400 Series AED Cabinet: www.activarcpg.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 AUTOMATED EXTERNAL DEFIBRILLATORS (AEDS)

- A. Automated External Defibrillators (AEDs) - General: FDA approval required.
 - 1. Automated external defibrillators (AED) will be Owner provided and are not in the Contract.

2.03 EMERGENCY AID CABINETS

- A. Type: Automated external defibrillator (AED).
- B. Cabinet Construction: Non-fire-rated.
 - 1. Formed primed steel sheet; 0.036 inch thick base metal.
- C. Cabinet Configuration: Semi-recessed type.
 - 1. Size to accommodate AED.
 - 2. Trim: Flat rolled edge, with 3 inch wide face.
- D. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with wire pull handle and roller type catch. Hinge door for 180 degree opening with continuous piano hinge.
- E. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- F. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.
- G. Fabrication: Weld, fill, and grind components smooth.
- H. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- I. Finish of Door Pull or Handle: Stainless steel.
- J. Finish of Cabinet Interior: White powder coat.

2.04 ACCESSORIES

- A. Theft Alarm: Battery operated audible and strobe light alarm, 10 second delay for disarming, activated by opening cabinet door. Alarm deactivated when door is closed.

- B. Cabinet Door Signage: 'AED" decal, or vinyl self-adhering, prespaced black lettering and identifying graphic in accordance with authorities having jurisdiction (AHJ).
- C. Plastic Wall Signage: Tent style.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Wall Signs:
 - 1. Location: Where shown.
 - 2. Apply on walls after field painting is completed and has been accepted.
- D. Cabinet Lettering:
 - 1. Location: Face of glazing surface.

3.03 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust cabinet doors to operate smoothly without binding. Verify that alarms and integral locking devices operate properly.
- C. Touch up marred finishes. Replace cabinets that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

END OF SECTION

**SECTION 10 44 00
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

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 2022.
- B. UL (DIR) - Online Certifications Directory Current Edition.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide cabinet type and materials, door construction style and materials, trim style, color and finish, anchorage details, and installation instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Kidde, a unit of United Technologies Corp; Pro 10 MP - 466204: www.kidde.com/#sle.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Larsen's Manufacturing Co; Architectural Series, Model Nos. 2409-R2: www.larsensmfg.com/#sle.
- C. Fire Extinguisher Bracket:
 - 1. Kidde, a unit of United Technologies Corp; Part No. 366242: www.kidde.com/#sle.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Mild steel tank, with pressure gauge.
 - 1. Class: A:B:C type.
 - 2. Size: 10 pound.
 - 3. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS (FEC)

- A. Cabinet Construction: Non-fire rated.
 - 1. Formed primed steel sheet; 0.036 inch thick base metal.
- B. Cabinet Configuration: Recessed type.
 - 1. Size to accommodate accessories.
 - 2. Trim: Flat square edge, with [] inch wide face.
- C. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with continuous piano hinge.
- D. Door Glazing: Full Glass style, Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- F. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.

- G. Finish of Cabinet Interior: White colored enamel.
- H. Letters on interior surface of the glass shall read: "Fire Extinguisher".
 - 1. Color: Black.
 - 2. Orientation: Vertical.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, galvanized and enamel finished.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 5 feet-4 inches from finished floor to top of cabinets.
- C. Owner to furnish and place fire extinguishers in cabinets.

END OF SECTION

**SECTION 10 51 43
WIRE MESH STORAGE LOCKERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Gear lockers (EQ-8).

1.02 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gear Lockers:
 - 1. Basis of Design:
 - a. Groves, Inc.; Ready Rack - Wall Mounted Red Rack: www.readyrack.com.

2.02 LOCKER APPLICATIONS

- A. Gear Lockers: Wire mesh lockers, wall mounted.
 - 1. Unit Sizes:
 - a. Width: 24 inches.
 - b. Depth: 20 inches.
 - c. Height: 72 inches.
 - 2. Configuration:
 - a. Vertical: Single tier.
 - 3. Components:
 - a. Side Panels: Welded wire mesh with 1.25 inch square tubular frames .
 - b. Backs: Woven wire mesh with 1.25 inch square tubular frames .
 - 4. Color: Manufacturer's standard red.

2.03 WIRE MESH STORAGE LOCKERS

- A. Wire Mesh Lockers: Factory assembled, welded construction, modular assemblies of panels, doors, anchors, hardware, and accessories as required to provide a complete system.

2.04 MATERIALS AND COMPONENTS

- A. Welded Wire Mesh: Heavy duty steel with powder coat finish.
- B. Framing and Support Members:
 - 1. Material: ASTM A36/A36M steel shapes and ASTM A500/A500M cold-formed steel.
 - 2. Framing, Corner Posts, and Intermediate Support Members: Manufacturer's standard sizes for system specified and as indicated on drawings.
- C. Framed Panels:
 - 1. Fabrication: Mesh welded to frame.
- D. Manufacturer's standard adjustable boot shelf, adjustable helmet shelf, hanging pole the length of the unit, two (2) appeal hooks per locker, and one (1) name plate per locker.

2.05 FASTENERS

- A. Bolts, Nuts and Washers: Hot dip galvanized.

- B. Anchorage Devices: Provide power driven, powder actuated, and drilled expansion bolts.

2.06 FINISHES

- A. Painted Finish: Manufacturer's standard powder coat finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- D. Install fittings if not factory installed.
- E. Replace components that do not operate smoothly.

3.02 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

DIVISION 11 – NOT USED

DIVISION 12 – FURNISHINGS

**SECTION 12 21 13
HORIZONTAL LOUVER BLINDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Horizontal slat louver blinds.
- B. Operating hardware.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating physical and dimensional characteristics.
- C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
- D. Samples: Submit two samples, 5 inch long illustrating slat materials and finish, cord type and color.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Horizontal Louver Blinds:
 - 1. Hunter Douglas Architectural; H2 Model: www.hunterdouglasarchitectural.com/#sle.
 - 2. Levolor; Metal Blinds: www.levolor.com/commercial/#sle.
 - 3. SWFcontract, a division of Springs Window Fashions, LLC; []:
www.swfcontract.com/#sle.
 - 4. Louverdrape, Inc.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BLINDS

- A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.
- B. Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.
- C. Metal Slats: Spring tempered pre-finished aluminum; square slat corners, with manufacturing burrs removed.
 - 1. Width: 2 inch.
 - 2. Color: to be selected from manufacturer standards to match vinyl base.
- D. Slat Support: Woven polypropylene cord, ladder configuration.
- E. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
- F. Headrail Attachment: Ceiling brackets.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install blinds in accordance with manufacturer's instructions.
- B. Secure in place with flush countersunk fasteners.

END OF SECTION

DIVISION 13 – NOT USED

DIVISION 14 – CONVEYING EQUIPMENT

**SECTION 14 63 00
TRAVELING BRIDGE CRANE**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section covers the traveling bridge crane, complete with trolley and hoist **(EQ-42)**.
- B. The crane shall have an electrically operated bridge, an electrically operated trolley, and an electrically operated hoist.
- C. Shall be provided by crane manufacturer and contractor installing the crane.

1.02 GENERAL

- A. Equipment and accessories furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the Engineer.
- B. All components shall be the products of a single manufacturer.
- C. Equivalent products of other manufacturers regularly engaged in the production of equipment of this type may be furnished subject to acceptance by the Engineer.
- D. All modifications necessary to accommodate the equipment shall be subject to review and acceptance by the Engineer and shall be made at no additional cost to the Owner.
- E. The bridge crane assembly shall be preassembled and run in the shop, then matchmarked and disassembled for shipment.
- F. The General Equipment Stipulations shall apply to the equipment furnished under this section.
- G. Governing Standards
 - 1. Equipment furnished under this section shall comply with the applicable requirements of the following:
 - a. Occupational Safety and Health Standards of the U.S. Department of Labor; Subpart N, Materials Handling and Storage.
 - b. Crane Manufacturers Association of America (CMAA) Specification No. 74, "Specification for Top Running & Under Running Single Girder Electric Overhead Traveling Cranes".
 - c. ANSI/ASME HST-4M, "Performance Standard for Overhead Electric Wire Rope Hoists".
- H. Labels
 - 1. The bridge, trolley, and hoist shall each have a conspicuous, easy-to-read label showing manufacturer's name, crane serial number, and rated capacity.
 - 2. The rated capacity of the hoist shall also be shown on the load block.
- I. Painting
 - 1. Shop painting shall be as specified in the General Equipment Stipulations.
 - 2. Field painting is covered in Section 09 90 00 - Painting.

1.03 SUBMITTALS

- A. Provide submittals in accordance with Section 01 30 00 - Administrative Requirements and include the following:
 - 1. Complete outline and installation drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section.
 - 2. Drawings shall include electrical connection diagrams and schematics identifying all items requiring electrical control or power in the operation of the traveling crane assembly, and complete details and information on the power feed system.
 - 3. Submit installation plan for traveling bridge crane system for approval.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Kistler Crane and Hoist
Call 402-896-9090,
Mark McElligott,
mark@kistlercraneand hoist.com

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The traveling bridge crane shall be a shop-assembled unit with top running bridge, trolley and hoist. The bridge crane assembly shall be designed for the following conditions:
 - 1. CMAA Classification: Class C
 - 2. Hoist Type: Electric wire rope.
 - 3. Hoisting capacity (tons): 5.
 - 4. Distance center-to-center of runway beams and crane rails: 22'-3" (Field verify).
 - 5. Size of runway beams (in. x lb/ft):
 - 6. Approximate overall length of runway beams and crane rails: 60'-0" (Field verify).
 - 7. Maximum available clearance beyond center line of runway beams: 0'-7" (side clearance).
 - 8. Operating floor elevation: 0'-0".
 - 9. Pendant control station elevation: 3'-6" to 4'-0".
 - 10. Crane speeds at rated capacity
 - a. Crane Drive: 100 FPM, 2- step VFD.
 - b. Trolley: 65 FPM, 2- step VFD.
 - c. Hoist (two-speeds)
 - 1) Low speed: 3.3 FPM.
 - 2) High speed: 20 FPM.
 - d. Trolley Drive: Motorized.
 - e. Bridge Drive: Dual Motor Drive.
 - f. Required hook travel, lift required: 17'-0".
 - g. Hook saddle elevation at lowest position: 0'-0".
 - h. Hook saddle elevation at highest position: ≤17'-0".

2.03 BRIDGE

- A. The bridge shall be single girder type, rigidly supported by end trucks, and shall be designed to run on the top of the crane rail. The bridge shall be constructed to accommodate a bottom running hoist trolley. The wearing surface of upper flanges shall be either specially fabricated flanges or standard flanges ground smooth.
- B. Steel design and fabrication shall comply with applicable portions of the specifications of the American Institute of Steel Construction. Loadings, impact allowances, and allowable stresses shall be in accordance with the governing standards. Deflection of the main girder shall not exceed L/600 of the span, with the maximum hoist load at any point.
- C. Bridge girders shall be constructed from structural beams, Steel, ASTM A36 or A992, as required.
- D. End Trucks
 - 1. End trucks, each fabricated from ASTM A36 or equal structural steel members, shall be designed to distribute the loading equally to each wheel, shall be securely attached to the beam by welding or with fitted bolts in reamed holes, and shall be provided with heavy gusset plates to ensure adequate rigidity and squareness.
 - 2. Each truck shall have heavy end plates to engage the stops on the crane rails.
 - 3. End trucks shall have a wheelbase of approximately 1/8 the bridge span.

4. The end trucks and wheels shall be designed to operate on the crane rails and shall clear the standard ASCE crane rail fittings, anchors, and splices.
- E. Wheels
1. Bridge crane wheels shall be of the double flange type, made of rolled, forged, or cast steel, with machined universal crowned or tapered hardened treads, designed to operate on the top flange of the runway beam.
 2. Axles may be either rotating or fixed type.
 3. Wheel bearings shall be permanently shielded, lifetime-lubricated, antifriction type, adequate for radial and end thrust loading.
- F. Bridge Drive Mechanism shall be by Detroit Hoist or equal.
1. Bridge drive shall be dual-motor.
 2. Bridge drive shall be designed to stop the bridge within CMAA specifications.
 3. End trucks shall be equipped with rail sweeps and energy absorbing rubber bumpers.
 4. Bridge shall be furnished with an adjustable frequency inverter drive and two-step or infinitely variable speed control.
 5. Bridge motors shall be inverter duty motors with a minimum Class F insulation and motor enclosures shall be TENV.
 6. Bearings shall be lifetime-lubricated, antifriction type.

2.04 TROLLEY AND HOIST

- A. The trolley and hoist shall be Detroit Hoist or equal. The hoist shall be of the cable winding drum type, and the trolley shall be designed to run on the lower flange of the crane bridge.
1. Trolley – The trolley frame shall be ASTM A36 steel or equal, shall contain the hoist, and shall be electrically driven type.
 2. Wheels shall be single flange type, made from rolled, forged, or cast steel, with hardened treads. Wheel bearings shall be permanently shielded, lifetime-lubricated, antifriction type, adequate for radial and end thrust loading.
 3. Trolleys shall have safety drop lugs and energy absorbing bumpers.
- B. Hoist
1. The hoist shall consist of a two-speed or VFD electric motor, a grooved winding drum, and gearing, built integrally with the trolley. Antifriction bearings shall be used throughout. The ratio between the diameter of the drum and the diameter of the hoisting cable shall be at least 20 to 1. At least two laps of cable shall remain on the drum when the lifting hook is in the lowest position.
 2. Wire rope shall be constructed from galvanized steel having a minimum safety factor of 5.
 3. Hoist reeving shall be double reeved.
 4. The hoist shall be provided with electrical disc brakes arranged so that the load may be raised or lowered by electric power and automatically sustained at any position of the hook when the power is cut off. The electric brake shall be released whenever current is flowing to the hoist motor and shall be automatically activated when the current is shut off or interrupted.
 5. The hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 110% of the rated load.
 6. The hoist shall be provided with adjustable limit switches to stop the hoisting mechanism at the upper and lower limits of hook travel.
 7. The lifting tackle shall consist of a lower block and hook, necessary sheaves, and wire rope, made especially for hoisting service. Rope shall be as recommended by the rope manufacturer for use on the specified drum. The lower block and hook shall be of the safety type, with guarded sheaves and a slow-opening, nonfracturing, forged steel hook. The hook shall be supported on a ball or roller thrust bearing for easy turning, and shall include a spring loaded flipper style safety latch. The sheaves shall have antifriction or sleeve type bearings.

2.05 BUMPERS AND STOPS

- A. Bumpers and stops in compliance with the governing standards shall be installed on the bridge, trolley, and crane rails. The bumpers and stops shall be located so that no part of the bridge or trolley encroaches on the clearances specified or indicated on the drawings.

2.06 ELECTRICAL

A. General

- 1. Electrical control enclosures shall be NEMA 4/12 type unless otherwise noted.
- 2. All insulated wire shall be heat resisting and shall be insulated for 600 volts.

B. Motors

- 1. Motors shall be high-starting torque, squirrel-cage, totally enclosed type, designed especially for crane and hoist service and suitable for operation on the power supply specified.
- 2. Motor size and speed shall be adequate to start the fully rated load capacity.
- 3. Hoist motor brake shall be DC disc type with adequate torque to stop and hold over 125% of the hoist rated load.
- 4. Total Bridge HP: 2 @ 1/3.
- 5. Hoist HP: 6.7 kw.
- 6. Trolley HP: 2 @ .37 kw

C. Controllers

- 1. Control of bridge drive, hoist, and trolley motions shall all be from a single pendant push-button station. Controllers shall be of the reversing, magnetic contactor type, with thermal overload protection, and shall be installed at the motor and operated from the pendant station. Pushbutton enclosure shall have a rating of NEMA 4X.
- 2. The pendant shall contain a separate push button for each of the following motions: off, on, hoist up and down, trolley forward and reverse, and bridge drive forward and reverse.
- 3. The pendant shall be mounted from independent track on bridge.
- 4. Push buttons shall be of the mechanical or electrical interlocking type to prevent possibility of damage to equipment should two or more buttons be depressed simultaneously. Push buttons shall be provided with a spring return to neutral and shall automatically return to the off position when pressure on the button is released.
- 5. A control power transformer with one secondary lead fused and the other grounded shall be provided to reduce voltage at the push-button station to a maximum of 120 volts.
- 6. The pendant control cable shall be heavy-duty type with extra-flexible stranding and neoprene jacket.
- 7. Support for the pendant station shall be provided by a stainless steel wire rope or chain equipped with a suitable strain-relief clamp for the conductor cable.

D. Power Feed System

- 1. A complete electric power feed system for the crane assembly and runway shall be provided. Power supply for the hoist shall be 480 volt, 3 phase, 60 Hz. All power required for the operation of the hoist, trolley and end trucks shall be developed from this source.
- 2. Runway electrification shall be Duct-o-wire 90 amp figure 8, 4-bar safety type rigid conductors.
- 3. Cross bridge electrification shall be flat cable style festoon system with terminal box, multi-conductor cord, plug connectors (when available) and accessories. Cable are to be hardwired when plug connectors are not available.
- 4. The current and voltage rating of the conductors and collectors shall be not less than 90 amperes continuous duty, 135 amperes intermittent duty.
- 5. Stationary conductors shall be installed adjacent to the east runway, with supports and brackets as required.
- 6. Collectors for hoist operation shall be installed on the hoist trolley and wired to the hoist.
- 7. Conductors and collectors shall be installed in conformity with the recommendations and instructions of the system manufacturer.

8. The feeder circuit for the crane assembly will be furnished and installed under the electrical section, to the location indicated on the drawings.
9. A suitable surface-mounted junction box, with all hanger brackets and other accessories required for a complete installation, shall be furnished and installed under this section at the location indicated, and the feeder circuit wired in.

PART 3 EXECUTION

3.01 ERECTION

- A. The crane, hoist, and trolley shall be erected by workers who are regularly engaged in crane erecting and who are acceptable to the crane manufacturer.

3.02 WIRING

- A. All wiring shall be installed in intermediate metal conduit in accordance with the National Electrical Code.

3.03 INSPECTION AND TESTING

- A. After complete assembly and installation, the crane shall be tested. A manufacturer's representative shall be present during all field inspection and testing. The inspection and testing shall verify that the crane has been assembled properly and that all required adjustments have been made.
- B. Acceptance Testing
 1. The crane shall be subject to operational and rated load testing.
 - a. The crane shall raise, lower, hold in any position, and transport a test load equal to 125 percent of the rated capacity of the crane, with no detrimental effects on the crane.
 - b. All motions shall be executed satisfactorily.
 - c. The Contractor shall provide the test weights.
 - d. The following functions shall be tested:
 - 1) Hoisting and lowering.
 - 2) Trolley travel.
 - 3) Bridge travel.
 - 4) Limit switches, locking and safety devices.
 2. The trip setting of hoist limit switches shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed.
 3. The actuating mechanism of the limit switch shall be located to trip the switch, under all conditions, in sufficient time to prevent contact of the hook or hook block with any part of the trolley.
 4. Hoisting and lowering tests will be conducted with 0, and 125 percent of the nominal or rated load.
 5. The rated load test shall consist of the following operations:
 - a. The test load shall be lifted a sufficient distance to ensure that the load is supported by the crane and held by the hoist brakes.
 - b. The test load shall be transported by means of the trolley for the full length of the bridge.
 - c. The test load shall be transported by means of the bridge for the full length of the runway in one direction with the trolley as close to the extreme right-hand end of the crane as practical and in the other direction with the trolley as close to the extreme left-hand end of the crane as practical.
 - d. The test load shall be lowered, stopped, and held with the brakes.
- C. Following completion of the tests, the crane shall be inspected by the Contractor and the manufacturer's representative, in the presence of the Engineer, for misalignment, breakage, and undue wear. All deficiencies shall be corrected by the Contractor in a manner acceptable to the Engineer.
- D. Test Reports

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1. Field inspection and testing of the crane shall be documented by the crane manufacturer's representative through the Contractor, noting the deficiencies and corrections and certifying that the crane is acceptable for operation.
2. Certification of the inspection shall be submitted to the Engineer.

END OF SECTION

DIVISION 21 – FIRE SUPPRESSION

SECTION 21 01 00
GENERAL REQUIREMENTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- B. Division 21, 22 and 23 Conditions apply to this Section.

1.02 SUMMARY

- A. This Section includes general fire suppression requirements and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of fire suppression systems.
- B. Refer to Section 23 01 00 for "General Requirements for Mechanical Systems."
- C. Refer to Section 23 05 00 for "Basic Mechanical Materials and Methods."
- D. Refer to Section 23 05 05 for "Basic Mechanical Piping Materials and Methods."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 21 10 00
WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.

1.03 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.04 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications: Per NFPA 13 and Factory Mutual.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design: Per NFPA 13 and Factory Mutual.
 - 4. Maximum Protection Area per Sprinkler: Per UL listing and Factory Mutual.
 - 5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 and Factory Mutual.

1.05 SUBMITTALS

- A. Qualification Data: Fire sprinkler designer with NICET-III certification or registered professional fire protection engineer.
- B. Product Data: For the following:
 - 1. Piping materials, including sprinkler specialty fittings.
 - 2. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 - 3. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
 - 4. Hose connections, including size, type, and finish.
 - 5. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
 - 6. Alarm devices, including electrical data.
- C. Fire-hydrant flow test report.
- D. Preliminary Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, submitted to architect/Engineer for preliminary review prior to submitting to authorities having jurisdiction.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

- G. Operation and Maintenance Data: For sprinkler specialties include in emergency, operation, and maintenance manuals.
- H. See 230100 General Requirements for Mechanical Systems for additional information.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified fire sprinkler designer with NICET-III certification or registered professional fire protection engineer.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."

1.07 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.08 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.01 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.

2.02 CORROSION PROTECTION PIPING ENCASEMENT

- A. Encasement for underground ductile iron piping:
 - 1. Standards: ASTM A 674 or AWWA C105.
 - 2. Form: Sheet or tube.
 - 3. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, cross laminated PE film of 0,004-inch minimum thickness.
 - 4. Color: Black

2.03 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 - 3. Gray-Iron Threaded Fittings: ASME B16.4.
 - 4. Steel Threaded Couplings: ASTM A 865.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795.

1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting.
- C. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795.
 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- D. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll-grooved ends.
 1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
- E. Threaded-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe; with factory- or field-threaded ends.
 1. Cast-Iron Threaded Flanges: ASME B16.1.
 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 5. Steel Threaded Couplings: ASTM A 865.
- F. Plain-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe.
 1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting.
- G. Plain-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe.
 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- H. Grooved-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe; with factory- or field-formed, roll-grooved ends.
 1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
- I. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10.
 1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting.
- J. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13 specified wall thickness in NPS 6 to NPS 10.
 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- K. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends.

1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.04 DIELECTRIC FITTINGS

- A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.
- B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.
- C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.
- D. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.
- E. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225 deg F.
- F. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225 deg F.

2.05 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

2.06 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 3. NPS 3: Ductile-iron body with grooved ends.
- C. Butterfly Valves: UL 1091.
 1. NPS 2 and Smaller: Bronze body with threaded ends.
 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
- D. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
- E. Gate Valves: UL 262, OS&Y type. Gate valves shall be used only where required by code.
 1. NPS 2 and Smaller: Bronze body with threaded ends.
 2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
- F. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, supervisory switch.
2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

2.07 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends. Gate valves shall be used only where required by code.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends. Globe valves shall be used only where required by code.

2.08 SPECIALTY VALVES

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
 1. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
- B. Pressure-Regulating Valves: UL 1468, brass or bronze, 400-psig minimum rating. Include female NPS inlet and outlet, adjustable setting feature, and straight or 90-degree-angle pattern design as indicated.
- C. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.

2.09 FLEXIBLE SPRINKLER HOSE FITTINGS

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Victaulic Company.
2. Standard: UL 1474.
3. Type: Braided flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.
6. Maximum Length: 36 inches.

2.10 SPRINKLERS

- A. Sprinklers shall be UL listed, with 175-psig minimum pressure rating.
- B. Automatic Sprinklers: With heat-responsive element complying with the following:
 1. UL 199, for nonresidential applications.
- C. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- D. Sprinkler types, features, and options as follows:
 1. Concealed ceiling sprinklers, including flat cover plates.
 2. Extended-coverage sprinklers.
 3. Flush ceiling sprinklers, including escutcheon.
 4. Pendent sprinklers.
 5. Sidewall sprinklers.
 6. Sidewall, dry-type sprinklers.
 7. Upright sprinklers.
- E. Sprinkler Finishes: Chrome plated, bronze, and painted.

- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Color selected by architect from supplier's standard colors.
 - 2. Sidewall Mounting: Color selected by architect from supplier's standard colors.
- G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.11 FIRE DEPARTMENT CONNECTIONS

- A. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."
 - 1. Type: Exposed, projecting, with two inlets and round escutcheon plate.
 - 2. Finish: Polished chrome-plated.

2.12 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm: UL 464, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.
- C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- D. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
- E. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
- F. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

2.13 PRESSURE GAGES

- A. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
 - 1. Water System Piping: Include caption "WATER" on dial face.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.02 EARTHWORK

- A. Refer to Architectural and Civil documents for excavating, trenching, and backfilling.

3.03 EXAMINATION

- A. Examine roughing-in for hose connections to verify actual locations of piping connections before installation.

- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 PIPING APPLICATIONS, GENERAL

- A. Shop weld pipe joints where welded piping is indicated.
- B. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- C. Piping between Fire Department Connections and Check Valves: Galvanized standard-weight steel pipe with threaded ends; or grooved joints.
- D. Underground Service-Entrance Piping: Ductile-iron, mechanical-joint pipe and fittings and restrained joints. Provide corrosion protection encasement on all underground pipe and fittings.

3.05 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
 - 1. Sprinkler Mains:
 - a. Steel piping as allowed by NFPA13, Factory Mutual and Authority Having Jurisdiction with wall thickness of schedule 10 or greater.
 - 2. Branch Piping:
 - a. Steel piping as allowed by NFPA13, Factory Mutual and Authority Having Jurisdiction with wall thickness of schedule 10 or greater.

3.06 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and Factory Mutual.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves. Gate valves shall be used only where required by code.
 - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and Factory Mutual.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves. Gate valves shall be used only where required by code.
 - b. Throttling Duty: Use ball valves.

3.07 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic Mechanical Piping Materials and Methods" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Twist-Locked Joints: Insert plain-end piping into locking-lug fitting and rotate retainer lug one-quarter turn.
- D. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.
- E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
 - 3. General Requirements:

- a. All grooved joint couplings, fittings, valves, and specialties shall be the products of a same manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - b. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.
 - c. Couplings shall be fully installed at visual pad-to-pad offset contact. Couplings that require gapping of bolt pads or specific torque ratings for proper installation are not permitted.
 - d. Install in accordance with the manufacturer's latest published installation instructions. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.
- F. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
- 1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
 - 2. NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.08 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 33 for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Refer to Division 22 for backflow preventers.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.09 PIPING INSTALLATION

- A. Refer to Division 23 Section "Basic Mechanical Piping Materials and Methods" for basic piping installation.
- B. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints.
- D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler zone control valves, test assemblies, and drain risers.
- J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- K. Install alarm devices in piping systems.
- L. Hangers and Supports: Comply with NFPA 13 and Factory Mutual for hanger materials.

- M. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.
- N. Fill wet-pipe sprinkler system piping with water.

3.10 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and Factory Mutual and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
- D. Specialty Valves:
 - 1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

3.11 SPRINKLER APPLICATIONS

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Concealed sprinklers.
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Concealed, dry sprinklers.
 - 5. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Color selected by architect from standard supplier color options in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.
 - b. Concealed Sprinklers: Rough brass, with factory-painted flat cover plate with color selected by architect from standard supplier color options.

3.12 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.13 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire department connections in vertical wall.
- B. Install ball drip valve at each check valve for fire department connection.

3.14 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Plumbing Specialties" for backflow preventers.
- D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

- F. Electrical Connections: Power wiring is specified in Division 26.
- G. Coordinate with Electrical contractor to connect alarm devices to fire alarm.

3.15 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and Factory Mutual.

3.16 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Energize circuits to electrical equipment and devices.
 - 4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 5. Coordinate with fire alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.17 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

3.18 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

DIVISION 22 - PLUMBING

**SECTION 22 01 00
GENERAL REQUIREMENTS FOR PLUMBING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- B. Division 21, 22 and 23 Conditions apply to this Section.

1.02 SUMMARY

- A. This Section includes general mechanical requirements and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of plumbing systems.
- B. Refer to Section 23 01 00 for General Requirements for Mechanical Systems.
- C. Refer to Section 23 05 00 for Basic Mechanical Materials and Methods.
- D. Refer to Section 23 05 05 for Basic Mechanical Piping Materials and Methods.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

**SECTION 22 05 23
VALVES FOR PLUMBING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes general duty valves common to several mechanical piping systems. Special purpose valves are specified in Division 22 piping system Sections.

1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.04 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- B. All valves used in potable water service shall be certified lead free per NSF-61G and NSF 372.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Division.
 - b. Hammond Valve Corporation.
 - c. Milwaukee Valve Company, Inc.
 - d. NIBCO Inc.
 - e. Stockham Valves & Fittings, Inc.
 - f. Tyler Pipe.
 - g. Victaulic Company of America.
 - 2. Check Valves:
 - a. Cla-Val Co.
 - b. Conbraco Industries, Inc.; Apollo Division.
 - c. Hammond Valve Corporation.
 - d. Keystone Valve USA, Inc.
 - e. Kitz Corp. of America.
 - f. Metraflex Company.
 - g. Milwaukee Valve Company, Inc.
 - h. NIBCO Inc.
 - i. Red-White Valve Corp.
 - j. Stockham Valves & Fittings, Inc.
 - k. Tyler Pipe.
 - l. Val-Matic Valve & Mfg. Corp.
 - m. Victaulic Company of America.

2.02 BASIC, COMMON FEATURES

- A. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated.
- C. Operators: Use specified operators and handwheels, except provide the following special operator features:
 - 1. Handwheels: For valves other than quarter turn.
 - 2. Lever Handles: For quarter-turn valves 6 inches and smaller.
 - 3. Memory Stops: For balancing applications.
- D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- E. Threads: ASME B1.20.1.
- F. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- G. Solder Joint: ASME B16.18.

2.03 BALL VALVES

- A. Ball Valves: MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 or ASTM B283 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and conventional port for 3/4-inch valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections, lever handle operator. Valves shall be certified lead free.

2.04 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections. Valves shall be certified lead free.
- B. Wafer Check Valves: Class 125, 200-psi CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges. Valves shall be certified lead free.
- C. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections. Valves shall be certified lead free.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.02 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.

- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
 - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.
 - 3. Lift Check Valve: With stem upright and plumb.

3.03 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2-1/2 Inches and Smaller: Solder ends.
 - 2.

3.04 APPLICATION SCHEDULE

- A. General Application: Use ball and butterfly valves for shutoff duty; ball and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
 - 1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
 - 2. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or elastomer-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
 - 3. Bronze Swing Check: Class 125, with rubber seat.
 - 4. Check Valves: Class 125, swing or wafer type as indicated.

3.05 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION

SECTION 22 07 20
PIPE INSULATION FOR PLUMBING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes preformed, rigid, and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.03 SUBMITTALS

- A. Product Data: Include product data description, list of materials, thickness, density and k-values for each product type, locations, manufacturer's installation instructions, flames spread, and smoke developed ratings.

1.04 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 - d. Schuller International, Inc.

2.02 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 - a. Nominal density is 2.5 lb/cu. Ft. or more.
 - b. Thermal conductivity (k-value) at 100 deg F is 0.28 Btu x in./h x sq. ft. x deg F or less
 - 2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 - 3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 - 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 - 5. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

- C. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.

2.03 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd, 4 inch tape width.
- B. Bands: 3/4 inch wide, materials compatible with jacket:
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

2.04 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.02 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- D. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- E. Apply insulation with the least number of joints practical.
- F. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- G. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- H. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- I. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- J. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- K. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
- L. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- M. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- N. Floor Penetrations: Apply insulation continuously through floor assembly.

3.03 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes by securing each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
- B. Apply preformed pipe insulation to outer diameter of pipe flange.
- C. Apply insulation to fittings and elbows as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with standard PVC fitting covers.
- D. Apply insulation to valves and specialties as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.04 INSULATION APPLICATION SCHEDULE

- A. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.
 2. Vibration-control devices.
 3. Below-grade piping, unless otherwise indicated.
 4. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.
- B. See PIPING INSULATION SCHEDULE on Sheet M5-2.

END OF SECTION

SECTION 22 11 16
WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes water distribution piping from locations indicated to fixtures and equipment inside building.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the 125 psig minimum working-pressure ratings, unless otherwise indicated:

1.04 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.01 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Soft Copper Tube: ASTM B 88, Types K, water tube, annealed temper.
- C. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.

2.02 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Copper, Solder-Joint Pressure Fittings: ASME B16.18 cast-copper alloy or ASME B16.22 wrought copper.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions: ASME B16.18, cast-copper-alloy, hexagonal-stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends. Include threads conforming to ASME B1.20.1 on threaded ends.

2.03 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.
- B. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.
- C. Solder: ASTM B 32, Alloy Sn95, Sn94, or E; lead free.
- D. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.04 VALVES

- A. Refer to Division 22 Section "Valves for Plumbing" for general-duty valves.
- B. Refer to Division 22 Section "Plumbing Specialties" for special-duty valves.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Fitting Option: Mechanically formed tee-branch outlets and brazed joints may be used on aboveground copper tubing.
- C. Service Entrance Piping, Underground:
 - 1. Soft copper tube, Type K; copper, solder-joint pressure fittings; and brazed joints.
- D. Water Distribution Piping:
 - 1. Aboveground: Hard copper tube, Type L; copper, solder-joint fittings; and soldered joints.

3.02 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball valves.
 - 2. Throttling Duty: Use ball valves.

3.03 PIPING INSTALLATION, GENERAL

- A. Refer to Division 23 Section "Basic Mechanical Piping Materials and Methods" for basic piping installation.
- B. Install piping level without pitch or with 0.25 percent slope downward toward drain when drains are indicated.

3.04 SERVICE ENTRANCE PIPING INSTALLATION

- A. Extend service entrance piping to exterior water service piping in sizes and locations indicated for service entrances into building.
- B. Rough-in water piping for water meter installation according to utility company's requirements. Verify water meter requirements with utility company. Provide water meters as required by utility company.
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each service entrance pipe.
- D. Install water-pressure regulators downstream from shutoff valves. Refer to Division 22 Section "Plumbing Specialties" for water-pressure regulators.
- E. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

3.05 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.06 VALVE INSTALLATION

- A. Sectional Valves: Install sectional valves close to main on each branch and riser serving plumbing fixtures or equipment, and where indicated. Use ball valves.
- B. Shutoff Valves: Install shutoff valve on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated. Use ball valves for piping 2-inch NPS and smaller.
- C. Drain Valves: Install hose-end drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
- D. Calibrated Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated. Refer to Division 22 Section "Plumbing Specialties" for calibrated balancing valves.

3.07 FIELD QUALITY CONTROL

- A. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- B. Test service entrance piping and water distribution piping as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave interior piping uncovered and unconcealed new, altered, extended, or replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 3. Cap and subject piping to static water pressure as required by the local Plumbing Code. If the local Plumbing Code does not stipulate testing requirements, cap and subject piping to static water pressure of 100 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 15 minutes. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. If testing is to be performed at temperatures below freezing, an air test may be performed in lieu of water testing if allowed by local plumbing code and approved by engineer.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.08 CLEANING

- A. Clean and disinfect service entrance piping and water distribution piping as follows:
 - 1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for 3 hours.
 - c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
- B. Prepare and submit reports for purging and disinfecting activities.
- C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.09 START-UP

- A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- B. Perform the following steps before putting into operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- D. Set water-pressure regulators at 80 psig maximum outlet pressure, unless otherwise indicated.

END OF SECTION

SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes all-bronze and bronze-fitted centrifugal pumps for domestic hot-water circulation.

1.03 SUBMITTALS

- A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett Domestic Pump; ITT Industries.
 - 3. Grundfos Pumps Corp.
 - 4. Taco, Inc.
 - 5. WILO USA LLC

2.02 CLOSE COUPLED, IN-LINE, CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, single-stage, close-coupled, in-line, sealless centrifugal pumps as defined in ANSI/HI 5.1-5.6.
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
 - 2. Casing: Bronze, with threaded companion-flange connections.
 - 3. Impeller: Corrosion-resistant material.
 - 4. Motor: Single speed, unless otherwise indicated.

PART 3 - EXECUTION

3.01 PUMP INSTALLATION

- A. Comply with ANSI/HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
- D. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping.

3.03 START UP

- A. Verify that pumps are installed and connected according to the Contract Documents.
- B. Perform the following preventive maintenance operations and checks before starting:
 - 1. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
 - 2. Check suction piping connections for tightness to avoid drawing air into pumps.
 - 3. Clean strainers.
 - 4. Verify that pump controls are correct for required application.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain domestic water pumps.

END OF SECTION

SECTION 22 13 16
DRAINAGE AND VENT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes sanitary drainage and vent piping inside building and to locations indicated.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.04 SUBMITTALS

- A. Test Results and Reports: Specified in "Field Quality Control" Article.
- B. See "Submittal Schedule" located at the end of Section 23 01 00 – General Requirements for Mechanical Systems.

1.05 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.01 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Hub-and-Spigot, Cast-Iron Soil Pipe: ASTM A 74, Service and Extra Heavy classes. Include ASTM C 564 rubber gasket, with dimensions required for pipe class, for each hub.
- C. Hubless, Cast-Iron Soil Pipe: ASTM A 888 or CISPI 301.
- D. PVC Plastic Pipe: ASTM D 2665, solid wall, Schedule 40.

2.02 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Threaded-Fitting, End Connections: ASME B1.20.1.
- C. Hub-and-Spigot, Cast-Iron, Soil-Pipe Fittings: ASTM A 74, Service and Extra Heavy classes, hub and spigot. Include ASTM C 564 rubber gasket, with dimensions required for pipe class, for each hub.
- D. Hubless, Cast-Iron, Soil-Pipe Fittings: CISPI 301.
- E. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 drain, waste, and vent pipe patterns.

2.03 JOINING MATERIALS

- A. Refer to Division 23 Section "Basic Mechanical Piping Materials and Methods" for commonly used joining materials.
- B. Solder: ASTM B 32, Alloy Sn95, Sn94, or E; lead free.
- C. Hubless, Cast-Iron, Soil-Piping Couplings: CISPI 310/NSF assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve or gasket with integral, center pipe stop. Neoprene Couplings with stainless steel clamps.

- D. PVC: Solvent Welded fittings with primer-less type PVC cement listed for specific use.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Aboveground, Sanitary Waste and Vent Piping: Use the following:
 - 1. 1-1/2 to 10-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and hubless, cast-iron, soil-piping couplings:
- C. Underground, Sanitary Waste, and Vent Piping: Use the following:
 - 1. 2- to 12-Inch NPS: Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
 - 2. 2- to 12-Inch NPS: PVC plastic pipe, PVC socket fittings and solvent welded joints.

3.02 PIPING INSTALLATION

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install double grade cleanout and extension to grade at connections of building sanitary drains with building sanitary sewers.
- C. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for wall penetration systems.
- D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- E. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- G. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Sanitary Drain: 1/4" per foot downward in direction of flow for piping 3-inch NPS and smaller; 1/8" per foot downward in direction of flow for piping 4-inch NPS and larger.
 - 2. Vent Piping: 1/8" per foot downward toward vertical fixture vent or toward vent stack.
- H. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Compression Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- I. PVC Piping Joints: Join drainage piping according to ASTM D 2665.
- J. Install indirect waste piping per local code requirements. Maintain code required air gaps.

3.03 FIELD QUALITY CONTROL

- A. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

- B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.04 CLEANING AND PROTECTING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 13 19
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes plumbing specialties for the following:
 - 1. Water distribution systems.
 - 2. Soil, waste, and vent systems.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Water Distribution Piping: 125 psig.
 - 2. Soil, Waste, and Vent Piping: 10-foot head of water.

1.04 SUBMITTALS

- A. Product Data: For each plumbing specialty indicated. Include rated capacities of selected equipment and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following plumbing specialty products:
 - 1. Backflow preventers.
 - 2. Water regulators.
 - 3. Balancing valves.
 - 4. Water hammer arresters.
 - 5. Drain valves.
 - 6. Hose bibbs and hydrants.
 - 7. Outlet boxes.
 - 8. Cleanouts.
 - 9. Floor drains.
 - 10. Vent caps, vent terminals, and roof flashing assemblies.
- B. Reports: Specified in "Field Quality Control" Article.
- C. Maintenance Data: For specialties to include in the maintenance manuals. Include the following:
 - 1. Backflow preventers.
 - 2. Water regulators.
- D. See "Submittal Schedule" located at the end of Section 23 01 00 – General Requirements for Mechanical Systems.

1.05 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, dimensional requirements, and characteristics of plumbing specialties and are based on the specific types and models indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. Provide listing/approval stamp, label, or other marking on plumbing specialties made to specified standards.
- C. Listing and Labeling: Provide electrically operated plumbing specialties specified in this Section that are listed and labeled as defined in National Electrical Code, Article 100.
- D. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- E. Comply with NFPA 70, "National Electrical Code," for electrical components.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Backflow Preventers:
 - a. Ames Co., Inc.
 - b. B & K Industries, Inc.
 - c. Cla-Val Co.
 - d. CMB Industries; Febco Div.
 - e. Conbraco Industries, Inc.
 - f. FLOMATIC Corp.
 - g. Grinnell Corp.; Mueller Co. Marketing Group for Hersey Products Div.
 - h. IMI Cash Valve.
 - i. Sparco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Industries, Inc.; Wilkins Div.
 2. Water Pressure Regulators:
 - a. Bermad, Inc.
 - b. Cashco, Inc.
 - c. Cla-Val Co.
 - d. Conbraco Industries, Inc.
 - e. FLOMATIC Corp.
 - f. G A Industries, Inc.
 - g. Honeywell Braukmann.
 - h. IMI Cash Valve.
 - i. Kaye & Mac Donald, Inc.
 - j. Keckley: O.C. Keckley Co.
 - k. Spence Engineering Co., Inc.
 - l. Watts Industries, Inc.; Water Products Div.
 - m. Zurn Industries, Inc.; Wilkins Div.
 3. Calibrated Balancing Valves:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Flow Design, Inc.
 - d. ITT Fluid Technology Corp.; ITT Bell & Gossett Div.
 - e. Taco, Inc.
 - f. Tour & Andersson, Inc.; Valve Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Oventrop
 4. Thermostatic Water Mixing Valves:
 - a. Lawler Manufacturing Co., Inc.
 - b. Leonard Valve Co.
 - c. Mark Controls Corp.; Powers Process Controls.
 - d. Symmons Industries, Inc.
 - e. T & S Brass and Bronze Works, Inc.
 5. Outlet Boxes:
 - a. Acorn Engineering Co.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corp.
 - d. LSP-Specialty Products Co.
 - e. Oatey Co.
 - f. Plastic Oddities, Inc.
 - g. Symmons Industries, Inc.
 6. Hydrants:
 - a. Enpoco, Inc.
 - b. Josam Co.
 - c. Murdock, Inc.

- d. Smith: Jay R. Smith Mfg. Co.
- e. Tyler Pipe; Wade Div.
- f. Watts Industries, Inc.; Ancon Drain Div.
- g. Watts Industries, Inc.; Water Products Div.
- h. Woodford Manufacturing Co.
- i. Zurn Industries, Inc.; Hydromechanics Div.
- 7. Water Hammer Arresters:
 - a. Amtrol, Inc.
 - b. Enpoco, Inc.
 - c. Josam Co.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Co., Inc.
 - f. Smith: Jay R. Smith Mfg. Co.
 - g. Sparco, Inc.
 - h. Tyler Pipe; Wade Div.
 - i. Watts Industries, Inc.; Ancon Drain Div.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Industries, Inc.; Hydromechanics Div.
 - l. MIFAB, Inc.
- 8. Floor Drains and Drain Specialties
 - a. Josam Co.
 - b. Sioux Chief Manufacturing Co., Inc.
 - c. Smith: Jay R. Smith Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Watts Industries, Inc., Ancon Drain Div.
 - f. Zurn Industries, Inc., Hydromechanics Div.
 - g. MIFAB, Inc.
- 9. Trench Drains:
 - a. ACO USA
 - b. Josam Co.
 - c. Smith: Jay R. Smith Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Watts Industries, Inc.
 - f. Zurn Industries, Inc.
 - g. MIFAB, Inc.

2.02 BACKFLOW PREVENTERS

- A. General: ASSE standard, backflow preventers, of size indicated for maximum flow rate and maximum pressure loss indicated.
 - 1. Bronze body with threaded ends.
 - 2. Interior Components: Corrosion-resistant materials.
 - 3. Exterior Finish: Polished chrome-plate if used in chrome-plated piping system.
 - 4. Strainer on inlet.
- B. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- C. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- D. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves.
- E. Double-Check Backflow Prevention Assemblies: ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; and test cocks with 2 positive-seating check valves.

- F. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm flow and applications with up to 10-foot head back pressure. Include 2 check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7 garden-hose thread on outlet.

2.03 WATER PRESSURE REGULATORS

- A. General: water regulators, rated for initial working pressure of 150 psig minimum, of size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed or separate field-installed Y-pattern strainer.
 - 1. Bronze body, renewable nickel alloy seats, stainless steel internal parts, with threaded ends.

2.04 BALANCING VALVES

- A. Memory-Stop Balancing Valves, 2-Inch NPS and Smaller: ball valve, rated for 400-psig minimum CWP. Include 2-piece, ASTM B 62 bronze body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, solder-joint ends, and vinyl-covered steel handle with memory-stop device.

2.05 THERMOSTATIC WATER MIXING VALVES

- A. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and capacity at pressure loss as indicated.
 - 1. Bimetal Thermostat, Operation and Pressure Rating: 125 psig minimum.
 - 2. Liquid-Filled Motor, Operation and Pressure Rating: 100 psig minimum.
- B. Thermostatic Water Mixing Valves: Unit, with the following:
 - 1. Piping, of sizes and in arrangement indicated. Include valves and unions.
 - 2. Piping Component Finish: Rough brass.
 - 3. Cabinet: Steel box with steel hinged door and white enameled finish.
 - 4. Cabinet Mounting: Surface.
 - 5. Thermometer: Manufacturer's standard.
- C. Single Fixture under counter thermostatic mixing valves. Rough chrome, thermostatic mixing valve with adjustable outlet temperature, integral check valves on both inlets, elastomer seal to prevent cross connection from hot to cold.

2.06 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch round perforations, unless otherwise indicated. Screwed screen retainer with centered blowdown with hose-end drain valve

2.07 OUTLET BOXES

- A. General: Recessed-mounting outlet boxes with fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- B. Ice Maker Outlet Boxes: With recessed box and faceplate, hose connection and shut-off valve.

2.08 INTERCEPTORS

- A. Oil Interceptor: Construct oil interceptor per local code requirements.

2.09 HYDRANTS

- A. See PLUMBING FIXTURE SCHEDULE on Sheet M5-3.

2.10 CLEANOUTS

- A. Cleanout Plugs: Cast iron or brass, threads complying with ANSI B2.1, countersunk head. Engrave heads to identify system.
- B. Floor Cleanouts: Cast iron body and frame with cleanout plug and adjustable round nickel bronze top. Provide to match floor system:
 - 1. Exposed finish type, standard mill finish.

2. Exposed flush type, standard non-slip scored or abrasive finish.
 3. Exposed flush type, standard mill finish and carpet marker.
 4. Heavy duty for traffic applications.
- C. Wall Cleanouts: Cast iron body adaptable to pipe with cast bronze, brass or PVC cleanout plug; stainless steel cover, vandal proof screws.

2.11 FLOOR DRAINS

- A. See PLUMBING FIXTURE SCHEDULE on Sheet M5-3.

2.12 TRENCH DRAINS

- A. See PLUMBING FIXTURE SCHEDULE on Sheet M5-3.

2.13 FLASHING

- A. Floor Drains: Non-plasticized, chlorinated, polyethylene, concealed, water-proof membrane, 0.40" thick, solvent weldable. 48" square minimum.
- B. Vents thru Roof (VTR): 24" square minimum
1. Non-plasticized, chlorinated, polyethylene, concealed, water-proof membrane, 0.40" thick, solvent weldable.
 2. Lead sheet, 2-1/2" lb/sf, concealed

2.14 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASME A112.26.1M, ASSE 1010, or PDI-WH 201, bellows or piston type with pressurized cushioning chamber. Sizes are based on water-supply fixture units, ASME A112.26.1M sizes A through F and PDI-WH 201 sizes A through F.
- B. Domestic water expansion tanks: Precharged hydropneumatic expansion tank approved for potable water, with steel shell, polypropylene liner, stainless steel system connection and FDA diaphragm. Working temperature and pressure shall be 200°F and 150 psig. Tanks over 5 cubic feet capacity of 250 psi shall be ASME constructed.
- C. Roof Flashing Assemblies: Manufactured assembly made of 4-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe with galvanized steel boot reinforcement, and counterflashing fitting.
- D. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- E. Air-Gap Fittings: ASME A112.1.2, cast iron or cast bronze, with fixed air gap, inlet for drain pipe or tube, and threaded or spigot outlet.
- F. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- G. Vent Terminals: Commercially manufactured, shop-fabricated or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing, as indicated.

PART 3 - EXECUTION

3.01 PLUMBING SPECIALTY INSTALLATION

- A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.
- B. Install backflow preventers of type, size, and capacity indicated, at each water-supply connection to mechanical equipment and systems, and to other equipment and water systems as indicated. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment. Install air-gap fitting on units with atmospheric-vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer.
- C. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.

- D. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve, and where indicated.
- E. Install cleanouts in aboveground piping and building drain piping as indicated, and where not indicated, according to the following:
 - 1. Size same as drainage piping up to 4-inch NPS. Use 4-inch NPS for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping 4-inch NPS and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- F. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- G. Install cleanout wall access covers with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- H. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- I. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- J. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- K. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor or as indicated. Size outlets as indicated.
- L. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- M. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- N. Position floor drains for easy access and maintenance.
- O. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
- P. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install water-supply stop valves in accessible locations.
- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- R. Locate drainage piping as close as possible to bottom of floor slab supporting fixtures and drains.
- S. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- T. Install water hammer arrestor at each battery of plumbing fixture connections and additionally as required to eliminate water hammer. Locate per manufacturer's recommendations or Standard PDI-WH 201. Locate in easily accessible location for future maintenance.
- U. Install flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Arrange for electric-power connections to plumbing specialties and devices that require power. Electric power, wiring, and disconnect switches are specified in Division 26 Sections.

- C. Supply Runouts to Plumbing Specialties: Install hot- and cold-water-supply piping of sizes indicated, but not smaller than required by authorities having jurisdiction
- D. Drainage Runouts to Plumbing Specialties: Install drainage and vent piping, with approved trap, of sizes indicated, but not smaller than required by authorities having jurisdiction.

3.03 START-UP

- A. Before startup, perform the following checks:
 - 1. System tests are complete.
 - 2. Damaged and defective specialties and accessories have been replaced or repaired.
 - 3. Clear space is provided for servicing specialties.
- B. Before operating systems, perform the following steps:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open general-duty valves to fully open position.
 - 3. Remove and clean strainers.
 - 4. Verify that drainage and vent piping are clear of obstructions. Flush with water until clear.
- C. Startup Procedures: Follow manufacturer's written instructions. If no procedures are prescribed by manufacturer, energize circuits for electrically operated units. Start and run units through complete sequence of operations.

3.04 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain, plumbing specialties.

END OF SECTION

SECTION 22 15 13
GENERAL SERVICE COMPRESSED AIR PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes piping and related specialties for general-service compressed-air systems:
 - 1. Pipes, tubes, and fittings.
 - 2. Joining materials.
 - 3. Valves.
 - 4. Dielectric fittings.
 - 5. Flexible pipe connectors.
 - 6. Specialties.
 - 7. Quick couplings.
 - 8. Hose assemblies.

1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. HDPE: High-density polyethylene plastic.
- E. NBR: Acrylonitrile-butadiene rubber.
- F. PE: Polyethylene plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Plastic pipes, fittings, and valves.
 - 2. Dielectric fittings.
 - 3. Flexible pipe connectors.
 - 4. Safety valves.
 - 5. Pressure regulators. Include rated capacities and operating characteristics.
 - 6. Automatic drain valves.
 - 7. Filters. Include rated capacities and operating characteristics.
 - 8. Lubricators. Include rated capacities and operating characteristics.
 - 9. Quick couplings.
 - 10. Hose assemblies.
- B. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

- A. Aluminum Piping System: Aluminum pipe, Alloy Grade AA 6035-T5, for push-connect bite ring couplings, and roll-groove couplings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Applied System Technologies.
 - b. Dan Am Air.
 - c. Gardner Denver, Inc.
 - d. Ingersoll-Rand.
 - e. SynergAir.
 - 2. Source Limitations: Obtain aluminum piping systems and components from single source from single manufacturer.
 - 3. Pressure and Temperature Range: Aluminum piping and related specialties for general-service compressed-air systems operating at 220 psig or less, across a temperature range of minus 4 to plus 176 deg F.
 - 4. Tubing, 1/2" to 8": Aluminum pipe, Alloy Grade AA 6063-T5.
 - 5. Pipe Coating: Powder-coated paint certified nontoxic to AAMA 603 and AAMA 605, blue for compressed air.
 - 6. Tubing shall be quality controlled to comply with tolerances specified by roll-groove or push-to-connect coupling manufacturer. Tubing manufacturer shall follow ISO 9001:2000 quality standards.
 - 7. Pipe Identification: Decal with maximum working pressure and temperature on each length of pipe.
 - 8. Push-Connect Bite Ring Couplings, 1/2" to 2": Solid-brass and nickel-plated body, high nitrile rubber O-ring seal in excess of 36 percent, and AISI Type 304 stainless-steel clamping washer.
 - 9. Fittings: Solid brass and nickel plated.
 - 10. Ball Valves, 2" and smaller: NPT threaded ends, or push-connect bite ring ends.

- B. Copper Tube: ASTM B88, Type L seamless, drawn-temper, water tube.
 - 1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
 - 2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
 - 3. Copper Unions: ASME B16.22 or MSS SP-123.

2.02 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

2.03 VALVES

- A. Ball and Check: Comply with requirements in Section 22 05 23 "Valves for Plumbing"

2.04 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

- B. Dielectric Unions:
 - 1. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

2.05 FLEXIBLE PIPE CONNECTORS

- A. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: 200 psig minimum.
 - 2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
 - 3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.06 SPECIALTIES

- A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
 - 1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
 - 1. Type: Pilot operated.
- C. Air-Line Pressure Regulators: Diaphragm operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
- D. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
- E. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.
- F. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.
- G. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration and drain cock. Include mounting bracket if wall mounting is indicated.

- H. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.
 - 1. Provide with automatic feed device for supplying oil to lubricator.

2.07 QUICK COUPLINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aeroquip Corporation.
 - 2. Milton Industries, Inc.
 - 3. Parker Hannifin Corp.
 - 4. Schrader-Bridgeport/Standard Thomson.
 - 5. Tuthill Corporation.
- B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 - 1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
 - 2. Plug End: Straight-through type with barbed outlet for attaching hose.
- D. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
 - 1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
 - 2. Plug End: With barbed outlet for attaching hose.

2.08 HOSE ASSEMBLIES

- A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
 - 1. Hose: Reinforced single-wire-braid, CR-covered hose for compressed-air service.
 - 2. Hose Clamps: Stainless-steel clamps or bands.
 - 3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
 - 4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

- A. Compressed-Air Piping:
 - 1. Aluminum pipe; solid-brass nickel-plated fittings; and push-connect bite ring couplings.
 - 2. Type L, copper tube; wrought-copper fittings; and brazed joints.
- B. Drain Piping: Same as compressed air piping

3.02 VALVE APPLICATIONS

- A. General-Duty Valves for Aluminum Piping System: Provide valves, made by piping system manufacturer, that are compatible with piping.
 - 1. Ball Valves: NPT threaded ends, or push-connect bite ring ends.
- B. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" in Section 220523, "Valves for Plumbing Piping," according to the following:
 - 1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
 - 2. Equipment Isolation Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

3.03 PIPING INSTALLATION, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and machines to allow service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
- H. Flanged joints may be used instead of specified joint for any piping or tubing system.
- I. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- K. Install piping to permit valve servicing.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install sleeves for piping penetrations of walls, ceilings, and floors.
- O. Install sleeve seals for piping penetrations of concrete walls and slabs.
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.04 INSTALLATION OF ALUMINUM PIPING SYSTEMS

- A. Install aluminum piping systems according to manufacturer's written instructions, using manufacturer's recommended tools, accessories, and methods.
- B. Install branch connections NPS 2 and smaller, to compressed-air mains using aluminum piping system reducing outlet tee with water trapping capabilities. Provide drain leg and drain trap at end of each main and branch and at low points.
- C. Install automatic drain valves on dryers. Discharge condensate shall be piped and connected to oil-water separator.
- D. Support aluminum pipe using manufacturer's hangers and supports, designed for use with the system.
- E. Allow for expansion and contraction of aluminum piping system.

3.05 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- E. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.
- F. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.
- G. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.06 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Section 22 05 23 "Valves for Plumbing Piping,"
- B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
- C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.
- D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.07 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. NPS 2 and Smaller: Use dielectric unions.

3.08 FLEXIBLE PIPE CONNECTOR INSTALLATION

- A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.
- B. Install stainless-steel-hose flexible pipe connectors in compressed-air piping.

3.09 SPECIALTY INSTALLATION

- A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
- B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
- C. Install air-line pressure regulators in branch piping to equipment and tools.
- D. Install automatic drain valves on dryers. Discharge condensate onto nearest floor drain.
- E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters.
- F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters.
- G. Install quick couplings at piping terminals for hose connections.
- H. Install hose assemblies at hose connections.

3.10 CONNECTIONS

- A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

3.11 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Section 22 05 05 for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
 2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

- D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- E. Base of Vertical Piping: MSS Type 52, spring hangers.
- F. Support horizontal piping within 12 inches of each fitting and coupling.
- G. Use manufacturer's recommended hangers and supports for aluminum piping system.
 - 1. Description: Wire rope using adjustable camlock system with standard threaded stud for connection to provided hangers.
 - 2. Hangers: UV-stabilized nylon and galvanized clevis style.
 - 3. Install hangers for aluminum piping every 8 feet
 - 4. Install supports for vertical aluminum piping every 8 feet.

3.12 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 22 05 00.

3.13 FIELD QUALITY CONTROL

- A. Perform field tests and inspections.
- B. Tests and Inspections:
 - 1. Piping Leak Tests for Aluminum Compressed-Air Piping: Test new piping system and modified parts of existing piping system. Cap and fill general-service compressed-air piping system to pressure of 15 psig, hold pressure for 10 minutes. Repeat until reaching required operating pressure, not to exceed 220 psig. Once desired operating pressure is met, let stand for one hour.
 - 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect filters lubricators and pressure regulators for proper operation.
- C. Prepare test reports.

END OF SECTION

SECTION 22 33 00
DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following electric water heaters:
 - 1. Light-commercial electric water heaters.
 - 2. Compression tanks.
 - 3. Water heater accessories.

1.03 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For electric water heaters to include in operation and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.
- E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
 - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period(s): From date of Substantial Completion:
 - a. Electric Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: One year.
 - b. Compression Tanks: One year.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS

- A. Description: Comply with UL 174 for household, storage electric water heaters.
1. Manufacturers:
 - a. American Water Heater Company.
 - b. Bradford White Corporation.
 - c. Electric Heater Company (The); Hubbell Heaters Division.
 - d. GSW Water Heating Company.
 - e. Heat Transfer Products, Inc.
 - f. Lochinvar Corporation.
 - g. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - h. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - i. Smith, A. O. Water Products Company.
 - j. State Industries, Inc.
 2. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1.
 - e. Jacket: Steel with enameled finish.
 - f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Screw-in immersion type; wired for simultaneous or non-simultaneous operation as indicated on drawings.
 - h. Temperature Control: Adjustable thermostat for each element.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

2.03 COMPRESSION TANKS

- A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
1. Manufacturers:
 - a. AMTROL Inc.
 - b. Armstrong Pumps, Inc.
 - c. Flexcon Industries.
 - d. Honeywell Sparco.
 - e. Myers, F. E.; Pentair Pump Group (The).
 - f. Smith, A. O.; Aqua-Air Div.
 - g. State Industries, Inc.
 - h. Taco, Inc.
 - i. Watts Regulator Co.
 - j. Wessels Co.
 2. Construction:

- a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
- b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
- c. Air-Charging Valve: Factory installed.

2.04 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

- A. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- B. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- C. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains.
- D. Fill water heaters with water.
- E. Charge compression tanks with air.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.
- D. Make connections with dielectric fittings where piping is made of dissimilar metal.

3.03 FIELD QUALITY CONTROL

- A. Perform startup service per manufacturer's recommendations.
- B. In addition to manufacturer's written installation and startup checks, perform the following:
 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 2. Verify that piping system tests are complete.
 3. Check for piping connection leaks.
 4. Check for clear relief valve inlets, outlets, and drain piping.
 5. Test operation of safety controls, relief valves, and devices.
 6. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F unless piping system application requires higher temperature.

3.04 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain water heaters.
 1. Train Owner's maintenance personnel on procedures for starting and stopping, troubleshooting, servicing, and maintaining equipment.
 2. Review data in maintenance manuals.

OPPD Training Building

3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

**SECTION 22 40 00
PLUMBING FIXTURES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes plumbing fixtures and trim, faucets, other fittings, and related components.

1.03 DEFINITIONS

- A. Accessible: Plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped, disabled, and elderly people.

1.04 SUBMITTALS

- A. Product Data for each plumbing fixture category and type specified. Include selected fixture, trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Wiring diagrams from manufacturer for electrically operated units.
- C. Maintenance data for plumbing fixtures and components to include in the operation and maintenance manuals.
- D. See "Submittal Schedule" located at the end of Section 23 01 00 – "General Requirements for Mechanical Systems".

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of CABO A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; regarding plumbing fixtures for physically handicapped people.
- B. Energy Policy Act Requirements: Comply with requirements of Public Law 102-486, "Energy Policy Act," regarding water flow rate and water consumption of plumbing fixtures.
- C. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Vitreous-China and Enameled Fixtures:
 - a. Kohler Co.
 - b. American Standard, Inc.
 - c. Briggs Industries, Inc.
 - d. ProFlo (Manufactured by Briggs, supplied by Ferguson)
 - e. Crane Plumbing.
 - f. Eljer Industries.
 - g. Gerber Plumbing Fixtures Corp.
 - h. Mansfield Plumbing Products, Inc.
 - i. Universal-Rundle Corp.
 - j. Sloan Valve Co.
 - 2. Flushometer Valves:
 - a. Sloan Valve Co
 - b. Coyne & Delany Co.
 - c. Speakman Co.

- d. TOTO KIKI USA, Inc.
- e. Zurn Industries, Inc.; Flush Valve Operations.
- 3. Toilet Seats:
 - a. American Standard, Inc.
 - b. Bemis Mfg. Co.
 - c. Centoco Manufacturing Corp.
 - d. Church Seat Co.
 - e. Eljer Industries.
 - f. Kohler Co.
 - g. Olsonite Corp.
 - h. Sanderson Plumbing Products, Inc.; Beneke Industries, Ltd.
 - i. Sperzel.
- 4. Supply Fittings and Faucets:
 - a. American Standard, Inc.
 - b. Chicago Faucet Co.
 - c. Crane Plumbing.
 - d. Eljer Industries.
 - e. Kohler Co.
 - f. Masco Canada, Ltd.; Cambridge Brass Div.
 - g. Masco Corp.; Delta Faucet Co.
 - h. Moen, Inc.
 - i. Price Pfister, Inc.
 - j. Speakman Co.
 - k. Symmons Industries, Inc.
 - l. T & S Brass and Bronze Works, Inc.
 - m. Zurn Industries, Inc.
- 5. Stainless-Steel Sinks:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Co.
 - c. Kohler Co.
 - d. Moen, Inc.
- 6. Disposers:
 - a. Emerson Electric Co.; In-Sink-Erator Div.
 - b. General Electric Co.; GE Answer Center.
 - c. Kitchen Aid, Inc.
 - d. Maytag Co.
 - e. Waste King, Inc.
 - f. White Consolidated Industries, Inc.; Major Appliance Group.
- 7. Fitting Insulation Kit:
 - a. Brocar Products, Inc.
 - b. Engineered Brass Co.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
- 8. Mop-Sinks and Basins:
 - a. Fiat Products, Inc.
 - b. Stern-Williams Co., Inc.
 - c. Aqua Glass Corp.
 - d. Mustee: E.L. Mustee & Sons, Inc.
- 9. Electric Water Coolers
 - a. EBCO Manufacturing Co.
 - b. Elkay Manufacturing Co.
 - c. Halsey Taylor.
 - d. Haws Drinking Faucet Co.
 - e. Sunroc Corp.

- f. Oasis
- 10. Emergency Shower and Eyewash Stations
 - a. Bradley Corp.
 - b. Encon Safety Products Co.
 - c. Guardian Equipment.
 - d. Haws Drinking Faucet Co.
 - e. Murdock, Inc.
 - f. Speakman Co.
 - g. Western Emergency Equipment.
- 11. Fixture Carriers
 - a. J. R. Smith
 - b. Josam
 - c. Zurn
 - d. Wade
 - e. Acorn

2.02 FITTINGS

- A. Fittings for Plumbing Fixtures: Refer to plumbing fixture schedules at the end of this Section for materials for supplies, supply stops, supply risers, traps, and other fittings.
 - 1. Supply Inlets: Brass pipe or copper tube, size required for final connection.
 - 2. Supply Stops: Chrome-plated brass, angle or straight; compression, 1/4 turn ball stop valve, wheel-handle or loose-key type; same size as supply inlet and with outlet matching supply riser. Brass ball with PTFE seat. Rated for 40-deg F to 180-deg F and 125 psi maximum.
 - 3. Supply Risers: flexible copper tube with knob end. Use chrome-plated tube for exposed applications.
 - 4. Traps: Tubular brass with 0.045-inch wall thickness, slip-joint inlet, cleanout, wall flange, escutcheons, and size to match equipment. Use chrome-plated tube for exposed applications.
 - 5. Continuous Waste: Tubular brass, 0.045-inch wall thickness, with slip-joint inlet, and size to match equipment.
 - 6. Indirect Waste: Tubular brass, 0.045-inch wall thickness, and size to match equipment.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for potable, hot- and cold-water supply piping systems; soil, waste, and vent piping systems; and supports. Verify that locations and sizes of piping and locations and types of supports match those indicated, before installing and connecting fixtures. Use manufacturer's roughing-in data when roughing-in data are not indicated.

3.02 APPLICATIONS

- A. Include supports for plumbing fixtures according to the following:
 - 1. Carriers: For wall-hanging water closets and fixtures supported from wall construction.
 - 2. Chair Carriers: For wall-hanging urinals, lavatories, sinks, drinking fountains, and electric water coolers.
- B. Include fitting insulation kits for accessible fixtures according to the following:
 - 1. Lavatories: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
 - 2. Sinks: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
 - 3. Other Fixtures: Cover exposed fittings below fixture.

3.03 PLUMBING FIXTURE INSTALLATION

- A. Field Measurements: Coordinate roughing-in and final fixture locations and verify that plumbing fixtures can be installed to comply with original design and referenced standards.

- B. Assemble plumbing fixtures and trim, fittings, faucets, and other components according to manufacturers' written instructions.
- C. Install fixtures level and plumb according to manufacturers' written instructions, roughing-in drawings, and referenced standards.
- D. Install wall hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.
- E. Install toilet seats on water closets.
- F. Install wall hanging, back-outlet urinals with gasket seals.
- G. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for handicapped people to reach.
- H. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- I. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- J. Fasten recessed, wall-mounted fittings to reinforcement built into walls.
- K. Fasten wall-mounted fittings to reinforcement built into walls.
- L. Fasten counter-mounting plumbing fixtures to casework.
- M. Secure supplies to supports or substrate within pipe space behind fixture.
- N. Set mop basins in leveling bed of cement grout.
- O. Install individual stop valve in each water supply to fixture. Use gate or globe valve where specific stop valve is not specified.
 - 1. Exception: Omit stop valves on supplies to emergency equipment, except when permitted by authorities having jurisdiction. When permitted, install valve chained and locked in OPEN position.
- P. Install water supply stop valves in accessible locations.
- Q. Install faucet, laminar-flow fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
- R. Install supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- S. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
- T. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes, except where otherwise indicated.
- U. Install disposers in sink outlets. Install switch where indicated, or in wall adjacent to sink if location is not indicated.
- V. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.
- W. Seal joints between fixtures and walls, floors, and counters using sanitary-type, 1-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.04 CONNECTIONS

- A. Supply and Waste Connections to Plumbing Fixtures: Refer to plumbing fixture schedules at the end of this Section for fitting sizes and connection requirements for each plumbing fixture. Install hot- and cold-water-supply, waste and vent piping of sizes indicated, but not smaller than required by authorities having jurisdiction.

3.05 FIELD QUALITY CONTROL

- A. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

- B. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- C. Test installed fixtures after water systems are pressurized and demonstrate proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.06 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at drinking fountains, electric water coolers, faucets, shower valves, and flushometer valves having controls, to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

3.07 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities, except when approved in writing by Owner.

3.08 PLUMBING FIXTURE SCHEDULE

- A. See PLUMBING FIXTURE SCHEDULE on Sheet M5-3.

END OF SECTION

**DIVISION 23 – HEATING, VENTILATING
AND AIR CONDITIONING (HVAC)**

SECTION 23 01 00

GENERAL REQUIREMENTS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes general mechanical requirements and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of all mechanical systems including: fire protection systems, plumbing systems; and heating, ventilation, and air conditioning (HVAC) systems.

1.03 WARRANTIES

- A. All materials, workmanship and equipment shall be warranted against defects or against injury from proper and usual wear for a period of one year after the date of substantial completion. Any item which becomes defective within the warranty period shall be repaired or replaced, at no additional cost to the Owner.
- B. All manufacture's warranties shall run to the benefit of the Owner. No manufacturer's warranties shall be voided or impaired.
- C. Warranty shall include repair of faulty workmanship.

1.04 INTERPRETATION OF DOCUMENTS

- A. Any questions regarding the meaning of any portion of the contract documents shall be submitted to the Architect/Engineer for interpretation. Definitive interpretations or clarification will be published by addenda or supplemental information. Verbal interpretation not issued by addendum or supplemental information shall not be considered part of the contract documents.
- B. The Architect/Engineer shall be the sole judge of interpretations of discrepancies within the contract documents.
- C. If ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of proposed methods or materials.

1.05 DEFINITIONS ABBREVIATIONS

- A. The following shall apply throughout the contract documents
 - 1. Code All applicable national state and local codes
 - 2. Furnish Supply and deliver to site ready for installation
 - 3. Indicated Noted, scheduled or specified
 - 4. Provide Furnish, install and connect complete and ready for final use by owner
 - 5. ADA Americans with Disabilities Act
 - 6. ANSI American National Standards Institute
 - 7. ARI Air-Conditioning and Refrigeration Institute
 - 8. ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers
 - 9. ASME American Society of Mechanical Engineers
 - 10. ASTM American Society for Testing and Materials
 - 11. HI Hydraulic Institute
 - 12. NEC National Electric Code (NFPA 70)
 - 13. NEMA National Electrical Manufacturers Association
 - 14. NFPA National Fire Protection Association

- 15. SMACNA Sheet Metal and Air Conditioning Contractors' National Association
- 16. UL Underwriters Laboratories Inc.

1.06 CODES AND STANDARDS

- A. All work shall be performed by competent craftsmen skilled in the trade involved and shall be done in a manner consistent with normal industry standards.
- B. All work shall conform to the currently adopted edition of the National Electric Code (NEC), International Building Code, International Mechanical Code, Uniform Plumbing Code, International Energy Code, and all other applicable state and local codes or standards.
- C. Where there is a conflict between the code and the contract documents, the code shall have precedence only then it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified shall not be substituted.

1.07 PERMITS

- A. Contractor shall become familiar and comply with all requirements regarding permits, fees, licenses, etc. All permits, licenses, inspections and arrangements required for the work shall be obtained by Contractor's effort and expense. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor.

1.08 SUBMITTALS

- A. Division 1 section "Submittals" shall be adhered to if more stringent than this section.
- B. Shop drawings shall be submitted to Architect/Engineer for review when required by other sections of this specification and for all equipment scheduled or specified on drawings.
 - 1. A letter of transmittal shall be accompanying each submittal. Submittals shall be numbered consecutively, and list products covered.
 - 2. Unless otherwise noted, submit an electronic copy of shop drawing and product data for review. Submit one (1) sample of each item required.
- C. Shop Drawings
 - 1. Shop drawings include fabrication and installation drawings, diagrams, schedules of other data specifically prepared for the project. Include dimensions and notations showing compliance with specified standards.
 - 2. Drawing sheet size shall be at least 8 ½" x 11" and not larger than 30"x42". For sheets larger than 11"x17", submit one sheet of reproducible media and one blue-line or photocopy print. Architect/Engineer action will be returned on reproducible media.
- D. Product Data
 - 1. Product data includes printed information, such as manufacture's installation instructions, catalog cuts, standard color charts, rough-in diagrams, wiring diagrams and performance curves.
 - 2. Each copy shall clearly indicate conformance with specified capacities, characteristics, dimensions and details. Mark all equipment with same item number as used on drawings. Mark each copy to clearly indicate applicable choices and options.
- E. Samples
 - 1. Samples are physical examples used to illustrate materials, equipment or workmanship
- F. Architect/Engineer will review or take appropriate action for submittals. Review is only to determine general conformance with design shown in contract documents.
- G. Architect/Engineer review of submittals shall not relieve contractor of responsibility for deviation from requirements of the contract documents or from errors or omissions within submittals.
- H. No portion of the work requiring submittals shall be commenced until the Architect/Engineer has reviewed the submittal.
- I. Electronic Floor Plan Drawings in AutoCAD 2013 format may be requested for use in preparation of shop drawings. Morrissey Engineering reserves the right to reject requests for electronic drawings. Electronic files shall be prepaid at \$50/sheet. Submit written request to Morrissey Engineering or email request to info@morrisseyengineering.com. Indicate the

project name, and floor plan sheets requested. The use of these drawings is intended solely for preparation of drawings required by this specification. Copyright law prohibits any other use. The user of the electronic files assumes full responsibility for the accuracy and scale of the drawings.

- J. See "Submittal Schedule" at the end of Section 23 01 00 – General Requirements for Mechanical Systems.

1.09 OPERATION AND MAINTENANCE MANUALS

- A. Assemble (3) complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
 - 1. Operation Data:
 - a. Emergency instructions and procedures.
 - b. System, subsystem, and equipment descriptions, including operating standards.
 - c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
 - d. Description of controls and sequence of operations.
 - e. Piping and wiring diagrams.
 - 2. Maintenance Data:
 - a. Manufacturer's information, including list of spare parts.
 - b. Name, address, and telephone number of installer or supplier.
 - c. Maintenance procedures.
 - d. Maintenance and service schedules for preventive and routine maintenance.
 - e. Maintenance record forms.
 - f. Sources of spare parts and maintenance materials.
 - g. Copies of maintenance service agreements.
 - h. Copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.10 PROJECT RECORD DOCUMENTS

- A. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
 - 1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
 - 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 - 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 - 5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
- D. Provide complete electronic copy of all record drawings, specifications, and product data.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All materials and equipment used in the construction of the project shall be new unused and undamaged unless otherwise specified. Materials and equipment shall be of latest design standards of manufacturer specified.
- B. Materials and equipment are limited by the requirements of the contract documents. Material and equipment shall be provided in accordance with the following:
 - 1. Basis of Design Products: Basis of Design Products are those products around which the project was designed in terms of capacity, performance, physical size and quality. Basis of Design Products shall be provided unless substitutions are made in accordance with this specification.
 - 2. Substitutions: Substitutions are product of manufacturers other than listed as Basis of Design. Substitutions shall meet each of the following requirements:
 - a. The product shall be manufactured by one of the acceptable manufacturers listed in the contract documents.
 - b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance and characteristics.
 - c. The contractor providing the substitution shall bear the total cost of all changes due to substitutions. These may include but are not limited to redesign costs and increased work by other contractors or the owner.
 - d. The Architect/Engineer shall be the sole judge of the suitability of the substitution items.
- C. Verify installation details and requirements for materials and equipment furnished by others and installed under this contract.

PART 3 - EXECUTION

3.01 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Provide instructors experienced in operation and maintenance procedures.
 - 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 - 3. Schedule training with Owner and Architect/Engineer with at least seven days' advance notice.
- B. Program Structure. Include instruction for the following:
 - 1. System design and operational philosophy.
 - 2. Review of documentation.
 - 3. Operations.
 - 4. Adjustments.
 - 5. Troubleshooting.
 - 6. Maintenance.
 - 7. Safety.

3.02 STARTING AND ADJUSTING

- A. Start and test all equipment and operating components to confirm proper operation. Test and adjust all systems to achieve designed capacity and performance.
- B. Provide three (3) copies of all test report to the Architect/Engineer for review prior to date of substantial completion.
- C. All equipment and systems discrepancies shall be corrected prior to final acceptance.

MECHANICAL SUBMITTAL SCHEDULE

Refer to individual specification sections for additional requirements and detail on each submittal.

Section	Section Name	Product Data	Shop Dwgs	Test Reports / Quality Control	Warranty	Extra Materials	O&M Data	Record Docs	Demonstration / Training
210100	General Requirements for Fire Suppression	√	√	√	√				√
211000	Water-Based Fire-Suppression Systems	√	√			√	√		
220100	General Requirements for Plumbing	√	√		√				
220523	Valves for Plumbing	√					√		
220720	Pipe Insulation for Plumbing	√							
221116	Water Distribution Piping			√				√	
221123	Domestic Water Pumps	√	√				√		√
221316	Drainage and Vent Piping	√		√				√	
221319	Plumbing Specialties	√					√		√
221513	General Service Compressed Air Piping	√	√				√		
223300	Domestic Water Heaters	√	√	√	√		√		√
224000	Plumbing Fixtures	√		√		√	√		
230100	General Requirements for Mechanical Systems	√	√		√		√	√	√
230500	Basic Mechanical Materials and Methods	√	√				√		
230505	Basic Mechanical Piping Materials and Methods	√					√		
230523	Valves for HVAC	√					√		
230593	Testing, Adjusting, and Balancing			√					
230700	Duct Insulation	√							
230720	Pipe Insulation for HVAC	√							
230900	HVAC Instrumentation and Controls	√	√	√	√		√	√	√
230993	Sequence of Operation for HVAC Controls		√	√			√	√	√
232113	Hydronic Piping	√	√					√	
233200	Refrigerant Piping and Accessories	√	√						
233113	Metal Ducts and Accessories	√	√		√		√	√	
233423	Power Ventilators	√	√		√	√	√		√
237200	Dedicated Outdoor Air Units	√	√		√	√	√		√
238126	Split-System Air-Conditioning Units	√	√		√	√	√		√
238127	Variable Refrigerant Flow HVAC System	√	√		√	√	√		√

END OF SECTION

SECTION 23 05 00
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following basic mechanical materials and methods and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of mechanical systems.
 - 1. Indenting Devices and Labels
 - 2. Grout
 - 3. Sealants
 - 4. Access Doors
 - 5. Electrical Requirements
 - 6. Motors
 - 7. Mechanical Equipment Installation
 - 8. Labeling and Identifying
 - 9. Construction Layout
 - 10. Data and Measurements

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.04 SUBMITTALS

- A. Product Data: For sealants and identification materials and devices.
- B. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- C. See "Submittal Schedule" at the end of Section 23 01 00 – General Requirements for Mechanical Systems.

1.05 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Each contractor shall make provisions for delivery and safe storage of materials. Materials shall be delivered in a timely manner to expedite the work.
- B. Protect stored piping, supplies and equipment from cold, moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

1.07 COORDINATION

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe, duct and equipment spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces.
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- H. Motors, equipment, controls, etc. shall be furnished, mounted, and connected according to the following schedule unless otherwise noted (E =Electrical Contractor, M = Mechanical Contractor):

Item	Furnished By	Set in place or mounted by	Power wiring and connection by	Control Wiring and connection by
1) Equipment Motors	M	M	E	M
2) Magnetic Motor Starters:				
a) Automatically controlled, with or without HOA switches.	E	E	E	M
b) Automatically controlled, with or without HOA switches and furnished as part of factory-wired mechanical equipment	M	M	E	M
c) Manually controlled	E	E	E	---
d) Manually controlled and furnished as part of factory-wired mechanical equipment	M	M	E	---
3) Disconnect switches, thermal overload switches, manual operating switches				
a) Furnished as part of factory wired mechanical equipment	M	M	E	--
b) Loose mounted	E	E	E	--
4) Transformers				
a) Serving 120 Volt and higher loads	E	E	E	--
b) Serving 24 Volt control power	M(1)	M	E	M
5) Low voltage controls and	M	M	M	M(2)

thermostats					
6)	Motorized control valves, damper motors, solenoid valves, etc.				
a)	Line Voltage	M	M	E	M
b)	Low Voltage	M	M	M	M
7)	Factory pre-wired control/power panels including remote sensing devices	M	M	E	M(3)
8)	Electric wall and unit heaters	E	E	E	E
9)	Fire Smoke Dampers				
	At air handling unit (24 Volt)	M	M	M	M
	In space (120 Volt)	M	M	E	E(4)

J. Notes:

1. When control power is not available, mechanical contractor shall provide control transformers as required to power all valves, dampers, etc.
2. Conduit rough-in for thermostats by electrical contractor where indicated on plans.
3. Remote condensing units and heat pumps control wiring including wiring of remote sensors by mechanical. Control circuit feeders by mechanical unless shown otherwise.
4. Smoke dampers will be specified as 115 volt (verify) with wiring by Electrical Contractor and control from the fire alarm panel. Smoke detectors furnished by electrical contractor are required to make dampers operate.

PART 2 - PRODUCTS

2.01 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 Sections. If more than one type is specified for application, selection is Installer's option, but provide one selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment.
 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 2. Location: Accessible and visible location.
- C. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.
 1. Fabricate in sizes required for message.
 2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
- D. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
- E. Valve Tags: 19 gauge, 1-1/2" diameter, polished brass, stamped or engraved 1/4" high piping system abbreviation in and 1/2" high sequenced valve numbers.
 1. Valve tag fastener: solid brass wire link or beaded chain, or 'S'-hook or size required for proper attachment of tags to valves.
- F. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap on, color-coded, complying with ASME A13.1.
- G. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.
- H. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

2.02 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.03 SEALANTS

- A. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging for application in vertical and horizontal joints. Color as selected by architect.
- B. Accessories: Primer, joint cleaner, joint backing and bond breaker as recommended by sealant manufacturer to suit application.
- C. Firestopping Materials: Provide firestopping material to maintain required rating of all fire-resistant assemblies according to requirements of "Firestopping" section of this specification.

2.04 ACCESS DOORS

- A. Prime Coated 14 gauge steel, flush, with screw driver operated cam lock. Frame to accommodate construction type; size as indicated.

2.05 ELECTRICAL REQUIREMENTS

- A. Compliance for HVAC Equipment
 - 1. Comply with applicable requirements of the National Electric Code (NFPA 70)
 - 2. Provide equipment and accessories that are listed and labeled as defined in NFPA 70
 - 3. Comply with applicable requirements of Underwriters Laboratory (UL)
 - 4. Comply with applicable requirements of NEMA standards
- B. Electrical Wire
 - 1. Wiring material shall be in accordance with the latest version of the National Electric Code (NFPA 70) and all applicable local codes and carry the UL label where applicable.
 - 2. All exposed wiring in return air plenums shall be rate cable for fire and smoke spread.

2.06 MOTORS

- A. BASIC MOTOR REQUIREMENTS
 - 1. Motors $\frac{3}{4}$ HP and Larger shall be polyphase. Motors Smaller than $\frac{3}{4}$ HP shall be single phase unless otherwise indicated
 - 2. Frequency Rating shall be 60 Hz. Voltage Rating is determined by voltage of circuit to which motor is connected.
 - 3. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - 4. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
 - 5. Enclosure: Open dripproof, unless otherwise indicated.
- B. POLYPHASE MOTORS
 - 1. General
 - a. Design Characteristics: NEMA MG 1, Design B, Energy-Efficient Design, unless otherwise indicated.
 - b. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.
 - c. Rotor: Squirrel cage, unless otherwise indicated.
 - d. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
 - e. Temperature Rise: Match insulation rating, unless otherwise indicated.
 - f. Insulation: Class F, unless otherwise indicated.

2. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.
- C. SINGLE-PHASE MOTORS
1. Permanent-split capacitor, Split-phase start, capacitor run or capacitor start, capacitor run as indicated or selected by manufacturer, to suit starting torque and other requirements of specific motor application.
 2. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.
 3. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, prelubricated sleeve bearings for other single-phase motors.
- D. ELECTRONICALLY COMMUTATED MOTORS (ECM)
1. Permanent magnet type motor with near-zero rotor losses designed for synchronous rotation.
 2. Brushless DC motor controlled by an integrated controller/inverter that operates the wound stator and senses rotor position to electrically commutate the stator as indicated or selected by manufacturer, to suit starting torque and other requirements of specific motor application. Coordinate input signal for speed with specific application.
 3. Motor shall be designed to maintain a minimum 70 percent efficiency over the entire operating range.
 4. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.
 5. Bearings: Sealed, prelubricated ball bearing type for poly-phase or single-phase motors.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment giving right of way to piping installed at required slope.

3.02 POSITION OF DEVICES

- A. Devices shall be installed at the height indicated below unless otherwise noted. All heights of outlets are measured from finished floor to centerline of device. Locate devices mounted on finish surfaces with regards to furring, trim, etc. Heights may be adjusted as necessary to clear wall mounted cabinets, electrical devices, etc. Where installed in masonry walls, mounting heights may be adjusted to correspond to block coursing. Where thermostats are located adjacent to light switches, match light switch mounting height. In no case shall devices requiring wheelchair accessibility be mounted above 48".
 1. Thermostats (where located adjacent to light switches, match light switch height) 48"
 2. Space Sensors (where located adjacent to light switches, match light switch height) 48"
 3. Temperature Control Panels (not requiring occupant interface) 60"

3.03 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 - 1. Plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.
 - 2. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior nonconcealed locations:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch if flow pattern is not obvious.
 - c. Near locations if pipes pass through walls, floors, ceilings, or enter nonaccessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
 - g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of mechanical equipment.
- C. Valve Tags:
 - 1. Install valve tag at all valves in piping systems listed below
 - a. Domestic water (excluding individual fixture isolation valves)
 - 2. Provide reproducible set of drawings indicating all valve locations.
- D. Label duct access doors at fire and smoke damper locations per NFPA 90A.
- E. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

3.04 FIRESTOPPING

- A. Apply firestopping to all duct and pipe penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.05 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 3-1/2" inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive-strength concrete and reinforcement

3.06 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.07 CONSTRUCTION LAYOUT

- A. Layout work in advance of installation using data and measurements from the site, the appropriate architectural and structural drawings and shop drawings.
- B. Confirm adequate clearance for installation, operation, maintenance and code required clearance including items installed by other contractors.
- C. If layout to provide clearance is not possible, promptly notify Architect/Engineer for clarification.

3.08 DATA AND MEASUREMENTS

- A. The data given herein and on the drawings is as accurate as could be secured. The existence and location of construction as indicated is not guaranteed. Before beginning work investigate

and verify the existence and location of items affecting work. Obtain exact locations, measurements, levels, etc., at the site and adapt work to actual conditions.

- B. Only site measurements may be utilized in calculations. Mechanical and electrical drawings are diagrammatic or schematic.

3.09 PAINTING AND FINISHING

- A. Refer to individual sections for paint materials, surface preparation, and application of paint.
- B. Do not paint piping specialties with factory-applied finish.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.10 HANGERS AND SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with applicable codes and standards.

3.11 GROUTING

- A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix and place and cure grout according to manufacturer's written instructions.

3.12 ACCESS

- A. Provide access to all equipment, valves, controls, etc. as required for operation, repair and maintenance.
- B. Access doors shall be provided when access through ceilings, chases, etc. is not provided by others.

3.13 ELECTRICAL WIRING

- A. Install all electrical wiring in accordance with the National Electric Code and Division 26 of this specification.
- B. All line voltage wire shall be installed in metal raceways.
- C. All low voltage wire in equipment rooms or exposed in space shall be installed in metal raceways.

END OF SECTION

SECTION 23 05 05
BASIC MECHANICAL PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 21, 22 and 23 Sections.
 - 1. Piping materials and installation instructions common to mechanical piping systems.
 - 2. Escutcheons.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Pipe hangers and supports
 - 6. Meters and gages
- B. Pipe and pipe fitting materials are specified in Division 23 piping system Sections.

1.03 DEFINITIONS

- A. MSS: Manufacturer's Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 PERFORMANCE REQUIREMENTS

- A. Design support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.05 SUBMITTALS

- A. Product Data: For dielectric fittings, mechanical sleeve seals, and each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated. Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
- B. Maintenance Data: For meters and gages to include in maintenance manuals. Submit valve schedules to include in maintenance manuals for each piping system. Valve schedule shall indicate valve number, piping system and location of valve.

1.06 QUALITY ASSURANCE

- A. Welders shall be qualified in accordance with applicable codes. Welding procedures and testing shall comply with ANSI B31.10 "Standard for Pressure Piping. Power Piping" and AWS Welding Handbook.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Dielectric Unions, Couplings, Flanges:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Co.
 - c. Eclipse, Inc.; Rockford-Eclipse Div.
 - d. Epco Sales Inc.
 - e. Hart Industries International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
 - 2. Mechanical Sleeve Seals:
 - a. Calpico, Inc.

- b. Metraflex Co.
- c. Thunderline/Link-Seal.
- 3. Pipe Hangers and Supports:
 - a. AAA Technology and Specialties Co., Inc.
 - b. Anvil
 - c. B-Line Systems, Inc. by Eaton
 - d. Carpenter & Patterson, Inc.
 - e. Grinnell Corp. B-Line Systems, Inc.
 - f. Grinnell Corp.; Power-Strut Unit.
 - g. GS Metals Corp.
 - h. Michigan Hanger Co., Inc.; O-Strut Div.
 - i. National Pipe Hanger Corp.
 - j. Thomas & Betts Corp.
 - k. Unistrut Corp.
 - l. Wesanco, Inc.
 - m. Thermal-Hanger Shield Inserts
- 4. Thermometers:
 - a. AMETEK, Inc.; U.S. Gauge Div
 - b. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
 - c. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
 - d. Ernst Gage Co.
 - e. Marshalltown Instruments
 - f. Miljoc Corporation
 - g. Noshok, Inc.
 - h. Reotemp Instrument Corp.
 - i. Tel-Tru Manufacturing Co., Inc.
 - j. Trerice: H. O. Trerice Co.
 - k. Weiss Instruments, Inc.
 - l. Winter's Thermogauges, Inc.
- 5. Pressure Gages:
 - a. AMETEK, Inc.; U.S. Gauge Div.
 - b. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
 - c. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
 - d. Ernst Gage Co.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation
 - g. Noshok, Inc.
 - h. Trerice: H. O. Trerice Co.
 - i. Weiss Instruments, Inc.
 - j. WIKA Instruments Corp.
 - k. Winter's Thermogauges, Inc.
- 6. Test Plugs:
 - a. Flow Design, Inc.
 - b. MG Piping Products Co.
 - c. Miljoco Corporation
 - d. National Meter.
 - e. Peterson Equipment Co., Inc.
 - f. Sisco Manufacturing Co.
 - g. Trerice: H. O. Trerice Co.
 - h. Watts Industries, Inc.; Water Products Div.

2.02 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
 - 2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
 - 3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
 - 4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
 - 5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
- E. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements: Manufacturer's standard solvent cements for PVC Piping. ASTM D 2564. Include primer according to ASTM F 656.
- H. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.04 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Assembly or fitting of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Unions:
 - 1. Standard: ASSE 1079.
 - 2. Pressure Rating: 125 psig minimum at 180 deg F.
 - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- F. Dielectric Flanges:
 - 1. Standard: ASSE 1079.
 - 2. Factory-fabricated, bolted, companion-flange assembly.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

- G. Dielectric-Flange Insulating Kits:
 - 1. Nonconducting materials for field assembly of companion flanges.
 - 2. Pressure Rating: 150 psig.
 - 3. Gasket: Neoprene or phenolic.
 - 4. Bolt Sleeves: Phenolic or polyethylene.
 - 5. Washers: Phenolic with steel backing washers.
- H. Dielectric Nipples:
 - 1. Standard: IAPMO PS 66.
 - 2. Electroplated steel nipple, complying with ASTM F 1545.
 - 3. Pressure Rating: 300 psig at 225 deg F.
 - 4. End Connections: Male threaded or grooved.
- I. Lining: Inert and noncorrosive, propylene.

2.05 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. PVC: Manufactured, permanent, with nailing flange for attaching to wooden forms.
 - 5. PVC Pipe: ASTM D 1785, Schedule 40.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. OD: Completely cover opening.
 - 3. Stamped Steel: One piece, with set screw, spring clips, concealed hinge and chrome-plated finish.

2.06 PIPE HANGERS AND SUPPORTS

- A. Pipe Hangers, Supports, and Components: factory-fabricated components.
 - 1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
 - 1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield. ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier

2.07 MISCELLANEOUS PIPE SUPPORTING MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.

2.08 THERMOMETERS, GENERAL

- A. Scale Range: Temperature ranges for services listed are as follows:

1. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
 2. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
- B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.09 LIQUID-IN-GLASS THERMOMETERS

- A. Case: Die-cast aluminum with hard powder-coat finish, acrylic front, 9 inches long.
- B. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- C. Tube: Blue reading, organic-liquid filled with magnifying lens.
- D. Scale: Satin-faced nonreflective aluminum with permanently etched markings or white finished aluminum with black markings.
- E. Stem: Die-cast aluminum for separable socket; of length to suit installation.

2.10 DIRECT-MOUNTING, FILLED-SYSTEM DIAL THERMOMETERS

- A. Description: Vapor-actuated, universal-angle dial type.
- B. Case: Stainless steel with 4-1/2-inch diameter, clear acrylic lens.
- C. Adjustable Joint: Brass, 180-degree adjustment in vertical plane, with locking device.
- D. Thermal Bulb: Copper with phosphor-bronze bourdon pressure tube.
- E. Movement: Brass, precision geared.
- F. Scale: Progressive, white finished aluminum with black markings.
- G. Stem: Copper for separable socket; of length to suit installation.

2.11 SEPARABLE SOCKETS (THERMOWELLS)

- A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
 1. Material: to match piping.
 2. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
 3. Insertion Length: To extend to one-third of diameter of pipe or 2 inches into pipe.

2.12 PRESSURE GAGES

- A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.
- B. Case: Stainless steel with 4-1/2-inch diameter, clear acrylic lens.
- C. Connector: Brass, NPS 1/4.
- D. Scale: White-coated aluminum with permanently etched markings or white finished aluminum with black markings.
- E. Accuracy: Grade 1A, plus or minus 1 percent of full scale.
- F. Range: Comply with the following:
 1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure.
 2. Fluids under Pressure: Two times the operating pressure.
- G. Gage Fitting Valves: NPS 1/4 brass or stainless-steel needle type.

2.13 TEST PLUGS

- A. Description: Brass-body test plug in NPS 1/2 fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 500 psig minimum.
- D. Core Inserts: Two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gage adapter with probe.

- E. Core Material for Air and Water: Nordel, good up to 350 deg F.
- F. Core material for Natural Gas: Neoprene, good up to 200 deg F.
- G. Test-Plug Cap: Gasketed and threaded cap, of same material as plug.
- H. Test Kit: Pressure gage and adapter with probe, two 5-inch pocket testing thermometers with magnifying lens, and protective carrying case.
 - 1. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 21, 22 and 23 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings.
- N. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
- O. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- P. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials
- R. Verify final equipment locations for roughing-in.

- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 - 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 - 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 - 8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to manufacturer's recommendations.
- U. Piping Connections: Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 - 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 - 3. Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.02 HANGER AND SUPPORT APPLICATIONS

- A. Comply with MSS SP-69 for pipe hanger selections and applications.
- B. Comply with MSS SP-89 for fabrication and installation procedures.
- C. Horizontal-Piping Hangers and Supports: Use swivel ring or clevis type hangers.
- D. Vertical-Piping: Use riser clamps.
- E. Saddles and Shields: Install of length recommended by manufacturer to prevent crushing insulation.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems. Field assemble and install according to manufacturer's written instructions.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

- E. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- H. Insulated Piping: Comply with the following:
 - 1. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - 2. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - 3. Do not exceed pipe stress limits according to ASME B31.9.
 - 4. Install protection saddles or thermal hanger shields, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 5. Install protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
- I. Support vertical piping and tubing at base and at each floor.
- J. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
 - 1. 3/4-Inch NPS and Smaller: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 2. 1-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 3. 1-1/4-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 4. 1-1/2 and 2-Inch NPS: Maximum horizontal spacing, 96 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
- K. Install hangers for steel and cast iron piping with the following maximum spacing and minimum rod diameters:
 - 1. 1-1/4-Inch NPS and Smaller: Maximum horizontal spacing, 84 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 2. 1-1/2-Inch NPS: Maximum horizontal spacing, 108 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 3. 2-Inch NPS: Maximum horizontal spacing, 10 feet with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 4. 2-1/2-Inch NPS: Maximum horizontal spacing, 11 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 5. 3-Inch NPS: Maximum horizontal spacing, 12 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 6. 4- and 5-Inch NPS: Maximum horizontal spacing, 12 feet with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.

3.04 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- D. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.05 METER AND GAGE INSTALLATION, GENERAL

- A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.
- B. Install meters and gages adjacent to machines and equipment to allow service and maintenance.
- C. Calibrate meters and gauges according to manufacturer's written instructions, after installation

3.06 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install thermometers at locations indicated on plans.
- C. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
- D. When thermometers are installed in piping 1" and smaller, install well in 1-1/4" with reducers to prevent restriction of flow.

3.07 PRESSURE-GAGE INSTALLATION

- A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- B. Install pressure gages at locations indicated on plans.
- C. Install pressure-gage needle valve and snubber in piping to pressure gages.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives.

1.03 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- D. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- E. AABC: Associated Air Balance Council.
- F. AMCA: Air Movement and Control Association.
- G. NEBB: National Environmental Balancing Bureau.
- H. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.04 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- C. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.

1.05 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
- B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

- D. Testing, Adjusting, and Balancing Reports: Use testing, adjusting, and balancing Agent's standard forms approved by the Architect/Engineer.
- E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB standards.
- F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.06 PROJECT CONDITIONS

- A. Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.07 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Perform testing, adjusting, and balancing after leakage and pressure tests on air systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- G. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- H. Examine strainers for clean screens and proper perforations.
- I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- J. Examine automatic temperature system components to verify proper operation.
- K. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.02 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and bal

ancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

- C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.03 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check dampers for proper position to achieve desired airflow path.
- E. Check for airflow blockages.
- F. Check condensate drains for proper connections and functioning.

3.04 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - 2. Measure static pressure across each air-handling unit component.
 - 3. Adjust fan speed higher or lower than design with the approval of the Architect/Engineer. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes. Do not make fan-speed adjustments that result in motor overload.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
- C. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.

3.05 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.06 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans: minus 10 to plus 10 percent.
 - 2. Air Outlets and Inlets: minus 10 to plus 10 percent.

3.07 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
- C. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of testing, adjusting, and balancing Agent.

3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
 10. Summary of contents.
 11. Notes to explain why certain final data in the body of reports vary from design values.
 12. Test conditions for fans and pump performance forms.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems.
- E. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center and amount of adjustments in inches.
 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat coil static-pressure differential in inches wg.
 - g. Cooling coil static-pressure differential in inches wg.
 - h. Heating coil static-pressure differential in inches wg.
 - i. Outside airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outside-air damper position.
 - l. Return-air damper position.
 - m. Variable frequency drive setting.
- F. Apparatus-Coil Test Reports: For apparatus coils, include the following:
1. Coil Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS.

- i. Tube and fin materials.
 - j. Circuiting arrangement.
 - 2. Test Data: Include design and actual values for the following:
 - a. Airflow rate in cfm.
 - b. Air pressure drop in inches wg.
 - c. Water flow rate in gpm.
 - d. Water pressure differential in feet of head or psig.
- G. Electric-Coil Test Reports: For electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btuh.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 - 2. Test Data: Include design and actual values for the following:
 - a. Airflow rate in cfm.
 - b. Voltage at each connection.
 - c. Amperage for each phase.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center and amount of adjustments in inches.
 - 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center and amount of adjustments in inches.
 - g. Number of belts, make, and size.
 - 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- I. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data: Include the following:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Duct static pressure in inches wg.
 - d. Duct size in inches.

- e. Duct area in sq. ft..
 - f. Design airflow rate in cfm.
 - g. Design velocity in fpm.
 - h. Actual airflow rate in cfm.
 - i. Actual average velocity in fpm.
 - j. Barometric pressure in psig.
- J. Air Outlet Reports:
- 1. Air outlet data
 - a. Make and type.
 - b. Model number and size.
 - 2. Test data: Include design and actual data for the following:
 - a. Airflow rate in cfm.
- K. Instrument Calibration Reports: For instrument calibration, include the following:
- 1. Report Data: Include the following:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.08 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

**SECTION 23 07 00
DUCT INSULATION**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes semi-rigid and flexible duct, plenum; acoustical duct liner; accessories and attachments; and sealing compounds.

1.03 SUBMITTALS

- A. Product Data: Include product data description, list of materials, thickness, density, k-values and r-values for each product type, locations, manufacturer's installation instructions, flames spread and smoke developed ratings.
- B. See "Submittal Schedule" located at the end of Section 23 01 00 – General Requirements for Mechanical Systems.

1.04 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Insulation:
 - a. CertainTeed
 - b. Armaflex
 - c. Rubatex
 - d. Knauf
 - e. Owens-Corning
 - f. Halstead
 - g. Armstrong
 - h. Manville
 - i. Pittsburgh Corning

2.02 INSULATION MATERIALS

- A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- B. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type I, 0.75 pcf density, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- C. Acoustical duct liner: ASTM C 518 with resin and black mat coated surface exposed to air stream to prevent erosion of glass fibers. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature. Nominal Density 1.5 lbs per cubic foot, minimum noise reduction charac

teristic shall be 0.55 for 1" thickness; rated for 6000 fpm air velocity; air friction multiplier less than 1.6 at 2000 fpm.

2.03 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd.
- B. Bands: 3/4 inch wide, materials compatible with jacket:
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.04 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.02 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- D. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- E. Apply insulation with the least number of joints practical.
- F. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- G. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- H. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- I. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

- J. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- K. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- L. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
- M. Secure insulation with adhesive and anchor pins and speed washers.

3.03 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited.
- B. Butt transverse joints without gaps and coat joint with adhesive.
- C. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- D. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- E. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- F. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profile or are integrally formed from duct wall.
- G. Ductwork sizes indicated on drawings are the free area size. Ductwork sizes shall be increased to accommodate the addition of liner to maintain the plan indicated free area size.

3.04 DUCT AND PLENUM APPLICATION SCHEDULE

- A. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - 1. Fibrous-glass ducts.
 - 2. Factory-insulated flexible ducts.
 - 3. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 - 4. Flexible connectors.
 - 5. Vibration-control devices.
 - 6. Testing agency labels and stamps.
 - 7. Nameplates and data plates.
 - 8. Access panels and doors in air-distribution systems.
- B. See DUCT INSULATION SCHEDULE on Sheet M5-2.

END OF SECTION

**SECTION 23 07 20
PIPE INSULATION FOR HVAC**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.03 SUBMITTALS

- A. Product Data: Include product data description, list of materials, thickness, density, k-values and r-values for each product type, locations, manufacturer's installation instructions, flames spread and smoke developed ratings.
- B. See "Submittal Schedule" located at the end of Section 23 01 00 – General Requirements for Mechanical Systems.

1.04 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 - d. Schuller International, Inc.
 - e. Johns Manville
 - 2. Flexible Elastomeric Thermal Insulation:
 - a. Armacell
 - b. Armstrong World Industries, Inc.
 - c. Rubatex Corp.

2.02 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 - a. Nominal density is 2.5 lb/cu. Ft. or more.
 - b. Thermal conductivity (k-value) at 125 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
 - 2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

- a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 5. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Thermal conductivity (k-value) at 90 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less
 2. Adhesive: As recommended by insulation material manufacturer.
 3. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- D. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 2. Adhesive: As recommended by insulation material manufacturer.

2.03 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd, 4 inch tape width.
- B. Bands: 3/4 inch wide, materials compatible with jacket:
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

2.04 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.02 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- D. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- E. Apply insulation with the least number of joints practical.

- F. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- G. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- H. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- I. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- J. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
 - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- K. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- L. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- M. Floor Penetrations: Apply insulation continuously through floor assembly.

3.03 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes by securing each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
- B. Apply preformed pipe insulation to outer diameter of pipe flange.
- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 - 3. Cover fittings with standard PVC fitting covers.
- D. Apply insulation to valves and specialties as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 - 4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.04 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Follow manufacturer's written instructions for applying insulation.

2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply pipe insulation to outer diameter of pipe flanges.
- C. Apply insulation to fittings and elbows as follows:
 1. Apply mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:
 1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.05 INSULATION APPLICATION SCHEDULE

- A. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 1. Flexible connectors.
 2. Vibration-control devices.
 3. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.
- B. See Sheet M5-2 for "PIPING INSULATION SCHEDULE"

END OF SECTION

SECTION 23 09 00
HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.01 PRODUCTS NOT FURNISHED OR INSTALLED UNDER BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. General:
 - 1. Coordination Meeting: The Installer furnishing the DDC network shall meet with the Installer(s) furnishing each of the following products to coordinate details of the interface between these products and the DDC network. The Owner or his designated representative shall be present at this meeting. Each Installer shall provide the Owner and all other Installers with details of the proposed interface including PICS for BACnet equipment, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the DDC network. Submittals for these products shall not be approved prior to the completion of this meeting.
- B. Section 23 73 13 – Packaged Dedicated Outdoor Air Unit:
 - 1. Packaged AHU or evaporative cooler controls: Unit shall be furnished configured to accept control inputs from an external building automation system controller as specified in Section 23 09 93. Factory mounted safeties and other controls shall not interfere with this controller.
- C. Section 23 81 27 - Variable Refrigerant Air-Conditioning Units
 - 1. VRF controls: The VRF vendor shall furnish VRF equipment with an interface to the control and monitoring points specified in Section 23 09 93. These specified points shall be the minimum acceptable interface. The connection to these points shall be by one of the following methods:(a) Hardwired connection such as relay, 0-10VDC, or 4-20mA. (b) BACnet/IP network connection. (c) BACnet over ARCNET network connection. (d) BACnet MS/TP network connection.
- D. Communications with Third Party Equipment:
 - 1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interface for integration into the Direct Digital Control System described in this section.

1.02 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

1.03 DESCRIPTION

- A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and an operator workstation. The operator workstation shall be a personal computer (PC) with a color monitor, mouse, keyboard, and printer. The PC shall allow operators to interface with system via dynamic color graphics. Depict each mechanical system and building floor plan by a point-and-click graphic. Furnish a modem or network interface card for remote access to the network and for paging operators when an alarm occurs.
 - 1. Web-based Option: Furnish and install a web server instead of a PC operator workstation. Operators shall be able to access the system through a conventional web browser on each PC connected to the network.

1.04 APPROVED CONTROL SYSTEM PRIMARY MANUFACTURERS

A. The following are approved control system manufacturers and product lines

Contractor (Omaha, NE)	Product Line
Parallel Technologies, Inc.	Siemens

Note:

- No alternate controls contractor shall be acceptable.

1.05 QUALITY ASSURANCE

A. Installer and Manufacturer Qualifications

- Installer shall have an established working relationship with Control System Manufacturer of not less than three years.
- Installer shall have a local staff within 50 miles of the project site that are trained and capable of giving instructions and providing routine and emergency maintenance of the BAS, all components and software/firmware and all other elements of the BAS.
- Have comprehensive local service and support facilities for the total BAS as provided.
- Maintain local, or have approved local contracted access to, supplies of essential expendable parts.

1.06 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications.

1.07 SYSTEM PERFORMANCE

A. Performance Standards. System shall conform to the following minimum standards over network connections:

- Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 seconds.
- Object Scan. Data used or displayed at a controller or workstation shall have been current within the previous 10 seconds.
- Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 seconds.
- Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
- Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

TABLE 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	± 1 °F
Ducted Air	± 1 °F
Outside Air	± 2 °F
Dew Point	± 3 °F
Delta-T	± 0.25 °F
Relative Humidity	±5% RH
Air Pressure (ducts)	± 0.1 in. w.g.)
Air Pressure (space)	± 0.01 in. w.g.)
Electrical (A, V, W, Power Factor)	± 1% of reading (<i>see Note 3</i>)

Note 1: Accuracy applies to 10%–100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters

TABLE 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	± 0.2 in. w.g. ± 0.01 in. w.g.	0–6 in. w.g. - 0.1 to 0.1 in. w.g.
Airflow	± 10% of full scale	
Space Temperature	± 1.0 °F	
Duct Temperature	± 1.0 °F	
Humidity	± 5% RH	

1.08 SUBMITTALS

- A. Product Data and Shop Drawings: Meet requirements of Division 1 on Shop Drawings, Product Data, and Samples. In addition, Contractor shall provide shop drawings or other submittals on all hardware, software, and installation to be provided. No work may begin on any segment of this project until submittals have been successfully reviewed for conformity with the design intent. Six (6) copies are required. Provide drawings as AutoCAD 2018 (or newer) compatible files on optical disk (file format: .dwg, .dxf, .vsd, or comparable) with three 11" x 17" prints of each drawing. When manufacturer's cutsheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall be provided within 12 weeks of contract award. Submittals shall include:
 - 1. Direct Digital Control System Hardware:
 - a. A complete bill of materials of equipment to be used indicating quantity, manufacturer, model number, and other relevant technical data.
 - b. Schedule of dampers including size, leakage, and flow characteristics.
 - c. Schedule of valves including flow characteristics.
 - d. Manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for the items listed below and other relevant items not listed below:
 - 1) Direct Digital Controller (controller panels)
 - 2) Transducers/Transmitters
 - 3) Sensors (including accuracy data)
 - 4) Actuators
 - 5) Valves
 - 6) Relays/Switches
 - 7) Control Panels
 - 8) Power Supply
 - 9) Batteries
 - 10) Operator Interface Equipment
 - 11) Wiring
 - e. Wiring diagrams and layouts for each control panel. Show all termination numbers.
 - f. Schematic diagrams for all field sensors and controllers.
 - 2. Central System Hardware and Software:
 - a. A complete bill of material of equipment used, indicating quantity, manufacturer, model number, and other relevant technical data.
 - b. Manufacturer's description and technical data, such as product specification sheets and installation/maintenance instructions for the items listed below and other relevant items not listed below:
 - 1) Central Processing Unit
 - 2) Monitors
 - 3) Printers
 - 4) Keyboard
 - 5) Power Supply
 - 6) Battery Backup

- 7) Interface Equipment Between CPU and Control Panels
- 8) Operating System Software
- 9) Operator Interface Software
- 10) Color Graphic Software
- 11) Third-Party Software
- c. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.
- d. Riser diagrams of wiring between central control unit and all control panels.
3. Controlled Systems
 - a. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
 - c. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, it shall be labeled with the same name. All terminals shall be labeled.
 - d. An instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.
 - e. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
 - f. A point list for each system controller including both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, and the location of the I/O device. Software flag points, alarm points, etc.
4. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.
5. A description of the proposed process along with all report formats and checklists to be used in Part 3: "Control System Demonstration and Acceptance."
6. A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface included in the submittal.
- B. Project Record Documents: Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include:
 1. Project Record Drawings. As-built versions of the submittal shop drawings provided as AutoCAD 2018 (or newer) compatible files on optical media and as 11" x 17" prints.
 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Part 3: "Control System Demonstration and Acceptance."
 3. Operation and Maintenance (O & M) Manual.
 4. As-built versions of submittal product data.
 5. Names, addresses, and 24-hour telephone numbers of installing contractors and service representatives for equipment and control systems.
 6. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 7. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 8. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive

- maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - 9. Documentation of all programs created using custom programming language including setpoints, tuning parameters, and object database.
 - 10. Graphic files, programs, and database on magnetic or optical media.
 - 11. List of recommended spare parts with part numbers and suppliers.
 - 12. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - 13. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
 - 14. Licenses, guarantees, and warranty documents for equipment and systems.
 - 15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- C. Training Materials. Provide course outline and manual for each class at least six weeks before first class. Engineer will modify course outlines and manuals if necessary, to meet Owner's needs. Engineer will review and approve course outlines and manuals at least three weeks before first class.

1.09 WARRANTY

- A. Warrant work as follows:
- 1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
 - 2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
 - 3. Any software modifications or upgrades that become standard product offerings from the BAS contractor and/or BAS equipment vendors during the warranty period shall be brought to the attention of the Owner and, if the Owner wishes, shall be provided at no additional cost to the Owner. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

1.10 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
- 1. Graphics
 - 2. Record drawings
 - 3. Database
 - 4. Application programming code
 - 5. Documentation
 - 6. All software and hardware licenses

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner or Owner's representative. Spare parts shall be available for at least five years after completion of this contract.

2.02 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet or Lonmark internetwork. Only the open protocols BACnet or Lontalk will be accepted on this project. Lontalk controllers must be certified through Lonmark (www.lonmark.org) and BACnet controllers shall follow the standard BACnet templates and conform to ANSI/ASHRAE Standard 135-2004, BACnet. No other communication protocols will be accepted.
- B. All Building Controllers shall have a communications port for connections with the operator interfaces. This may be either a network interface node for connection to the Ethernet network or an RS-232/RS-485 port for Point to Point connection.
- C. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, reports, system software, and custom programs shall be viewable and editable from each internetwork controller.
 - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute specified control system operation. An authorized operator shall be able to edit cross-controller links by typing a standard object address.
- D. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring. Expansion shall not require operator interface hardware additions or software revisions.
- E. Workstations, Building Control Panels and Controllers with real-time clocks shall use a time synchronization service. The system shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight savings and standard time as applicable.

2.03 OPERATOR INTERFACE

- A. Operator Interface. PC-based workstations shall reside on high-speed network with building controllers as shown on system drawings. Each workstation or each standard browser connected to server shall be able to access all system information.
- B. Hardware. Each operator workstation or web server shall consist of the following:
 - 1. Computer: Hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified elsewhere in this document. The following hardware requirements also apply:
 - a. The solid state drive (SSD) shall have sufficient memory to store:
 - 1) All required operator workstation software
 - 2) A DDC database at least twice the size of the delivered system database
 - 3) One year of trend data based on the points specified to be trended at their specified trend intervals.
 - b. Provide additional hardware (communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.
 - c. Minimum hardware configuration shall include the following:
 - 1) Intel Core i7-2600 3.4 GHz processor with 8MB Cache
 - 2) 12 GB of SDRAM
 - 3) 16x CD-RW/DVD optical drive
 - 4) 2 TB – Solid State Drive (SSD) providing data at 3 GB/sec
 - 5) 24-in high definition monitor
 - 2. Uninterruptable Power Supply (UPS): Internal battery module as follows:
 - a. Input voltage: 120 volt
 - b. Output voltage: 120 volt

- c. Power capacity: 400 Watt/ 650 VA
 - d. Internal surge protection
 - e. Circuit breaker
 - f. One (1) chorded input connector
 - g. Four (4) output connectors
 - h. LED indicators
 - i. Audible alarm
 - j. One (1) 9Ah 12 volt lead acid battery
3. Printer/scanner: Wireless color, ink-jet type as follows:
- a. Print head: 4800 x 1200 dpi optimized color resolution.
 - b. Paper handling: Minimum 100 sheets.
 - c. Print speed: Minimum of 17 ppm in black and 12 ppm in color.
- C. System Software
- 1. Operating System. Furnish a concurrent multi-tasking operating system. The operating system also shall support the use of other common software applications. Examples include Microsoft Excel, Microsoft Word, and Microsoft Access. Acceptable operating systems are Windows 7 Professional 64Bit.
 - 2. System Graphics. The operator workstation software shall be graphically oriented and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled and heating water system, and graphics that summarize conditions on each floor of each building included in this contract.
 - a. Functionality. Graphics shall allow operator to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters. Provide a method for the operator to easily move between graphic displays. The hierarchy of graphics shall be logically organized and require no more than three mouse clicks when navigating between systems.
 - b. The system graphics shall be able to be modified while on-line. An operator with the proper password level shall be able to add, delete, or change dynamic objects on a graphic.
 - c. Dynamic objects shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the object.
 - d. System graphics shall indicate if a controlled point is overridden in manual mode. Show overridden points in a color that is easily distinguished between points under automatic control.
 - e. Separate the floor graphics into logical areas if the size of the floor is such that the presentation of data is not easily readable.
 - f. Provide links on each system graphic to relevant control drawing as-builts and equipment submittal documentation.
- D. System Applications. Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation:
- 1. Automatic System Database Save and Restore. Each workstation shall store on the solid state drive (SSD) a copy of the current database of each Building Controller. This database shall be updated whenever a change is made in any system panel. The storage of these data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel. This capability may be disabled by the operator.
 - 2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to save the database from any system panel. The operator also shall be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
 - 3. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection.

4. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the functions accessible to viewing and/or changing each system application, editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time period shall be user-adjustable. All system security data shall be stored in an encrypted format.
6. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
7. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, alarm limit differentials, states, and reactions for each object in the system.
8. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying upon acronyms or other mnemonics.
9. Alarm Reactions. The operator shall be able to determine (by object) what, if any, actions are to be taken during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation, or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day.
10. Trend Logs. The operator shall be able to define a custom trend log for any data object in the system. This definition shall include interval, start time, and stop time. Trend data shall be sampled and stored on the building controller panel, be archivable on the solid state drive (SSD), and be retrievable for use in spreadsheets and standard database programs.
11. Alarm and Event Log. The operator shall be able to view all system alarms and change of states from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the solid state drive (SSD) on the workstation.
12. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system. The status shall be available by menu, on graphics, or through custom programs.
13. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archivable on the solid state drive (SSD) for historical reporting. Provide the ability for the operator to obtain real-time logs of all objects by type or status (e.g., alarm, lockout, normal). Reports and logs shall be stored on the PC solid state drive (SSD) in a format that is readily accessible by other standard software applications, including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer and shall be set to be printed either on operator command or at a specific time each day.

2.04 CONTROLLERS

- A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 1.6.
- B. Communication.

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
 2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
 3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
 4. Stand-Alone Operation. Each piece of equipment specified in Section 23 09 93 shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.
- C. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- D. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- E. Memory.
1. Controller memory shall support operating system, database, and programming requirements.
 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- F. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- G. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption

2.05 INPUT/OUTPUT INTERFACE

- A. Hardwire inputs and output points into the system through building, custom application, or application specific controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of On/Off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
- D. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.
- E. Analog inputs shall allow the monitoring of low-voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with—and field configurable to—commonly available sensing devices.
- F. Binary outputs shall provide for On/Off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have

three-position (On/Off/Auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on building or custom application controllers shall have status lights and a two-position (AUTO/MANUAL) switch. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.
- H. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
- I. Input/Output points shall be the universal type, i.e., controller input or output may be designated (in software) as either a binary or analog type point with appropriate properties. Application specific controllers are exempted from this requirement.
- J. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.06 POWER SUPPLIES AND LINE FILTERING

- A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
- B. Power line filtering.
 - 1. Provide transient voltage and surge suppression for all workstations and controllers either internally or as an external component. Surge protection shall have the following at a minimum:
 - 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 better at 40 Hz to 100 Hz

2.07 ACTUATORS

- A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Manufacturers:
 - a. Belimo Aircontrols (USA), Inc.
 - b. Honeywell
 - c. Johnson Controls
 - d. Siemens Controls
 - 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 - 3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

- g. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24 V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-VAC or 8 W at 24-VDC.
9. Proportional Signal: 2- to 10-VDC or 4 to 20 mA, and 2- to 10-VDC position feedback signal.
10. Temperature Rating: Minus 20 to plus 122 deg F.
11. Temperature Rating (Smoke Dampers): Minus 20 to plus 250 deg F.
12. Exterior applications: Housing shall be NEMA 4 rated and provided with an anti-condensation heater.
13. Run Time: Stroke dampers from fully closed to fully open according to the following:
 - a. Two position normal service 75 seconds
 - b. Modulating normal service 150 seconds
 - c. Emergency service (stair pressurization, Smoke containment, etc.) 30 seconds

2.08 DAMPERS

- A. Manufacturers:
 1. Air Balance Inc.
 2. Johnson Controls
 3. Honeywell
 4. Nailor Industries
 5. Ruskin
- B. Dampers: General
 1. Multiple section two position dampers shall be controlled by one BAS output unless indicated otherwise.
 2. Individual sections shall be limited to 18 square feet in size. Individual sections for generator applications shall not be larger than 12.5 square feet in size. Each section shall have a separate actuator.
 3. Jackshaft extensions shall not be used for controlling multiple sections.
 4. Actuators shall be mounted to provide adequate service access. Wherever possible mount actuators on the exterior of the duct/damper section. Obtain approval for proposed installations of actuators within ductwork, plenums, airstreams, etc. Furnish access doors where required to allow access.
- C. Dampers: AMCA-rated, parallel or opposed-blade design; 0.108-inch minimum thick, galvanized steel or 0.125-inch minimum thick, extruded aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 4. Edge Seals, Low-Leakage Applications: Use replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf when tested according to AMCA 500D.
 5. Use parallel blade dampers in all mixing applications.
- D. Hardwired interlocks:

1. Provide all required hardwired interlocks between fans and intake and discharge dampers and any motor actuated damper as identified within this Section or the Mechanical Drawings, whether or not furnished under this Section unless the fan is furnished with interlock by manufacturer.
2. BAS Contractor shall provide all wiring as required for the control and interlocking of automatic dampers. BAS Contractor shall also provide power supply and control signal wiring between damper actuators and interlocked motor control circuits, thermostats, duct pressure limit switches, safeties, etc.
3. Power for isolation dampers on fans and air handling units shall be integral to the associated fan motor control circuit. Coordinate actuator power supply wiring and fire alarm system override control of dampers with Division 26.
4. BAS Contractor shall provide any necessary damper position switches and wiring to achieve the operational requirements outlined in Section 23 09 93 "Sequences of Controls". Provide damper end switches hardwire interlocked to prevent fan motor operation in both the hand and auto position of the hand/off/auto motor control circuit.

2.09 ELECTRONIC SENSORS

- A. Temperature sensors.
 1. Manufacturers:
 - a. BEC Controls Corporation
 - b. Honeywell
 - c. I.T.M. Instruments Inc.
 - d. MAMAC Systems, Inc.
 - e. Precon
 - f. RDF Corporation
 - g. TAC
 - h. Veris Industries
 2. Accuracy:
 - a. Thermistor sensors: Plus, or minus 0.5 deg F at calibration point.
 - b. RTDs and transmitters: Plus, or minus 0.2 percent at calibration point.
 3. Wire: Twisted, shielded-pair cable.
 4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 5. Averaging Elements in Ducts: minimum 72" long or (one linear foot per square foot) of duct cross-sectional area, whichever is greater. Use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 7. Room Sensors:
 - a. Set-Point Adjustment and Indication: Yes.
 - b. Room Temperature Indication: Yes.
 - c. Occupancy override: Yes.
 - d. Color: Color from manufacturer's standard.
 - e. Thermostat Guards: None
 - f. Insulating Bases: For sensors located on exterior walls.
 8. Outside-Air Sensors: Install sensors on north wall, shielded from direct sunlight.

2.10 AUXILIARY CONTROL DEVICES

- A. Binary Temperature Devices
 1. Low-voltage space thermostat shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) set point range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
 2. Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator,

UL listed for electrical rating, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

3. Low-Limit Thermostat: Snap-acting, double-pole, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
 - a. Bulb Length: Minimum 20 feet.
 - b. Quantity: One thermostat for every 20 sq. ft. of coil surface. Provide suitable supports as recommended by manufacturer.
 - c. Interlock to the associated fan so that fan will shut down when HOA switch is in Hand or Auto position.
- B. Relays
1. Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
 2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable $\pm 200\%$ (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
- C. Current transformers
1. AC current transformers shall be UL/CSA Recognized and completely encased (except for terminals) in approved plastic material.
 2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
 3. Transformers shall be fixed-core or split-core type for installation on new or existing wiring, respectively.

2.11 LOCAL CONTROL PANELS

- A. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
- B. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
- C. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.12 CONTROL RACEWAYS

- A. EMT: ANSI C80.3, zinc-coated steel, with steel or cast set-screw or compression fittings.
- B. FMC: Zinc-coated steel.
- C. Raceway Fittings: Specifically designed for the raceway type with which used.

2.13 CONTROL CONDUCTORS

- A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
- B. Conductors, Larger Than No. 10 AWG: Stranded copper.
- C. Insulation: Thermoplastic, rated at 75 deg C minimum.
- D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.14 LOW VOLTAGE CONDUCTORS

- A. Provide conductors including the following:
 1. Control panel to control panel – Systimax (or equal) CAT 5E plenum cable or manufactures recommendation
 2. Control panel to net or sub LAN Controller – Belden RS 485 shielded cable or manufacturer's recommendation.

3. Controller or panel to controlled devices – Belden (or equal) 2 or 3 wire shielded cable or manufacturers recommendation.
4. All wiring shall be plenum rated unless installed in conduit.
5. Utilize riser rated cable if applicable.

2.15 RACEWAY AND CABLE SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2 inches o.c., in webs.
- D. Delete paragraph below if only metal supports are used.
- E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Expansion Anchors: Carbon-steel wedge or sleeve type.
- H. Toggle Bolts: All-steel springhead type.
- I. Powder-Driven Threaded Studs: Heat-treated steel.

2.16 BOXES

- A. Hollow wall and ceiling spaces: Outlet boxes for concealed applications shall be 4" square with single or multiple gang plaster ring in round or square configuration to match the device being installed. Depth of ring shall be selected so that face of ring is recessed back from face of finished surface by approximately 1/8".
- B. Masonry walls: Outlet boxes in masonry walls shall be 4" square with single or multiple gang masonry rings with square edges. Masonry boxes may also be used where 4" square boxes are impractical. Slush boxes in place to prevent movement with in walls. Flush mounted boxes and conduit are to be used unless otherwise indicated.
- C. Exposed Exterior boxes: Where exposed boxes are required, they shall be the cast type with threaded hubs and gasketed covers. Use of these boxes is by approval only. Flush mounted boxes and conduit are to be used unless otherwise indicated.
- D. Interior junction boxes: Interior junction boxes shall be 4" square minimum with knock outs as required. Provide a flat steel coverplate.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.
- C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and at the expense of—this contractor.

3.02 PROTECTION

- A. The contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.
- B. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.03 COORDINATION

- A. Site
 - 1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.
 - 2. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.
- B. Test and Balance
 - 1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
 - 2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
 - 3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
 - 4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.
- C. Life Safety
 - 1. Duct smoke detectors required for air handler shutdown are supplied under Division 26 of this specification. The contractor shall interlock smoke detectors to air handlers for shutdown as described in 230993, "Sequences of Operation."
 - 2. Smoke dampers and actuators required for duct smoke isolation are provided under a Section of Division 23. The contractor shall interlock these dampers to the air handlers as described in 230993, "Sequences of Operation."
 - 3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Section of Division 23. Control of these dampers shall be by Division 26. The contractor shall provide control air to the dampers.
- D. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
 - 1. All communication media and equipment shall be provided as specified in Part 2, "Communication" of this specification.
 - 2. Each supplier of a controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
 - 3. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.
 - 4. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
 - 5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.04 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.05 FIELD QUALITY CONTROL

- A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.
- C. Contractor shall have work inspected by local and/ or state authorities having jurisdiction over the work.

3.06 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification. Where the requirements of this section differ from those in Division 26, the requirements of this section shall take precedence.
- B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway according to NEC and Division 26 requirements.
- C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.)
- D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.
- E. All wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage— shall be installed in raceway.
- F. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- G. Do not install wiring in raceway containing tubing.
- H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 10 ft intervals.
- I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- J. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- K. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.
- L. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- M. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

- N. Size of raceway and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- O. Include one pull string in each raceway 1 in. or larger.
- P. Use coded conductors throughout with conductors of different colors.
- Q. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- R. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 in. from high-temperature equipment (e.g., steam pipes or flues).
- S. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- T. Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.
- U. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
- V. The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- W. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 ft in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
- X. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.

3.07 COMMUNICATION WIRING

- A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.
- B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- C. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
- D. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.
- G. All runs of communication wiring shall be unspliced length when that length is commercially available.
- H. All communication wiring shall be labeled to indicate origination and destination data.
- I. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.08 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Coordinate location of wall mounted devices with other devices to provide symmetrical and aligned installation. Review final locations with Architect/Engineer prior to installation. Install occupant adjustable devices 48 inches above the floor in compliance with ADA regulations. Install all other devices 60 inches above the floor unless otherwise shown.
- D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
- F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Differential air static pressure.
 - 1. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
 - 2. Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.
 - 3. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 - 4. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
 - 5. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.

3.09 ACTUATORS

- A. Mount and link control damper actuators according to manufacturer's instructions.
 - 1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 - 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 3. Provide all mounting hardware and linkages for actuator installation.
- B. Electric/Electronic
 - 1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
 - 2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.10 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 5 cm (2 in.) of termination with the DDC address or termination number.

- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels and enclosures with minimum 0.5" high letters on laminated plastic nameplates.
 - 1. Maintain consistency throughout project.
 - 2. Indicated and cross referenced in the record documentation.
- D. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
- E. Identify room sensors relating to terminal box or valves with nameplates.
- F. Manufacturers' nameplates and UL or CSA labels are to be visible and legible after equipment is installed.
- G. Identifiers shall match record documents.

3.11 CONTROLLERS

- A. Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.
 - 1. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional controller boards or point modules shall be required to implement use of these spare points.

3.12 PROGRAMMING

- A. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Software Programming
 - 1. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation.
- B. Operator Interface
 - 1. Standard graphics—Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.
 - 2. Show terminal equipment information on a "graphic" summary table. Provide dynamic information for each point shown.
 - 3. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.13 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Start-up Testing: All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.

1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.
4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.
6. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum start/stop routines.
7. Alarms and Interlocks:
 - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.14 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.
5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
6. Demonstrate compliance with Part 1, "System Performance."
7. Demonstrate compliance with sequences of operation through all modes of operation.
8. Demonstrate complete operation of operator interface.
9. Additionally, the following items shall be demonstrated:
 - a. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10

seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.

- b. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
 - c. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and electronic formats.
10. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.
- B. Acceptance
1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
 2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.15 CLEANING

- A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.16 TRAINING

- A. Provide a minimum of 16 hours of on-site or classroom training throughout the contract period for personnel designated by the owner.
- B. Provide course outline and materials in accordance with the "Submittals" article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.
- C. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- D. Classroom training shall be done using a network of working controllers representative of the installed hardware.

3.17 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

END OF SECTION

SECTION 23 09 93
SEQUENCE OF OPERATION FOR HVAC CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes control sequences for the following HVAC systems, subsystems, and equipment. Sequence of Control indicated illustrates basic control function only. Provide all control devices required for controlling air handling units, exhaust fans, physical plant equipment, terminal equipment, and all related items.
- B. The Control Contractor shall perform the initial input of all required operational data for each point that is to be used based on information supplied to the Contractor by the Owner. The Contractor shall assist the Owner's staff in developing the schedule and shall demonstrate the operation of the system using the data.
- C. Provide adequate English language notation in the software to assist the operator in understanding the intent of the programmed sequences.
- D. The Control Contractor shall be responsible for the stable operation of all control loops. If the Control Contractor has not provided self-tuning PID control algorithms, then the Control Contractor shall manually tune all control loops. Verify all control loops are stable whether or not they are self-tuning.
- E. The Control Contractor shall provide any modifications to the operating sequences as requested by the Owner without additional costs until the final acceptance of the entire control system.
- F. Related Sections include the following:
 - 1. Division 23 Section 23 09 00 "HVAC Instrumentation and Controls" for control equipment and devices and for submittal requirements.

1.03 DEFINITIONS

- A. BAS: Building Automation System.
- B. VVT: Variable Volume / Variable Temperature.
- C. PID: Proportional-integral-derivative.
- D. Points List:
 - 1. AI = Analog Input
 - 2. AO = Analog Output
 - 3. BI = Binary Input
 - 4. BO = Binary Output
 - 5. HI = Indicated a hardwired interface requirement. These points are not monitored by the BAS unless indicated in any of the previous columns.
 - 6. AV = Analog Value. A software point that may be editable or read-only.
 - 7. BV = Binary Value. A software point that may be editable or read-only.
 - 8. Trend = The BAS shall be configured to collect and display a trend log of this object.
 - a. Temperature points: Initially set to sample data every 15 minutes unless noted otherwise.
 - b. Pressure points: Initially set to sample data every 1 minute unless noted otherwise.
 - c. Binary points: Initially set to sample data anytime there is a change of value.

9. Alarm = The BAS shall be configured to generate an alarm when this object exceeds user definable limits, as described in the Sequence of Controls.
- E. Abbreviations: The following abbreviations may be used in graphics, schematic, point names, and other applications where space is limited.
1. AC - Air Conditioning
 2. ACU - Air Conditioning Unit
 3. AHU - Air Handling Unit
 4. BYP - Bypass
 5. CO2 – Carbon Dioxide
 6. DA - Discharge Air
 7. DP – Differential Pressure
 8. DMP - Damper
 9. EA - Exhaust Air
 10. EF - Exhaust Fan
 11. EVAP - Evaporators
 12. FCU - Fan Coil Unit
 13. HOA - Hand / Off / Auto
 14. HP - Heat Pump
 15. HRU - Heat Recovery Unit
 16. MAX - Maximum
 17. MIN - Minimum
 18. OAT - Outdoor Air Temperature
 19. OAH – Outdoor Air Humidity
 20. RA - Return Air
 21. RAT – Return Air Temperature
 22. RF - Return Fan
 23. RH - Relative Humidity
 24. SA - Supply Air
 25. SAT – Supply Air Temperature
 26. SF - Supply Fan
 27. SP - Static Pressure
 28. TEMP - Temperature
 29. UH - Unit Heater
 30. VFD – Variable Frequency Drive

1.04 VRF SYSTEM

- A. The variable refrigerant flow system shall have an independent control system provided by system manufacturer. Interface with the variable refrigerant flow system master control panel through BACnet interface to monitor all system parameters and report all system alarms. Coordinate interface requirements with the variable refrigerant flow equipment supplier.
- B. Manufacturer's controller shall be connected to all indoor units and heat pumps. Indoor VRF units shall operate utilizing the manufacturer's standard control sequences to maintain adjustable indoor set point temperatures. Each zone shall have its own controller which allows the User to adjust setpoints and modes of operation independent of other zones.

- C. Schedule identified below shall be standard list of control points that shall be controlled and/or monitored through the building management system.
- D. Ducted fan coil unit controller shall have ability to energize supplemental electric heat (integral to unit) based on adjustable temperature deviation from space heating setpoint. Heater shall run in conjunction with refrigerant circuit.
- E. Provide BAS interface with VRF system. VRF system shall have controller that allows the following features (minimum) to be monitored and controlled via the building management system:
 - 1. Enable / disable fan coil units
 - 2. Modify mode of operation (cool, heat, fan, auto, and dry).
 - 3. Provide fan status
 - 4. Provide fan speed
 - 5. Filter sign reset signal
 - 6. Disable room controller
 - 7. Energy saving offset control of fan coil unit setpoints
 - 8. Heat pump compressor status
 - 9. All zones shall contain a high and low temperature alarm that is interfaced to the BAS. Alarms shall initially set for +/- 5 off of effective setpoint (adj.)
- F. VRF system occupancy schedule shall be confirmed with the Owner. Include adjustable schedule through the BAS to provide alternate setpoints during periods where there is no/light occupancy. Various schedules shall be created for the various parts of the building that will be operated differently throughout the year. As part of the final programming stage of project, coordinate these values with the Owner and setup initial schedule for building that can be modified in the future.
- G. Integral outdoor heat pump controls furnished with equipment shall sequence the outdoor unit mode of operation, fan speed, stop control, standby control, startup control, electronic expansion valve control, defrost cycle, etc. as required. System setup of heat pumps shall be configured by the equipment manufacturer for the specific setup / application of project.

POINT NAME	Hardware Points					Software Points				Show on Graphic	Notes
	AI	AO	BI	BO	HI	AV	BV	Trend	Alarm		
FCU ENABLE				X				X		X	
FCU MODE OF OPERATION				X				X		X	
FCU FAN STATUS			X					X		X	
FCU FAN SPEED	X							X		X	
FCU FILTER STATUS (DIRTY)			X					X	X	X	
RETURN AIR TEMPERATURE	X							X		X	
DISABLE ROOM CONTROLLER				X				X		X	
COMPRESSOR STATUS			X					X		X	
OCCUPIED CLG / HTG SP		X						X		X	
UNOCCUPIED CLG / HTG SP		X						X		X	
OCCUPANCY MODE				X				X		X	
ROOM TEMPERATURE	X							X		X	
ALARM STATUS			X					X	X	X	
MAX / MIN CLG SP		X						X			
MAX / MIN HTG SP		X						X			

1.05 DEDICATED OUTSIDE AIR ROOFTOP UNIT (DOAU-1) AND ELECT DUCT HEATER (EDH-1)

- A. The BAS shall enable / disable the unit based on occupancy schedule. Factory provided controls shall control all basic functions including cooling, reheating, heating, etc. to maintain required discharge air conditions. BAS shall provide necessary sensors to execute all sequences. In general, the system shall operate as follows:
- B. System Off – When the system is off:
 - 1. The outside air damper shall be closed.
 - 2. The relief air damper shall be closed.
 - 3. Supply fan shall be off.
 - 4. Exhaust fan shall be off.
 - 5. Heating/cooling coil shall be disabled.
 - 6. Hot gas reheat shall be disabled.
 - 7. Energy Recovery Wheel shall be disabled.
 - 8. Electric heating coils shall be disabled.
- C. Initiation of System Start-Up – The system shall be started:
 - 1. Manually initiated by operator through BAS.
 - 2. Automatically by BAS through occupancy schedule.
- D. System Operation – After system start-up has been initiated the following shall occur:
 - 1. VRF evaporator unit fans shall be allowed to start and operate for a minimum of 5 minutes (adjustable) prior to starting dedicated outside air unit.
 - 2. The supply and exhaust fans shall be enabled. During occupied hours the outside / exhaust air dampers shall be open, and the supply / exhaust fans shall run continuously. During Unoccupied hours the outside / relief air dampers shall be closed and the supply / exhaust fans shall be off.
 - 3. Electric heating shall modulate to maintain the discharge air temperature setpoint upstream of energy recovery wheel (45°F adj.).
 - 4. The energy recovery wheel shall operate to minimize energy use. If conditions are favorable, the energy recovery wheel shall be bypassed.
 - 5. DX cooling shall be staged to maintain the discharge air temperature and relative humidity setpoints. Cooling shall be locked out at outside air temperatures below 55°F.
 - 6. DX hot gas reheat shall be modulated to maintain discharge air temperature setpoint.
 - 7. Electric duct heater (EDH-1) shall modulate to maintain the discharge air temperature setpoint (70°F adj.). EDH-1 shall be locked out when entering air temperature from dedicated outdoor air unit is above 65°F (adj).
 - 8. Relief air motorized damper shall modulate to maintain building plenum pressure (0.10" adj).
- E. System Shutdown – Shall be initiated as follows:
 - 1. Manually initiated by operator through BAS.
 - 2. Automatically through occupancy schedule.
 - 3. Automatically in the event of building power failure or fire alarm.
- F. System Setpoints – The setpoints shall be operator changeable and initially set as follows:
 - 1. Cooling discharge air temperature shall be 74°F.
 - 2. Cooling discharge air relative humidity shall be 60%.
 - 3. Heating discharge air temperature shall be 70°F.
- G. Failure Positions – The following shall occur upon component failure or loss of power:

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1. Outside air damper shall close.
2. Relief air damper shall close.
3. Electric preheating coil shall be disabled.
4. The supply fan shall be off.
5. Heating/Cooling shall be disabled.
6. Hot gas reheat shall be disabled.
7. Energy recovery wheel shall be disabled.
8. Electric duct heater EDH-1 shall be disabled.

POINT NAME	Hardware Points					Software Points				Show on Graphic	Notes
	AI	AO	BI	BO	HI	AV	BV	Trend	Alarm		
DISCHARGE AIR TEMPERATURE	X							X		X	
DISCHARGE AIR TEMPERATURE SETPOINT ADJUSTMENT	X							X		X	
DISCHARGE AIR RELATIVE HUMIDITY	X							X		X	
OUTSIDE AIR TEMPERATURE	X							X		X	MAY BE SHARED GLOBALLY WHERE LISTED IN OTHER POINT LISTS
OUTSIDE AIR HUMIDITY	X							X		X	
OUTSIDE AIR ENTHALPY						X		X		X	
SUPPLY FAN ENABLE				X				X		X	
SUPPLY FAN STATUS			X					X		X	
EXHAUST FAN ENABLE				X				X		X	
EXHAUST FAN STATUS			X					X		X	
ENERGY RECOVERY WHEEL ENABLE				X				X		X	
ENERGY RECOVERY WHEEL STATUS			X					X		X	
OUTSIDE AIR DAMPER		X						X		X	
RELIEF DAMPER		X						X		X	
REHEAT CONTROL		X						X		X	
FAILURE ALARM									X		
HEATING COIL ENABLE				X				X		X	
HEATING COIL STATUS			X					X		X	
HIGH DISCHARGE AIR TEMP									X		
LOW DISCHARGE AIR TEMP									X		

POINT NAME	Hardware Points					Software Points				Show on Graphic	Notes	
	AI	AO	BI	BO	HI	AV	BV	Trend	Alarm			
HIGH DISCHARGE AIR RELATIVE HUMIDITY										X		
SYSTEM STATUS AND ALARMS										x	x	BACnet Interface to System controller

1.06 MISC. FAN CONTROL (EF-1)

- A. System Off – When the system is off:
 - 1. The fan shall be off.
 - 2. Motorized back draft damper shall be closed.
- B. Initiation of System Start-Up – The system shall be started:
 - 1. Manually initiated by operator through BAS.
 - 2. Manually initiated by wall switch.
- C. System Operation – After system start-up has been initiated the following shall occur:
 - 1. The exhaust fan shall start. The motorized back draft damper shall be interlocked with the fan enable circuit.
- D. System Shutdown – Shall be initiated as follows:
 - 1. Manually initiated by operator through BAS.
 - 2. Manually initiated by wall switch.

POINT NAME	Hardware Points					Software Points				Show on Graphic	Notes	
	AI	AO	BI	BO	HI	AV	BV	Trend	Alarm			
FAN STATUS			X					X		X		
FAN ENABLE				X				X		X		
BACK DRAFT DAMPER					X							
FAN FAILURE ALARM										X		

1.07 SPLIT SYSTEM AIR CONDITIONERS (AC-1)

- A. Split system air conditioner shall be controlled by the manufacturer furnished thermostat. Provide temperature sensor adjacent to manufacturer's thermostat to monitor space temperature. Space shall alarm at temperatures above 85°F (adj).

POINT NAME	Hardware Points					Software Points				Show on Graphic	Notes	
	AI	AO	BI	BO	HI	AV	BV	Trend	Alarm			
HIGH SPACE TEMPERATURE ALARM										X		

1.08 DOMESTIC CIRCULATOR PUMPS (HWCP-1 & HWCP-2)

- A. Pump shall cycle upon a signal from an aqua-stat installed on the domestic hot water line. Pump shall be enabled during scheduled occupied hours defined in the BAS.

POINT NAME	Hardware Points					Software Points				Show on Graphic	Notes	
	AI	AO	BI	BO	HI	AV	BV	Trend	Alarm			

POINT NAME	Hardware Points					Software Points				Show on Graphic	Notes
	AI	AO	BI	BO	HI	AV	BV	Trend	Alarm		
PUMP STATUS			X					X		X	
PUMP ENABLE				X				X		X	

1.09 EMERGENCY AMMONIA DETECTION SYSTEM SHUTDOWN – ALTERNATE #2 ONLY

- A. In emergency ammonia spill operation, dedicated outdoor air unit DOAU-1 shall be shutdown and all 24V motorized dampers (2 total) shall fully close. VRF system shall shutdown except for FCU-6, 7, 8 ceiling cassette fans shall circulate room air.
1. Manually activated by Shelter-in Place Status Switch.
 2. Automatically activated by outdoor air ammonia status.

POINT NAME	Hardware Points					Software Points				Show on Graphic	Notes
	AI	AO	BI	BO	HI	AV	BV	Trend	Alarm		
SHELTER-IN PLACE SWITCH STATUS			X					X		X	
OUTSIDE AIR AMMONIA STATUS				X				X		X	Existing may be utilized

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

**SECTION 23 21 13
HYDRONIC PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes piping, special-duty valves, and hydronic specialties for hot-water heating, chilled-water cooling, and condenser water systems; makeup water for these systems; blowdown drain lines; and condensate drain piping.

1.03 SUBMITTALS

- A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- B. Field Test Reports: Written reports of tests specified in Part 3 of this Section.
- C. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals.
- D. See "Submittal Schedule" located at the end of Section 23 01 00 – "General Requirements for Mechanical Systems".

1.04 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the applicable codes.
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grooved Mechanical-Joint Fittings and Couplings:
 - a. Central Sprinkler Company; Central Grooved Piping Products.
 - b. Grinnell Corporation.
 - c. Victaulic Company of America.
 - d. Star Fittings

2.02 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.

2.03 PIPING APPLICATIONS

- A. Condensate Drain Lines (CD)
 - 1. Type L drawn-temper copper tubing with soldered joints

2.04 PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Basic Mechanical Piping Materials and Methods" for basic piping installation requirements.
- B. Install drain piping at a uniform grade of 2.0 percent in direction of drain.
- C. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

- D. Anchor piping for proper direction of expansion and contraction.

2.05 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush system with clean water. Clean strainers.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
 3. Check expansion tanks to determine that they are not air bound and that system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.

2.06 START-UP

- A. Perform these adjustments before operating the system:
1. Fill system with water and required chemicals and/or antifreeze solution.
 2. Start pump and check pump for proper direction of rotation.
 3. Set automatic fill valves for required system pressure.
 4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

2.07 CLEANING

- A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING AND 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 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.03 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Liquid Lines: 535 psig.

1.04 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Filter dryers.
 - 4. Strainers.
 - 5. Branch Circuit (BC) Controllers
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.06 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.02 VALVES AND SPECIALTIES

- A. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
 2. Core: Removable ball-type check valve with stainless-steel spring.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig.
- B. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
 6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 deg F.
 8. Manual operator.
- C. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig.
 6. Maximum Operating Temperature: 240 deg F.
- D. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 deg F.
 6. Superheat: Adjustable.
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: 450 psig.
- E. Mufflers:
1. Body: Welded steel with corrosion-resistant coating.
 2. End Connections: Socket or flare.
 3. Working Pressure Rating: 500 psig.
 4. Maximum Operating Temperature: 275 deg F.
- F. Receivers: Comply with ARI 495.
1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 2. Comply with UL 207; listed and labeled by an NRTL.
 3. Body: Welded steel with corrosion-resistant coating.
 4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
 5. End Connections: Socket or threaded.

6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 275 deg F.
- G. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
 2. End Connections: Socket or threaded.
 3. Working Pressure Rating: 500 psig.
 4. Maximum Operating Temperature: 275 deg F.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- C. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.
- D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.02 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- B. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- C. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 1. Install valve so diaphragm case is warmer than bulb.
 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- D. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- E. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- F. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 1. Solenoid valves.
 2. Thermostatic expansion valves.
 3. Hot-gas bypass valves.
 4. Compressor.
- G. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- H. Install receivers sized to accommodate pump-down charge.

3.03 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Provide ceiling access doors if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- M. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- O. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Basic Mechanical Piping Materials and Methods."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.04 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.05 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section Basic Mechanical Materials And Methods.

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.

- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.07 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 - 4. Charge system with a new filter-dryer core in charging line.

3.08 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Verify that compressor oil level is correct.
 - 2. Open compressor suction and discharge valves.
 - 3. Open refrigerant valves except bypass valves that are used for other purposes.
 - 4. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13
METAL DUCTS AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes metal ducts and accessories for heating, ventilating, and air-conditioning systems, diffusers, registers and grilles, and gas vents.

1.03 DEFINITIONS

- A. Pressure Classification for Ductwork: As defined by to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and applicable codes.
 - 1. Low Pressure: Maximum 2500 fpm velocity; maximum 2.0" WG positive or -2.0" WG negative static pressure class.

1.04 SUBMITTALS

- A. Product data including product construction, installation instructions and performance data for the following:
 - 1. Sealing materials.
 - 2. Manual-volume dampers.
 - 3. Fire and smoke dampers.
 - 4. Duct-mounted access doors and panels.
 - 5. Flexible ducts
 - 6. Diffuser's Registers & Grilles
 - 7. Louvers
 - 8. Hangers and Supports
- B. No requirement for shop drawings if after examining the contract documents and actual conditions, contractor agrees system can be installed as shown.
- C. Shop Drawings: Show details of the following:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Duct layout indicating pressure classifications and sizes on plans.
 - 3. Fittings.
 - 4. Reinforcement and spacing.
 - 5. Seam and joint construction.
 - 6. Penetrations through fire-rated and other partitions.
 - 7. Hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.
- F. See "Submittal Schedule" located at the end of Section 23 01 00 – General Requirements for Mechanical Systems.

1.05 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Volume Dampers
 - a. Greenheck
 - b. Air Balance
 - c. American Warming
 - d. Cesco
 - e. Louvers and Dampers, Inc.
 - f. Penn
 - g. Prefco
 - h. Carnes
 - i. Ruskin
 - j. Vent Products
 2. Fire and Smoke Dampers
 - a. Greenheck
 - b. Air Balance
 - c. American Warming
 - d. Cesco
 - e. Louvers and Dampers, Inc.
 - f. Penn
 - g. Pottorff
 - h. Prefco
 - i. Carnes
 - j. Ruskin
 - k. Vent Products
 - l. Nailor Industries
 3. Flexible Ducts
 - a. Flexible Air Products
 - b. Flexmaster
 - c. Thermaflex
 - d. Certainteed
 - e. Wiremold
 - f. General Flex Corp
 - g. H.K. Porter
 4. Duct Access Doors
 - a. Air Balance
 - b. American Warming
 - c. Cesco
 - d. Ventfrabrics
 - e. Penn
 - f. Prefco
 - g. Carnes
 - h. Ruskin
 - i. Kees
 - j. United McGill
 - k. Nailor Industries
 5. Diffusers, Registers, Grilles
 - a. Carnes
 - b. J & J Register
 - c. Krueger
 - d. Reliable
 - e. Price
 - f. Tuttle and Bailey
 - g. Metal-Aire
 - h. Titus
 - i. Hart and Cooly

- j. Anemostat
- k. Nailor Industries
- 6. Roof Hoods
 - a. Acme
 - b. Greenheck
 - c. Cook
 - d. Louvers and Dampers, Inc.
 - e. Carnes
 - f. ILG
 - g. Penn
- 7. Duct Hangers & Supports:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne
 - c. Eberl Iron Works, Inc.
 - d. Gripple
 - e. Miro Industries, Inc.
 - f. The Pate Company
 - g. PHP Systems / Design

2.02 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form with standard, one-side bright finish for ducts exposed to view and with mill finish for concealed ducts.
- C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 SEALANT MATERIALS

- A. Duct Sealant: UL classified, non-combustible, flame spread 25 or less, smoke developed rating of 540 or less, resistant to water, pressure rupture rating of 16" WG minimum, suitable for use alone or with tape, application an operational temperature ranges appropriate for usage.

2.04 MANUFACTURED DUCT JOINTS

- A. Manufactured duct joining system to consist of roll formed angles, corner pieces, metal cleats and gasket material. Construct and join ductwork in accordance with the latest SMACNA test data and joint reinforcement schedule corresponding to duct gauge used. Corners to be down set design, no bolt design except bolting is required for medium pressure applications. Reinforcement requirement for sheet metal to comply with latest SMACNA for manufactured duct joining technique appropriate to get to pressure class.

2.05 MANUAL-VOLUME DAMPERS

- A. Fabricate in accordance with latest edition of SMACNA HVAC Duct Construction Standards – Metal and Flexible and as indicated.
- B. Fabricate single blade dampers for duct sizes 9 1/2" high x 30" width maximum. Single blade dampers to have spring end bearing regulator. Provide end brace for static pressure greater than 2.0" WG. Provide end brace for static pressure greater than 2.0".
- C. Fabricate multi-blade damper of opposed blade pattern using minimum 16 gauge steel with maximum blade sizes 6" x 48". Where width exceeds 48", provide regulator at both ends. Assemble center and edge crimped blades in 16 gauge channel frame with suitable hardware. Blades and frame to be galvanized or prime coated steel except where indicated for special application.
- D. Provide end bearings with end seals for pressure class required except in round duct 12" in diameter and smaller.

2.06 FIRE DAMPERS

- A. General: Labeled to UL 555
 - 1. 1-1/2 hour fire rating with 165°F fusible link unless otherwise indicated. Where wall or ceiling rating requires longer more than 1-1/2 hour rating, provide appropriate rated dampers. Where application requires higher temperature rating, use appropriate temperature rating.
 - 2. All fire dampers shall be rated for dynamic closure unless otherwise noted.
 - 3. Dynamic fire dampers shall be rated for minimum velocity of 2000 fpm. When duct velocity exceeds 2000 fpm, use appropriate velocity rating.
 - 4. Static rated dampers may be used only where HVAC systems are automatically shut down in the event of a fire or for transfer duct openings in walls or partitions.
- B. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- C. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
 - 1. Minimum Thickness: 0.052 inch or 0.138 inch thick as indicated, and length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- D. Mounting Orientation: Vertical or horizontal as indicated.
- E. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized steel blade connectors.
- F. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.

2.07 SMOKE DAMPERS

- A. General: Labeled to UL 555S. Combination fire and smoke dampers shall be labeled for one-and-one-half-hour rating to UL 555.
- B. Fusible Link: Replaceable, 165 deg F unless otherwise as indicated.
- C. Frame and Blades: 0.064-inch- thick, galvanized, sheet steel.
- D. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized, sheet steel; length to suit wall or floor application.
- E. Damper Motors: 115 V, single phase, 60 Hz., provide for modulating or two-position action per application.

2.08 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch- wide, curved blades set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches on center; and set into side strips suitable for mounting in ducts.

2.09 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
- B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

- E. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.
- F. Label: Label access doors at fire and smoke damper locations per NFPA 90A.

2.10 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Neoprene double-coated woven glass fiber fabric in accordance with NFPA 90A, suitable for temperatures and pressures of application, approximately 6" wide, crimped into metal edge strip.

2.11 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass-fiber insulation around a continuous inner liner.
 - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 2. Outer Jacket: Polyethylene film or Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.
 - 3. Inner Liner: Polyethylene film.
- C. Pressure Rating: 4-inch wg positive, 3/4-inch wg negative.
- D. Minimum R-value: R-5 for ducts inside building envelope. R-8 for ducts in unconditioned spaces.

2.12 ROOF HOODS

- A. Aluminum construction; 19 gauge x 1/2" galvanized mesh screen; motorized damper, 24" roof curb. Intake shall be 20" minimum above roof.
- B. Intake hoods shall be designed for intake velocity of 50% or neck. Relief hoods shall be designed for equal velocity to neck.

2.13 DIFFUSER, REGISTERS AND GRILLES

- A. General: Sizes, types and capacities as indicated. Verify ceiling and wall frame types and dimensions from architectural drawings. Factory baked enamel finish with color selected by Architect unless otherwise indicated.
- B. Diffusers: Circular, square, or rectangular air distribution outlet comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air. Opposed blade dampers.
- C. Grilles: Streamlined blades, single or double deflection as indicated.
- D. Registers: Combination grille and opposed damper assembly.

2.14 ACCESSORY HARDWARE

- A. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.15 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.
- B. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.01 DUCT FABRICATION

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
- B. Low Pressure duct
 - 1. Seams and Joints (Rectangular Ducts): Longitudinal seams shall be Pittsburgh lock, grooved seams or button punch snap lock. Transverse joints shall be drive slip. Joints 36" and larger shall be manufactured duct joining system with downset corners, or SMACNA T-25 formed on flanges with corner and cleat. Contractor option on smaller sizes
 - 2. Seams and Joints (Concealed Round Duct): Transverse joints in low velocity concealed round ducts shall be slip type secured with sheet metal screws equally spaced on 6" centers maximum with a minimum of three screws per joint. Joints shall be sealed with mastic during joining. Exposed inside edge of duct at joint shall point in direction of airflow. All duct joints exposed to weather shall be caulked weathertight.
 - 3. Seams and joints (Exposed Round Duct): Longitudinal seams shall be lock type spiral or grooved seams rolled spirally. Transverse joints shall be slip type up to 36" in diameter and shall be sealed with mastic during joining. Flanged and gasketed joints shall be used on size larger than 36" diameter.
- C. Rectangular fittings: Construct tees, bends and elbows with centerline radius of 1-1/2 times width of duct.
- D. Round Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
- E. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to low pressure standards
- F. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.
- G. Sizes shown on plans are inside clear dimensions. Ductwork utilizing duct liner shall be increased in size to accommodate the duct liner thickness.

3.02 DUCT INSTALLATION

- A. Drawings indicate general arrangement of ducts, fittings, and accessories. Minor modifications to route, size and shape of duct may be required to meet structural and other interference. Changes which could affect system performance shall be reviewed by Architect/Engineer prior to fabrication or installation of duct.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct.

- F. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.
- M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and fire-stopping sealant. Contractor shall be responsible to coordinate appropriately rated fire damper with supplier and engineer. All fire dampers shall be dynamically rated unless otherwise approved by Engineer and Authority Having Jurisdiction.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.04 PROTECTION OF DUCTWORK ON SITE

- A. Ductwork stored on site as well as installed ductwork that is left open to construction activities shall be covered. Provide protective coverings on open ends of ductwork to prevent excessive accumulation of dust and debris on interior surfaces. Protection and storage of ductwork shall be in accordance to SMACNA's 'Duct Cleanliness for New Construction'.

3.05 SEAM AND JOINT SEALING

- A. Low Pressure Ductwork: Seal per SMACNA Seal Class "C". Sealant material shall be installed per manufacturer's recommendations.

- B. Seal externally insulated ducts before insulation installation.

3.06 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

3.07 DUCT ACCESSORY INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for metal ducts.
- B. Install volume dampers at locations indicated and at all branch take-offs to air outlets and inlets.
- C. Provide fire dampers at locations indicated and where required by applicable codes. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
- D. Provide turning vanes in all mitered elbows and duct turns.
- E. Install duct access panels for access to inlet side of coils, equipment, control dampers, fire dampers, and smoke dampers.
- F. Final connections to air outlets and terminal units may be made with flexible duct. Install flexible ducts with metal collars or sleeves with draw bands. Length of flexible duct shall not exceed 36", path shall not exceed 45°.
- G. Provide flexible connections to motor driven equipment. Secure fabric to duct or fan collar with 3/16" rivets space not more than 5" on center. Provide thrust restraints so that connections are not in tension with equipment in operation.
- H. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.08 ADJUSTING

- A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for detailed procedures.
- B. Adjust duct accessories for proper settings and actions.

3.09 CLEANING

- A. After completing system installation, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.
- B. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION

SECTION 23 34 23
POWER VENTILATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. In-line centrifugal fans.

1.03 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
 - 2. Certified fan performance curves with system operating conditions indicated.
 - 3. Certified fan sound-power ratings.
 - 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 5. Material gages and finishes, including color charts.
 - 6. Dampers, including housings, linkages, and operators.
 - 7. Fan speed controllers.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For power ventilators to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.05 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. In-Line Centrifugal Fans:
 - a. Acme Engineering & Mfg. Corp.
 - b. Carnes Company HVAC.
 - c. Cook, Loren Company.
 - d. Greenheck Fan Corp.
 - e. ILG Industries, Inc./American Coolair Corp.
 - f. Penn Ventilation Companies, Inc.
 - g. York.

2.02 IN-LINE CENTRIFUGAL FANS

- A. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- B. Direct Drive Units (motors 2 HP or smaller):
 - 1. Electronically Commutated Motor
 - 2. Motor enclosures: Open type
 - 3. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan 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.
 - 4. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
 - 5. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
 - 6. Motor shall be speed controllable down to 20% of full speed (80% turndown).
 - 7. Speed shall be controlled by either a potentiometer dial mounted at the motor.
 - 8. Motor shall be a minimum of 85% efficient at all speeds.
- C. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- D. Accessories:
 - 1. Companion Flanges: For inlet and outlet duct connections.
- E. Accessories:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
 - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.03 MOTORS

- A. Comply with requirements in Division 23 Section "Basic Mechanical Materials and Methods."
- B. Enclosure Type: Guarded dripproof.

2.04 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Support suspended units from structure using threaded steel rods and vibration isolators.
- C. Install units with clearances for service and maintenance.

3.02 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Connect wiring according to Division 26.
- D. Ground equipment according to Division 26.

- E. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1. Install control and electrical power to field-mounted control devices.

3.03 FIELD QUALITY CONTROL

- A. Equipment Startup Checks:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Verify lubrication for bearings and other moving parts.
 - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 7. Disable automatic temperature-control operators.
- B. Starting Procedures:
 - 1. Energize motor and adjust fan to indicated rpm.
 - 2. Measure and record motor voltage and amperage.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- F. Replace fan and motor pulleys as required to achieve design airflow.
- G. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Lubricate bearings.

3.05 CLEANING

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power ventilators.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Review data in maintenance manuals.
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 23 72 00
DEDICATED OUTSIDE AIR UNITS (DOAU-1)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes packaged heating and cooling dedicated outside air units (DOAU's) with integral energy recovery.

1.03 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For dedicated outdoor air units
- E. to include in emergency, operation, and maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of dedicated outdoor air units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- D. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- E. Comply with NEC for electric heat section.

1.05 COORDINATION

- A. Coordinate size, location, and installation of dedicated outdoor air unit manufacturer's roof curbs and equipment supports with roof installer.
- B. Coordinate structural support with structural engineer.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of dedicated outdoor air unit that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than twenty-five years from date of Substantial Completion.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
 - 1. Aeon
 - 2. Carrier Corp.
 - 3. Daikin Applied
 - 4. Trane
 - 5. YORK International Corporation.

2.02 DEDICATED OUTDOOR AIR UNITS

- A. Furnish as shown on plans, heating and cooling unit. Unit performance and electrical characteristics shall be per the schedule.
- B. Configuration: Fabricate as detailed on prints and drawings:
 - 1. Return plenum / economizer section
 - 2. Filter section
 - 3. Cooling coil section
 - 4. Supply fan section
 - 5. Electric heating section.
 - 6. Condensing unit section.
 - 7. Energy Recovery Wheel section
 - 8. Hot Gas Reheat section
- C. The complete unit shall be cETLus listed.
- D. Each unit shall be specifically designed for outdoor on grade application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.
- E. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.
- F. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.
- G. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.

2.03 CASING, AND FRAME

- A. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 2" thick with an R-value of 12.0. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g. Unit cabinet shall have insulated floor, walls, and roof.
- B. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. Finished panel surfaces to withstand a minimum 750-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.

- C. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.
- D. The unit base shall overhang the curb for positive water runoff and shall seat on the curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

2.04 ECONOMIZER SECTION

- A. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 4 cfm / square foot of damper area at 1" differential pressure per ASHRAE 90.1 Energy Standard. A powered exhaust fan shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.

2.05 HEATING SECTION

- A. The unit shall include an electric preheating section. The electric heater design shall be installed upstream of the energy recovery wheel.
- B. Electric heating shall meet the requirements of the National Electric Code and UL.
- C. Each module shall have SCR control with complete modulation over entire range of heating output.
- D. Heating elements shall be open coil, 80% nickel, 20% chromium, Grade A resistance wire.
- E. Heating coil terminal boxes shall be NEMA 1 rated with hinged, latching cover.
- F. The factory-installed DDC unit control system shall control the heating module.

2.06 ENERGY RECOVERY

- A. The unit shall be provided with an AHRI certified rotary wheel air-to-air heat exchanger in a cassette frame complete with seals, drive motor and drive belt. The energy recovery wheel shall be an integral part of the unit with unitary construction and does not require field assembly. Bolt-on energy recovery units that require field assembly and section to section gasketing and sealing are not acceptable.
- B. The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation Equipment.
- C. The unit shall be designed with a track so the entire energy recovery wheel cassette can slide out from the unit to facilitate cleaning.
- D. The unit shall have 2" Merv 13 filters for the outdoor air before the wheel to help keep the wheel clean and reduce maintenance. Filter access shall be by a hinged access door with ¼ turn latches.

- E. The matrix design shall have channels to reduce cross contamination between the outdoor air and the exhaust air. The layers shall be effectively captured in aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belt(s) of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.
- F. The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.
- G. Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning.
- H. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel. Wheels shall be connected to the shaft by means of taper lock hubs.
- I. The exhaust air fan shall be a direct drive SWSI plenum fan. The exhaust fan shall be sized for the airflow requirements per the construction schedule. The unit controller shall control the exhaust fan to maintain building pressure. The exhaust fan motor shall be an ECM motor. The unit shall have single point electrical power connection and shall be ETL listed.
- J. The control of the energy recovery wheel shall be an integral part of the unit's DDC controller. The DDC controller shall have visibility of the outdoor air temperature, leaving wheel temperature, return air temperature, and exhaust air temperature. These temperatures shall be displayed at the units DDC controller LCD display. All of these temperatures shall be made available through the BACnet interface.
- K. The unit with the energy recovery wheel shall incorporate the economizer operation. The energy recovery wheel shall have a bypass damper. When the unit is in the economizer mode of operation the energy recovery wheel shall stop and the bypass dampers shall be opened. The outdoor air shall be drawn through the bypass dampers to reduce the pressure drop of the outdoor airstream.
- L. The unit DDC controller shall provide frost control for the energy recovery wheel. When a frost condition is encountered the unit controller shall stop the wheel. When in the frost control mode the wheel shall be jogged periodically and not be allowed to stay in the stationary position.

2.07 EXHAUST FAN

- A. Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft
- B. The fan motor shall be a totally enclosed EC motor that is speed controlled by the unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
- C. Fan assembly shall be a slide out assembly for servicing and maintenance.
- D. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.

2.08 FILTERS

- A. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" prefilter and a 6" final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the unit with 2" construction filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

2.09 COOLING COIL

- A. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.
- B. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.
- C. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.
- D. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.
- E. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

2.10 HOT GAS REHEAT

- A. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser.
- B. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.
- C. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.
- D. Each coil shall be factory leak tested with high-pressure air under water.

2.11 SUPPLY FAN

- A. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft.
- B. Fan assembly shall be a slide out assembly for servicing and maintenance
- C. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.
- D. The fan motor shall be a direct drive induction motor that is speed controlled by the integral unit VFD / controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

- E. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

2.12 CONSTANT AIR VOLUME CONTROL

- A. The unit controller shall control the motors on the supply and exhaust fans to maintain constant airflow. The unit controller shall provide discharge air temperature control with the compressor modulation.

2.13 CONDENSING SECTION

- A. Outdoor coils shall have seamless copper tubes, mechanically bonded into aluminum plate-type fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.
- B. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.
- C. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 0~125°F. Mechanical cooling shall be provided to 25° F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.
- D. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed.
- E. The unit shall have digital scroll type compressors. Compressors shall have direct-driven, hermetic compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provide with the scroll compressors. Crankcase heaters shall be included. Compressor shall be able to fully modulate from 20 percent to 100 percent.
- F. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.
- G. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.
- H. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

2.14 ELECTRICAL

- A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

- B. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

2.15 CONTROLS

- A. All BAS components shall be compatible with BACnet protocol. Coordinate interface with Temperature Control Contractor.
- B. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.
- C. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand-alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.
- D. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.
- E. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip
- F. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.
- G. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:
 - 1. Return air temperature.
 - 2. Discharge air temperature.
 - 3. Outdoor air temperature.
 - 4. Space air temperature.
 - 5. Outdoor enthalpy, high/low.
 - 6. Compressor suction temperature and pressure
 - 7. Compressor head pressure and temperature
 - 8. Expansion valve position
 - 9. Condenser fan speed
 - 10. Inverter compressor speed
 - 11. Dirty filter indication.
 - 12. Airflow verification.
 - 13. Cooling status.
 - 14. Control temperature (Changeover).
 - 15. VAV box output status.
 - 16. Cooling status/capacity.

17. Unit status.
 18. All time schedules.
 19. Active alarms with time and date.
 20. Previous alarms with time and date.
 21. Optimal start
 22. Supply fan and exhaust fan speed.
 23. System operating hours.
 24. Fan
 25. Exhaust fan
 26. Cooling
 27. Individual compressor
 28. Heating
 29. Economizer
 30. Tenant override
- H. The user interaction with the keypad shall provide the following:
1. Controls mode
 2. Off manual
 3. Auto
 4. Heat/Cool
 5. Cool only
 6. Heat only
 7. Fan only
 8. Occupancy mode
 9. Auto
 10. Occupied
 11. Unoccupied
 12. Tenant override
 13. Unit operation changeover control
 14. Return air temperature.
 15. Space temperature
 16. Network signal
 17. Cooling and heating change-over temperature with deadband
 18. Cooling discharge air temperature (DAT)
 19. Supply reset options.
 20. Return air temperature.
 21. Outdoor air temperature
 22. Space temperature
 23. Airflow (VAV)
 24. Network signal
 25. External (0-10 vdc)
 26. External (0-20 mA)
 27. Temperature alarm limits
 28. High supply air temperature
 29. Low supply air temperature
 30. High return air temperature
 31. Lockout control for compressors.
 32. Compressor interstage timers
 33. Night setback and setup space temperature.
 34. Building static pressure.
 35. Economizer changeover
 36. Enthalpy
 37. Drybulb temperature
 38. Currently time and date
 39. Tenant override time
 40. Occupied/unoccupied time schedule
 41. One event schedule

42. Holiday dates and duration
 43. Adjustable set points
 44. Service mode
 45. Timers normal (all time delays normal)
 46. Timers fast (all time delays 20 sec)
- I. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:
1. Zone sensor with tenant override switch
 2. Zone sensor with tenant override switch plus heating and cooling set point adjustment. (Space Comfort Control systems only)
- J. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
1. Airflow
 2. Outside air temperature
 3. Space temperature
 4. Return air temperature.
 5. External signal of 1-5 vdc
 6. External signal of 0-20 mA
 7. Network signal

2.16 ROOF CURB

- A. A prefabricated, vibration isolation (1" deflection), heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 20" high and include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb. Curb shall also include two internal channels to support two layers of drywall for sound attenuation.

2.17 MOTORS

- A. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances.
- B. Curb Support: Install unit on equipment pad, level and secure, according to ARI Guideline B. Secure units to curb support with anchor bolts.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
1. Install ducts to termination in roof curb.
 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 3. Connect supply ducts to rooftop unit with flexible duct connectors.
 4. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 1-1/2-inch- thick, acoustic duct liner.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field quality-control tests and inspections and prepare test reports:
 - 1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove malfunctioning units, replace with new units, and retest as specified above.

3.04 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Inspect for visible damage.
 - 2. Verify that clearances have been provided for servicing.
 - 3. Verify that controls are connected and operable.
 - 4. Verify that filters are installed.
 - 5. Clean outside coil and inspect for construction debris.
 - 6. Clean electric heating coil and inspect for construction debris.
 - 7. Adjust vibration isolators.
 - 8. Inspect operation of barometric dampers.
 - 9. Lubricate bearings on fan.
 - 10. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 11. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system in summer only.
 - b. Complete startup sheets and attach copy with Contractor's startup report.
 - 12. Calibrate thermostats.
 - 13. Adjust and inspect high-temperature limits.
 - 14. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.
 - 15. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

3.05 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop air conditioners.

END OF SECTION

SECTION 23 81 26
SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes split-system air-conditioning and condensing units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed mounting.

1.03 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.
- F. See "Submittal Schedule" located at the end of Section 23 – "General Requirements for Mechanical Systems".

1.04 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. Compressors: Five years from date of Substantial Completion.
 - b. All other components: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Air Conditioning; Div. of Carrier Corporation.
 - 2. Daikin Applied
 - 3. Lennox Industries Inc.
 - 4. LG Corporation
 - 5. Mitsubishi
 - 6. Sanyo
 - 7. York International Corp.

2.02 EVAPORATOR-FAN COMPONENTS

- A. Wall Mounted Cabinet: Plastic with removable panels on front and ends in manufacturer's standard color, and discharge drain pans with drain connection
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
- D. Washable Filters: 1 inch thick, in metal frames.
- E. Wiring Terminations: Connect motor to chassis wiring with plug connection.

2.03 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Steel, finished with baked enamel in manufacturer's standard color, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Compressor Type: Scroll.
 - 2. Inverter compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - 3. Refrigerant Charge: R-410A
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.
- E. Fan: Aluminum-propeller type, directly connected to motor.
- F. Motor: Permanently lubricated, with integral thermal-overload protection.
- G. Low Ambient Kit: Permits cooling operation down to -20° F.

2.04 ACCESSORIES

- A. Thermostat: Wired functioning to remotely control compressor and evaporator fan, with the following features:
 - 1. Compressor time delay.
 - 2. 24-hour time control of system stop and start.
 - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 - 4. Fan-speed selection, including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounting, compressor-condenser components on 4-inch-thick, reinforced concrete base; 4 inches larger on each side than unit.
- D. Install refrigerant piping per manufacturer's recommendations. Install piping to allow access to unit.

3.02 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to unit to allow service and maintenance.

3.03 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service. Complete installation and startup checks according to manufacturer's written instructions.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 1 Sections.

END OF SECTION

SECTION 23 81 27
VARIABLE REFRIGERANT FLOW HVAC SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The variable capacity, air conditioning system shall be a variable refrigerant volume split system as specified. The system shall consist of multiple indoor evaporator fan coil units, a two pipe refrigeration distribution system using PID control, and air-cooled heat recovery VRF units. The heat recovery units shall be a direct expansion (DX), air-cooled, multi-zone air-conditioning system with variable speed driven compressors using R-410A refrigerant. The heat recovery units connect to multiple indoor evaporator fan coil units. All zones shall be capable of operating separately with individual temperature control.
- B. The air-cooled heat recovery VRF units shall be interconnected to multiple indoor evaporator fan coil units.
- C. Each fan coil unit shall be able to maintain local setpoint temperature independently via local thermostat controllers.
- D. The system shall accommodate heat recovery; simultaneous heating and cooling by different indoor units served by the same air-cooled heat recovery VRF unit. Branch controllers or other manufacturer recommended means to provide heat recovery shall be provided.
- E. Control wiring shall be per the manufacturer's recommendation.
- F. Refrigerant piping sizing and routing shall be per the manufacturer's recommendation.

1.03 SUBMITTALS

- A. Product Data/Shop Drawings: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Provide shop drawings for the following items:
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Heat Recovery Units (include capacities, electrical connection data, etc.)
 - 4. Indoor VRF Terminal Units (include rated capacities, airflow, static pressure, installation configurations, required clearance, electrical connection data, etc.)
 - 5. All required accessory equipment
 - 6. System schematics showing refrigerant piping system
 - 7. System schematics showing control wiring requirements
- C. Operation and Maintenance Data: For all HVAC system equipment to include in emergency, operation, and maintenance manuals.
- D. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. The units shall be listed by Electrical Laboratories (ETL) and bear the cETL label.
- C. All wiring shall be in accordance with the National Electric Code (NEC).

- D. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
- E. The air-cooled heat recovery VRF units will be factory charged with R-410A.
- F. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-Up."
- G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

1.05 COORDINATION

- A. Coordinate sizes and locations of equipment with actual equipment provided, building structure, ceilings, architectural features, and other mechanical and electrical equipment.
- B. Ceiling space may be limited. Acceptable alternate manufacturers must coordinate with space available.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace any components of the HVAC system that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Ten years from date of Substantial Completion.
 - b. For Parts: Ten years from date of Substantial Completion.
 - c. For Labor: One year from date of Substantial Completion.
- B. Installation Requirements
 - 1. The system must be installed by a factory trained contractor/dealer. The bidders shall be required to submit training certification proof with bid documents. The mechanical contractor's installation price shall be based on the systems installation requirements. The mechanical contractor bids with complete knowledge of the HVAC system requirements. Untrained contractors who wish to bid this project may contact local manufacturer's representative to coordinate. Training must be completed prior to installation.

1.07 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set for each indoor fan coil unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis of Design: Trane
 - 2. Alternate Manufacturers:
 - a. Daikin
 - b. Samsung
 - c. Mitsubishi
- B. Alternate Manufacturer: Alternate equipment supplier shall provide a complete submittal indicating any changes in electrical requirements, refrigerant pipe design and routing, or control systems wiring or requirements different than the base specified system.
- C. All manufacturers listed above are still responsible for complying with the qualifications list in these specifications, on the drawings, and in the schedules.

- D. Manufacturer must have a minimum of 10 years' experience with VRF systems in the U.S. market.

2.02 ULTRA LOW AMBIENT AIR-COOLED UNITS

A. General:

1. The VRF heat pump unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, condenser heat exchanger, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator. High/low pressure gas line, liquid and suction lines must be individually insulated between the outdoor and indoor units.
2. Each VRF heat pump system shall be able to support the connection of multiple indoor units as indicated on the plans.
3. The system will automatically restart operation after a power failure without loss of system control settings.
4. The following safety devices shall be included on the condensing unit; high pressure switch, control circuit fuses, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor, over current protection for the inverter and anti-recycling timers.
5. To ensure the liquid refrigerant does not flash when supplying the fan coil units, the circuit shall be provided with a sub-cooling feature. Alternate branch devices with no sub cooling risk bubbles in liquid supplied to LEV and are not allowed.
6. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
7. The outdoor unit shall contain a heat interchanger circuit for sub-cooling liquid prior to entering the outdoor coil during the heating mode.
8. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.

B. Unit Cabinet:

1. The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

C. Fan:

1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of operation up to a maximum of 0.24 in. WG external static.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.

D. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

E. Basepan Heater:

1. Each outdoor unit module shall be equipped with a basepan heater. Basepan heater shall activate only when compressor is operating in heating mode at an outdoor ambient temperature of 39F or below. If an alternate manufacturer is selected, any additional material, cost, and labor to meet basepan heater condition and performance shall be incurred by the contractor.

F. Low Ambient Heating and Cooling

1. The outdoor unit shall have rated performance of heating operation at -13F ambient temperatures and cooling mode down to 23F ambient temperatures, without additional low ambient controls. The unit shall maintain 100% heat output at 0F without a supplemental heat source or a second compressor to boost low ambient heating

- performance. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
2. The outdoor unit shall be capable of operating in cooling mode down to -10F with manufacturer supplied low ambient kit.
- G. Compressor:
1. Provide hermetically sealed inverter scroll compressors, variable speed controlled to follow the variations in total cooling and heating load.
 2. Compressors shall be spring mounted.
 3. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, internal thermal overload protector, and oil separators as required.
- H. Control: The air-cooled unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system. Controls shall be installed by the mechanical contractor.

2.03 BRANCH CIRCUIT CONTROLLERS

- A. General
1. The BC (Branch Circuit) Controllers shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices with no subcooling risk bubbles in liquid supplied to LEV and are not allowed.
 2. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The BC Controller shall be suitable for use in plenums in accordance with UL1995 ed 4.
- B. BC Unit Cabinet:
1. The casing shall be fabricated of galvanized steel.
- C. Refrigerant Branches
1. All BC Controller refrigerant pipe connections shall be brazed.
- D. Refrigerant valves:
1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
 2. Each branch shall have multiple two-position valves to control refrigerant flow.
 3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
 4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

2.04 VRF INDOOR UNITS

- A. General: Indoor units shall operate with R-410A refrigerant and shall be equipped with an electronic expansion valve and computerized PID controls.
- B. General
1. DX cooling using R-410A refrigerant
 2. Factory assembled and tested with factory wiring, piping, expansion valve, control circuit board, and fan motor.
 3. Direct drive fan motor
 4. Condensate pan and factory condensate pump where indicated on plans.
- C. Filter: Manufacturer's standard washable filter in ceiling cartridge units. 2" pleated MERV 8 disposable filters with ducted units.
- D. Coil: Copper direct expansion refrigerant coil.
- E. Control: Manufacturer's standard microprocessor based controls.

- F. Provide branch controllers for VRF systems requiring heat recover; simultaneous heating and cooling for indoor units served by the same outdoor unit.
- G. Accessories:
 - 1. Fresh air intake and supply air duct connections where indicated on plans.
 - 2. Remote wall mounted temperature sensor or thermostat where indicated on plans.
 - 3. Condensate pumps where required and not integral, factory-provided.

2.05 Controls

- A. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC or tablet connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface. Web browser shall not require Java for standard operator functions.
 - 1. System controls and control components shall be installed in accordance with the manufacturer’s written installation instructions.
 - 2. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
 - 3. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.
 - 4. System shall be capable of email generation for remote alarm annunciation.
- B. Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in controls system configuration and operation.
 - Centralized Controller
 - 1. The Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple outdoor units The Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (heat recovery only), dry, setback (heat recovery only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the controller provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.
 - 2. Controller shall have integral BACnet IP capabilities that can be unlocked in the future by purchasing a license.

Centralized Controller			
Item	Description	Operation	Display
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. Auto mode is available for Heat Recovery units only.	Each Block, Group or Collective	Each Group

Centralized Controller			
Item	Description	Operation	Display
Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *1. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can be scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU

Centralized Controller			
Item	Description	Operation	Display
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC
External Input / Output	By using accessory cables, you can set and monitor the following. Input By level: "Batch start/stop", "Batch emergency stop" By pulse: "batch start/stop", "Enable/disable remote controller" Output: "start/stop", "error/Normal" *5. Requires the external I/O cables.	*5 Collective	*5 Collective

- C. Remote Controllers
 - 1. The Backlit Remote Controller shall have a digital display and allow the user to change on/off, mode (cool, heat, auto, dry, setback, and fan), temperature setting, and fan speed setting and airflow direction.
 - 2. The room temperature shall be sensed at either the remote controller or the Indoor Unit dependent on the indoor unit dipswitch setting.
 - 3. The remote controller shall display a four-digit error code in the event of system abnormality/error.
- D. See Specification Sections 230900 for additional temperature control system requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, outdoor equipment per support details on plans or manufacturer's recommendations.
- D. Install and connect refrigerant piping per manufacturer's recommendations.
- E. Mount the outdoor unit a minimum of 12" above the average snowfall line.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for access, service, and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to indoor VRF units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Duct Accessories."

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist. Follow the manufacturers required pressure test and triple evacuation procedure prior to charging the system.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.04 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service for the entire VRF HVAC system.
- B. Factory-authorized service representative shall provide full training of the VRF system to the owner/operator.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

DIVISION 26 - ELECTRICAL

SECTION 26 01 00
GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes general electrical requirements and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.

1.03 WARRANTIES

- A. All materials, workmanship and equipment shall be warranted against defects or against injury from proper and usual wear for a period of one year after the date of substantial completion. Certain equipment shall be warranted beginning at the time of final acceptance or for longer periods of time as specified in those sections of the Project Manual. Any item which becomes defective within the warranty period shall be repaired or replaced, at no additional cost to the Owner.
- B. All manufactures warranties shall run to the benefit of the Owner. No manufacturer's warranties shall be voided or impaired.
- C. Warranty shall include repair of faulty workmanship.

1.04 ALTERNATES

- A. Alternates, if required, shall be as described in the "Alternates" section of this specification, as described on the proposal form or as indicated on the drawings.

1.05 INTERPRETATION OF DOCUMENTS

- A. Any questions regarding the meaning of any portion of the contract documents shall be submitted to the Architect/Engineer for interpretation. Addenda or supplemental information will publish definitive interpretations or clarification. Verbal interpretation not issued by addendum or supplemental information shall not be considered part of the contract documents.
- B. The Architect/Engineer shall be the sole judge of interpretations of discrepancies within the contract documents.
- C. If ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of proposed methods or materials.

1.06 DEFINITIONS ABBREVIATIONS

- A. The following shall apply throughout the contract documents
 - 1. Code All applicable national state and local codes
 - 2. Furnish Supply and deliver to site ready for installation
 - 3. Indicated Noted, scheduled or specified
 - 4. Provide Furnish, install, and connect complete and ready for final use by owner
 - 5. ADA Americans with Disabilities Act
 - 6. ANSI American National Standards Institute
 - 7. ASTM American Society for Testing and Materials
 - 8. FM Factory Mutual System

9. IRI	HSB Industrial Risk Insurers
10. NEC	National Electric Code (NFPA 70)
11. NEMA	National Electrical Manufacturers Association
12. NFPA	National Fire Protection Association
13. UL	Underwriters Laboratories Inc.

1.07 CODES AND STANDARDS

- A. All work shall be performed by competent craftsmen skilled in the trade involved and shall be done in a manner consistent with normal industry standards.
- B. All work shall conform to the currently adopted edition of the National Electric Code (NEC), Local Building Code, and all other applicable state and local codes or standards.
- C. Where there is a conflict between the code and the contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified shall not be substituted.

1.08 PERMITS

- A. Contractor shall become familiar and comply with all requirements regarding permits, fees, licenses, etc. All permits, licenses, inspections and arrangements required for the work shall be obtained by Contractor's effort and expense. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor. Capital facilities fees will be paid by Owner.

1.09 SUBMITTALS

- A. Division 1 section "Submittals" shall be adhered to if more stringent than this section.
- B. Shop drawings shall be submitted to Architect/Engineer for review when required by other sections of this specification and **for all equipment scheduled or specified on drawings.**
 - 1. A letter of transmittal shall accompany each submittal. Submittals shall be numbered consecutively and list products covered.
 - 2. Unless otherwise noted, submit a minimum of six (6) copies of shop drawing and product data for review.
- C. Shop Drawings
 - 1. Shop drawings include fabrication and installation drawings, diagrams, schedules of other data specifically prepared for the project. Include dimensions and notations showing compliance with specified standards.
 - 2. Drawing sheet size shall be at least 8 ½" x 11" and no longer than 30" x 42". For sheets larger than 11" x 17", submit one sheet of reproducible media and one blue-line or photocopy print. Architect/Engineer action will be returned on reproducible media.
- D. Product Data
 - 1. Product data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, rough-in diagrams, wiring diagrams and performance curves.
 - 2. Each copy shall clearly indicate conformance with specified capacities, characteristics, dimensions and details. Mark all equipment with same item number as used on drawings. Mark each copy to clearly indicate applicable choices and options.
- E. Architect/Engineer will review or take appropriate action for submittals. Review is only to determine general conformance with design shown in contract documents.
- F. Architect/Engineer review of submittals shall not relieve contractor of responsibility for deviation from requirements of the contract documents or from errors or omissions within submittals.
- G. No portion of the work requiring submittals shall be commenced until the Architect/Engineer has reviewed the submittal.
- H. Electronic Floor Plan Drawings in AutoCAD 2002 format may be requested for use in preparation of shop drawings. Morrissey Engineering reserves the right to reject requests for electronic drawings. Electronic files shall be prepaid at \$50/sheet. Submit written request to

Morrissey Engineering or email request to info@morrisseyengineering.com. Indicate the project name, and floor plan sheets requested. The use of these drawings is intended solely for preparation of drawings required by this specification. Copyright law prohibits any other use. The user of the electronic files assumes full responsibility for the accuracy and scale of the drawings.

- I. See "Submittal Schedule" at the end of Section 26 01 00 – General Electrical Requirements.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Assemble three (3) complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
1. Operation Data:
 - a. Emergency instructions and procedures.
 - b. System, subsystem, and equipment descriptions, including operating standards.
 - c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
 - d. Description of controls and sequence of operations.
 - e. Piping and wiring diagrams.
 2. Maintenance Data:
 - a. Manufacturer's information, including list of spare parts.
 - b. Name, address, and telephone number of installer or supplier.
 - c. Maintenance procedures.
 - d. Maintenance and service schedules for preventive and routine maintenance.
 - e. Maintenance record forms.
 - f. Sources of spare parts and maintenance materials.
 - g. Copies of maintenance service agreements.
 - h. Copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.11 PROJECT RECORD DOCUMENTS

- A. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All materials and equipment used in the construction of the project shall be new unused and undamaged unless otherwise specified. Materials and equipment shall be of latest design standards of manufacturer specified.
- B. Materials and equipment are limited by the requirements of the contract documents. Material and equipment shall be provided in accordance with the following:
 - 1. Basis of Design Products: Basis of Design Products are those products around which the project was designed in terms of capacity, performance, physical size and quality. Basis of Design Products shall be provided unless substitutions are made in accordance with this specification.
 - 2. Substitutions: Substitutions are product of manufacturers other than listed as Basis of Design. Substitutions shall meet each of the following requirements and shall be subject to prior approval. Submissions requesting prior approval shall be received by the engineer no less than ten (10) days prior to project bid date.
 - a. The product shall be manufactured by one of the acceptable manufacturers listed in the contract documents.
 - b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance and characteristics.
 - c. The contractor providing the substitution shall bear the total cost of all changes due to substitutions. These may include but are not limited to redesign costs and increased work by other contractors or the Owner.
 - d. The Architect/Engineer shall be the sole judge of the suitability of the substitution items.
- C. Verify installation details and requirements for materials and equipment furnished by others and installed under this contract.

PART 3 - EXECUTION

3.01 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Provide 4 hours training in up to two separate sessions.
 - 1. Provide instructors experienced in operation and maintenance procedures.
 - 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 - 3. Schedule training with Owner and Architect/Engineer with at least seven days' advance notice.
- B. Upon completion of the project and before final payment is made, the Contractor shall furnish the Owner with videos containing instructions for the operation and maintenance of the following equipment or systems:
- C. Videos shall meet the following criteria:
 - 1. DVD'S in .wmv, .mpeg, or other format as directed by the Owner. Each DVD shall be delivered complete with an individual storage case. Both the DVD and the storage case shall be clearly labeled with the title and date of production and the names, addresses and phone numbers of the Contractor and all people responsible for the production of the tapes.
 - 2. Videos shall be clearly titled at the beginning of the DVD and on the DVD itself. Titles shall include a list of the equipment covered within the DVD. The list shall be in order of presentation.
 - 3. The presentation shall be rehearsed.
 - 4. The video shall contain professional quality audio and video with adequate lighting of subject.
 - 5. The operation and maintenance instructions for each item of equipment shall be preceded by a title.

6. The video shall contain instructions for operation and maintenance under both normal and emergency conditions.
 7. The video may incorporate any manufacturer video pertaining to the care, operation and/or maintenance of the item of equipment being presented.
- D. The production of videos shall not interfere with the work of other trades or with the work of the Owner's personnel. Coordination with other trades and with the Owner shall be the responsibility of the Contractor.
 - E. Instructional videos may be produced in conjunction with the operation instructions required above.

3.02 STARTING AND ADJUSTING

- A. Start and test all equipment and operating components to confirm proper operation. Test and adjust all systems to achieve designed capacity and performance.
- B. Provide three (3) copies of all test report to the Architect/Engineer for review prior to date of substantial completion.
- C. All equipment and systems discrepancies shall be corrected prior to final acceptance.

3.03 TEMPORARY POWER AND LIGHTING

- A. Electric Power Service: Provide temporary electric power from local utility with metering and with payment of use charges.
- B. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and construction equipment.
- C. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.

ELECTRICAL SUBMITTAL SCHEDULE

Refer to individual specification sections for additional requirements and detail on each submittal.

Section	Section Name	Product Data	Shop Dwgs	Test Reports / Quality Control	Warranty	Extra Materials	O&M Data	Record Docs	Demonstration / Training
260100	General Electrical Requirements	√	√						
260500	Basic Electrical Materials and Meth	√	√						
260536	Cable Trays	√	√						
260600	Grounding and Bonding	√							
262200	Dry Type Transformers	√			√		√		
262413	Switchboards	√	√		√		√		
262416	Panelboards	√	√		√		√		
262726	Wiring Devices	√	√				√		
262816	Disconnect Switches and Circuit Br	√					√		
264313	Surge Protective Devices (SPD's)	√			√		√		
265100	Lighting	√	√		√		√		
265200	Lighting Control	√	√				√		
268100	Fire Alarm	√	√		√		√		
271500	Communications Cabling Systems	√	√		√		√		
274134	Audio Visual Systems	√	√		√		√		
281300	Access Control	√	√		√		√		
282300	Video Surveillance	√	√		√		√		

END OF SECTION

**SECTION 26 05 00
BASIC ELECTRICAL MATERIALS AND METHODS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following basic electrical materials and methods and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.
 - 1. Conduits.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Outlet boxes.
 - 5. Electrical identification.
 - 6. Cutting and patching for electrical construction.
 - 7. Fire Stopping.
 - 8. Touchup painting.

1.03 MATERIAL QUALITY ASSURANCE

- A. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.04 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing of electrical materials and equipment with other trades.
- C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- E. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.
- F. Motors, equipment, controls, etc. shall be furnished, mounted, and connected according to the following schedule unless otherwise noted (E =Electrical Contractor, M =Mechanical Contractor):
- G.

Item	Furnished By	Set in place or mounted by	Power wiring and connection by	Control Wiring and connection by
1) Equipment Motors	M	M	E	M
2) Magnetic Motor Starters:				
a) Automatically controlled, with or without HOA switches.	E	E	E	M
b) Automatically controlled, with or without HOA switches and	M	M	E	M

OPPD Training Building

	furnished as part of factory-wired mechanical equipment				
	c) Manually controlled	E	E	E	---
	d) Manually controlled and furnished as part of factory-wired mechanical equipment	M	M	E	---
3)	Variable Frequency Drives	[M][E]	[M][E]	E	M
4)	Disconnect switches, thermal overload switches, manual operating switches				
	a) Furnished as part of factory wired mechanical equipment	M	M	E	--
	b) Loose mounted	E	E	E	--
5)	Transformers				
	a) Serving 120 Volt and higher loads	E	E	E	--
	b) Serving 24 Volt control power	M(1)	M	E	M
6)	Contactors	E	E	E	E
7)	Push-button stations, pilot lights	E	E	E	E
8)	Multi-speed switches				
	a) Furnished with equipment	M	E	E	M
	b) Loose mounted	E	E	E	M
9)	Line voltage thermostats and time clocks.	E[M]	E	E	E
10)	Low voltage controls and thermostats	M	M	M	M (2)
11)	Motorized valves, and float controls for tanks and sumps	M	M	E	M
12)	Temperature control panels	M	M	E	M
13)	Motorized control valves, damper motors, solenoid valves, etc.				
	a) Line Voltage	M	M	E	M
	b) Low Voltage	M	M	M	M
14)	Factory pre-wired control/power panels including remote sensing devices	M	M	E	M(3)
15)	Heat tape	E	E	E	E
16)	Electric wall and unit heaters	E[M]	E	E	E[M]
17)	Fire protection controls	M	M	E	E
18)	Fire Smoke Dampers				
	a) At air handling unit (24 Volt)	M	M	M	M
	b) In space (120 Volt)	M	M	E	E(4)
19)	Fire and smoke detectors including relays for fan shutdown	E	E	E	E(5)

H. Notes:

1. When control power is not available, mechanical contractor shall provide control transformers as required to power all valves, dampers, etc.
2. Conduit rough-in for thermostats by electrical contractor.
3. Fan coil units, remote condensing units and heat pumps control wiring including wiring of remote sensors by mechanical. Control circuit feeders by mechanical unless shown otherwise.
4. Smoke dampers will be specified as 115 volt (verify) with wiring by Electrical Contractor and control from the fire alarm panel. Smoke detectors furnished by electrical contractor are required to make dampers operate.
5. Wiring from alarm contacts to alarm system by Electrical; control function wiring by Mechanical.

6. Engine supplier provided.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Each contractor shall make provisions for delivery and safe storage of materials. Materials shall be delivered in a timely manner to expedite the work.
- B. Protect stored piping, supplies and equipment from cold, moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

PART 2 - PRODUCTS

2.01 CONDUITS

- A. Electrical metallic tubing (EMT): ANSI C80.3 and UL 797, zinc-coated steel with steel or die cast, set-screw or compression type fittings.
 1. Color coded exterior for system identification:
 - a. Fire Alarm – Red.
 - b. Power – Silver.
 - c. Security – Orange.
 - d. Communications – Blue.
- B. Flexible metal conduit (FMC): UL 1, Zinc-coated steel.
- C. Intermediate metal conduit (IMC): ANSI C80.6 and UL 1242, zinc-coated steel, with threaded fittings.
- D. Liquidtight flexible metal conduit (LFMC): Flexible steel conduit with PVC jacket and complying with UL 360.
- E. Rigid nonmetallic conduit (RNC): NEMA TC 2 and UL 651, EPC-40 (schedule 40) PVC, with NEMA TC3 fittings.
- F. Installation location shall determine conduit type permitted.
 1. For indoor installations:
 - a. Exposed: EMT.
 - b. Concealed: EMT.
 - c. Connection to vibrating equipment: FMC; except in wet or damp locations, use LFMC.
 - d. Boxes and enclosures: NEMA 250, Type 1, unless otherwise indicated.
 2. Use the following conduits for outdoor installations:
 - a. Exposed: IMC.
 - b. Underground: RNC.
 - c. Boxes and enclosures: NEMA 250, Type 3R or Type 4.
 3. At motors:
 - a. Connect motors and equipment subject to vibration, noise transmission, or movement with FMC of 72-inch maximum length.
 - b. Damp locations: LFMC.
- G. Conduit fittings: Specifically designed for the conduit type with which used. Comply with NEMA FB 1 and UL 514B.

2.02 CONDUCTORS

- A. Conductors and conductor insulation: Comply with NEMA WC 70.
- B. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
- C. Conductors, larger than No. 10 AWG: Stranded copper.
- D. Insulation: thermoplastic, rated at 75 deg C minimum.
 1. Feeders: Type THHN/THWN insulated conductors in conduit.
 2. Underground Feeders and Branch Circuits: Type THWN in conduit.
 3. Branch Circuits: Type THHN/THWN insulated conductors in conduit.
 4. Circuits over 100 feet from GFCI devices and all circuits from line isolation panels: Low-leakage XHHW in conduit.

- E. Wire connectors and splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.
- F. Unless otherwise indicated on the drawings, circuits are to be 20 amps with #12 AWG wire.
- G. **A green ground shall be installed with all branch and feeder circuits.** Unless otherwise indicated on the drawings, ground wires are to be #12 AWG.
- H. Provide a dedicated neutral conductor for each 120V and 277V branch circuit unless otherwise indicated on drawings.

2.03 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal items for use outdoors or in damp locations: Hot-dip galvanized steel.
- C. Slotted-steel channel supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.
- D. Conduit and cable supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
 - 1. In general, use the following support methods for outdoor **conduit** installations:
 - a. Individual exposed conduit: 1" and smaller; 2 hole straps.
 - b. Individual exposed conduit: 1-1/4" and larger; Minerallac.
 - c. Paired individual exposed conduit: Minerallac.
 - d. Rack exposed conduit: Unistrut with strut straps.
 - e. Concealed in concrete pour: Approved iron tie wire.
 - 2. In general, use the following support methods for indoor **conduit** installations:
 - a. Individual exposed conduit: 1" and smaller; 2 hole straps.
 - b. Individual exposed conduit: 1-1/4" and larger; Minerallac.
 - c. Individual lighting and power above lay-in ceilings: Dedicated ceiling wire with Cad-dy clips.
 - d. Racked exposed or concealed conduit: Unistrut with strut **straps**.
- E. Pipe sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Expansion anchors: Carbon-steel wedge or sleeve type.
- G. Toggle bolts: All-steel springhead type.
- H. Powder-driven threaded studs: Heat-treated steel.

2.04 BOXES

- A. Hollow wall and ceiling spaces: Outlet boxes for concealed applications shall be 4" square with single or multiple gang plaster ring in round or square configuration to match the device or fixture being installed. Depth of ring shall be selected so that face of ring is recessed back from face of finished surface by approximately 1/8".
- B. Masonry walls: Outlet boxes in masonry walls shall be 4" square with single or multiple gang masonry rings with square edges. Masonry boxes may also be used where 4" square boxes are impractical. Slush boxes in place to prevent movement within walls. **Flush mounted boxes and conduit are to be used unless otherwise indicated.**
- C. Exposed exterior boxes: Where exposed boxes are required, they shall be the cast type with threaded hubs and gasketed covers. **Use of these boxes is by approval only. Flush mounted boxes and conduit are to be used unless otherwise indicated.**
- D. Interior junction boxes: Interior junction boxes shall be 4" square minimum with knock outs as required. Larger boxes may be required and shall be sized per NEC. Provide a flat steel coverplate.
- E. Specialty junction boxes larger than 4 11/16": Junction and pull boxes shall be sized per NEC and arranged to facilitate pulling or splicing. Boxes shall be steel without knock outs, with hinged or screw on cover plates.

- F. Floor boxes: See "Wiring Devices" the drawings.

2.05 ELECTRICAL IDENTIFICATION

- A. Underground warning tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend that indicates type of underground line.
- B. Tape markers for wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- C. Engraved-plastic labels, signs, and instruction plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

2.06 ACCESS DOORS

- A. Prime coated 14 gauge steel, flush, with screw driver operated cam lock. Frame to accommodate construction type; size as indicated.

PART 3 - EXECUTION

3.01 UTILITY COORDINATION

- A. Utility locations indicated on drawings are approximate and the most accurate information available at the time of design. Prior to equipment and conduit installation, the contractor shall coordinate exact installation details and modify work plan accordingly to meet utility requirements. Correspond with utility company prior to any site development that may impact the installation such as irrigation installation, concrete or asphalt installation, landscaping, etc.
- B. Contact utility locating services prior to digging.

3.02 ELECTRICAL EQUIPMENT INSTALLATION

- A. Quality of workmanship: A neat and workmanlike installation shall be provided as defined in the National Electrical Installation Standards (NEIS) established by the National Electrical Contractors Association (NECA). NEIS standards shall be followed for all work including that which is concealed by construction.
- B. Neatness and craftsmanship shall be a priority. Installations shall be subject to regular observations performed by the Engineer or the Engineer's Representative. If an installation is deemed unsatisfactory by the Engineer or the Engineer's Representative due to quality of workmanship, code conflicts or deviations from the Construction Drawings or Specifications, the Contractor shall remedy the installation to the satisfaction of the Engineer.
- C. Inspect installed components for damage and faulty work, including the following:
 - 1. Conduits.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Concrete bases.
 - 6. Cutting and patching for electrical construction.
 - 7. Touchup painting.
- D. Headroom maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- E. Materials and components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- G. Right of way: Give to conduits and piping systems installed at a required slope.

3.03 CONDUIT AND CABLE INSTALLATION

- A. Conceal conduit and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Install conduit and cables at least 6 inches away from parallel runs of flues or hot-water pipes. Locate horizontal conduit runs above water piping.
- C. Use temporary conduit caps to prevent foreign matter from entering.
- D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- E. Use conduit and cable fittings compatible with conduit and cables and suitable for use and location.
- F. Conduits may be installed embedded in concrete under the following conditions:
 - 1. Contractor shall receive approval from a structural engineer if conduit is to be located in structural concrete.
 - 2. Leave at least 2-inch concrete cover.
 - 3. Do not displace more than 1/3 of the concrete thickness of the slab. For example, if the slab thickness is 3", maximum conduit size is to be 1" OD.
 - 4. Secure conduit to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 5. Where multiple conduits are run in an area, space conduit laterally to prevent voids in concrete. Fan out conduit runs for a minimum spacing of no less than 3 times the diameter of the larger conduit in a group. Do not place conduits within 12" of supporting beams, walls and columns.
 - 6. Install conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
 - 7. Where floor finish is to be exposed concrete, avoid excessive underfloor conduits and maximize cover over conduits to avoid floor cracking.
 - 8. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- G. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows where elbows can be installed parallel; otherwise, provide field bends for exposed parallel conduits.
- H. Install pull wires in empty conduits. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.
- I. Install interior telephone and signal system conduits in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
- J. Install exterior telephone and signal system conduits in maximum lengths of 500 feet and with a minimal number of 90-degree bends.
- K. Utilize sweep elbows for all telephone and signal system conduits 2" and larger.
- L. All **conduits routed through unfinished spaces** shall be routed as high as allowable to avoid future conflicts with build out.
- M. All conduits routed exposed in finished spaces shall be painted to match the surroundings. Unless otherwise required by Code, this shall include fire alarm, communication, or other color-specific conduits.
- N. Route conduits parallel to building structural members in a neat and orderly manner.
- O. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.04 CONDUIT SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.

- B. Install individual and multiple conduit hangers and riser clamps to support conduits. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Size supports for multiple conduits so capacity can be increased by **a 25 percent minimum** in the future.
- D. Install 1/4-inch diameter or larger threaded steel hanger rods, unless otherwise indicated.
- E. Simultaneously install vertical conductor supports with conductors.
- F. Separately support cast boxes that are threaded to conduits and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to conduits on opposite sides of the box and support the conduit with an approved fastener not more than 24 inches from the box.
- G. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength. Use factory hardware for all connections and assemblies including 45 and 90 degree attachment hardware.
- H. Install sleeves for cable and conduit penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and conduit penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- I. Install PVC sleeves for grounding cable riser penetrations of concrete slabs. Where ground wires are run through metal sleeves use grounding bushings on both ends of the conduit or sleeve.
- J. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 2. New concrete: Concrete inserts with machine screws and bolts.
 - 3. Light steel: Sheet-metal screws.
 - 4. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.05 WIRING INSTALLATION

- A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.
- C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values.

3.06 POSITION OF DEVICE OUTLETS

- A. Outlets shall be installed at the height indicated below unless otherwise noted. All heights of outlets are measured from finished floor to centerline of device. Heights may be adjusted as necessary to clear wall mounted cabinets, fin tube convectors, unit heaters, etc. Where installed in masonry walls, mounting heights may be adjusted to correspond to block coursing. In no case shall outlets be mounted below 15" or switches above 48":
 - 1. Wall switches 44".
 - 2. Receptacle outlet (general) 16".
 - 3. Receptacle outlet serving countertops 4" above counter or top of backsplash unless otherwise noted.
 - 4. Exterior receptacles 24"
 - 5. Communications outlet Match adjacent outlets.
 - 6. Communication system call station 44".
 - 7. Fire alarm signals 84" or 6" below ceiling (whichever is lower).

- | | |
|---------------------------------|---|
| 8. Fire alarm pull stations | 44" |
| 9. Exit lights | 4" between top of door frame and bottom of exit light where possible. |
| 10. Boiler emergency off switch | 62" |

3.07 ELECTRICAL IDENTIFICATION

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- E. Install warning markers directly above power and communication lines during trench backfilling for underground power, control, signal, and communication lines. Locate marker 6 to 8 inches below finished grade unless required otherwise by NEC. Markers shall be continuous and detectable with a metal detector from above ground after backfilling. Provide one strip of marker for each 16 inches of width if multiple lines are installed in a common trench or concrete envelope.
- F. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: Black.
 - 2. Phase B: Red.
 - 3. Phase C: Blue.
 - 4. Neutral: White.
 - 5. Ground: Green.
- G. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: Brown
 - 2. Phase B: Orange
 - 3. Phase C: Yellow
 - 4. Neutral: White with a colored stripe or gray
 - 5. Ground: Green.

3.08 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly and to resist passage of smoke and other gases. Products designed to achieve a fire or smoke resistance rating shall not be used in locations where such ratings are not required by AHJ. Coordinate location requirements with other disciplines and AHJ prior to installation.
 - 1. Limit air leakage to 5.0cfm per square foot tested in accordance with UL 1479.
 - 2. Materials labeled by a qualified testing agency acceptable to AHJ.
 - 3. Comply with manufacturer's written installation instructions and published drawings
 - 4. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - a. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - b. Contractor's name, address, and phone number.

- c. Designation of applicable testing and inspecting agency.
 - d. Date of installation.
 - e. Manufacturer's name.
 - f. Installer's name.
- B. All firestopping assemblies shall be from one manufacturer. Match manufacturer used by other trades or as directed by general contractor.
- C. Where electrical outlets are to be installed in fire rated walls, provide FlameSafe FSP1077 putty pads or equal to maintain adequate fire rating.
- D. Where lighting fixtures or other electrical devices are to be installed in fire rated ceilings, provide Tenmat Fire Rated Light Covers or equal to maintain adequate fire rating.

3.09 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.10 CONSTRUCTION LAYOUT

- A. Layout work in advance of installation using data and measurements from the site, the appropriate architectural and structural drawings and shop drawings.
- B. Confirm adequate clearance for installation, operation, maintenance and code required clearance including items installed by other contractors.
- C. If layout to provide clearance is not possible, promptly notify Architect/Engineer for clarification.

3.11 DATA AND MEASUREMENTS

- A. The data given herein and on the drawings is as accurate as could be secured. The existence and location of construction as indicated is not guaranteed. Before beginning work investigate and verify the existence and location of items affecting work. Obtain exact locations, measurements, levels, etc., at the site and adapt work to actual conditions.
- B. Only Architectural drawings site measurements may be utilized in calculations. Mechanical and electrical drawings are diagrammatic or schematic.

3.12 COMMISSIONING

- A. Participate in the commissioning process under the direction of the commissioning authority. Representative with expertise and authority to act on contractor's behalf shall perform commissioning activities including, but not limited to, the following:
1. Coordinate and integrate commissioning process activities with construction schedule.
 2. Attend meetings held on a regular basis at intervals determined by commissioning authority.
 3. Supply product documentation.
 4. Complete construction checklists provided by commissioning authority.
 5. Review and accept commissioning process test procedures provided by the Commissioning Authority.
 6. Complete commissioning process test procedures and functional testing.
 7. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 8. Cooperate with the commissioning authority for resolution of logged issues.

3.13 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint.
1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.14 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 36
CABLE TRAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes cable trays, cable tray firestopping fittings, and accessories.
- B. Related Sections include the following:
 - 1. Division 26 Section "Basic Electrical Materials and Methods" for cable tray supports not specified in this Section.
 - 2. Division 26 Section "Grounding and Bonding" for cable management bonding and grounding.
- C. Provide all equipment, materials, labor, and services, not specifically mentioned or shown, which may be necessary to complete or perfect all parts of the installation. Ensure that they are in compliance with requirements stated or reasonably inferred by the contract documents.

1.03 SUBMITTALS

- A. Product Data: Include data on features, ratings, and performance for each component specified.
 - 1. Cable Management Tray:
 - a. Tray
 - b. Mounting Hardware
 - c. Fire Stop Devices
 - 2. Grounding and Bonding:
 - a. Grounding connectors.
 - b. Lugs
 - c. Wire
- B. Shop Drawings: Detail fabrication and installation of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, straight lengths, and fittings.
- C. Coordination Drawings: Show proposed cable tray routing in relation to all other trade equipment and devices.
- D. Warranty documents for equipment.
- E. Qualification Data: For installer/ technician, installation supervisor, and field inspector.
- F. Operation and Maintenance Data:
 - 1. Provide three (3) copies of operations and maintenance manuals. As a minimum, manuals should include:
 - a. Complete schematics of each system component

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- B. Listing and Labeling: Provide cable trays and accessories specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A/B.
- E. Grounding: Comply with ANSI-J-STD-607-A.

1.05 COORDINATION

- A. Coordinate layout and installation of cable tray with other trades and installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions with prior approval of Architect/Engineer.

PART 2 - PRODUCTS

2.01 WIRE BASKET CABLE TRAY SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include the following:
 - 1. Cooper B-Line, Inc.
 - 2. Cablofil Inc.
 - 3. Chatsworth Products Inc.
 - 4. MP Husky
 - 5. MonoSystems, Inc.
 - 6. Hubbell Wiring Devices
 - 7. Basorfil
- B. Wire Basket Cable Tray:
 - 1. Nominal Dimensions: Wire mesh spacing shall not exceed 2 inches by 4 inches.
 - 2. Sizes and Layout: 4" Depth, 12" width unless otherwise indicated on drawings.
 - 3. Provide metal divider matching height of tray for the entire length of the tray.
- C. Material: Carbon steel wire, ASTM A 510, Grade 1008. Finish for carbon steel wire shall be applied after welding and bending of mesh and shall be electro-plated zinc galvanizing, ASTM B633, Type III, SC-1 or hot dip galvanizing, ASTM A 123.
- D. Fabrication: Fabricate cable tray products with rounded edges and smooth surfaces to protect cables from damage during installation. Wire welded, bent and surface treatment shall be after manufacture.
- E. Support System: Supports shall consist of threaded rods with associated fittings and/or wall brackets. Wall brackets shall be factory assemblies by cable tray manufacturer.
- F. Hardware: Hardware, including support components, splice connectors, grounding connectors, etc. furnished by manufacturer.
- G. Grounding: Provide grounding lugs for attachment of ground conductor to tray.
- H. Horizontal transition pieces (90s, 45s, etc.) shall be factory manufactured assemblies and shall not be cut and bent from straight runs.

2.02 CABLE TRAY FIRESTOPPING FITTINGS

- A. Thru-Wall Fire Rated Sleeve Fittings: Hilti CP 653 series Speed Sleeve (or equal by STI).
 - 1. Sizes: 2" or 4" diameter as indicated on plans.
- B. Thru-Wall Smoke Rated Fittings: STI NEZ Path system (or equal by Hilti).
 - 1. Sizes: 4" or 6" square as indicated on plans.
- C. Thru-Floor Fittings: STI EZ Path system (or approved equal).
 - 1. Size: 4" square, Ganged Pathway System
 - a. 4-opening (1x4 grid): STI Catalog #EZDG444
 - 2. Size: 3" square, Single Pathway System, STI Catalog #EZDP133CAK
 - a. Provide 4" conduit sleeve through floor to accommodate kit.
- D. Rating: Maintain fire rating of penetrated wall. Install firestopping thru-wall fitting on each side of penetrated wall. Assembly shall have a minimum UL rating of 3 hours when used with 4-pair cable.
- E. Identification: Pre-printed factory label for each thru-wall fitting.
- F. Accessories: Provide all accessories as required for a complete installation.

2.03 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install cable tray level and plumb according to manufacturer's written instructions, layout on Drawings, and referenced standards.
- B. Install bottom of all wire basket cable tray nominally 4" above finished ceilings where possible. Allow space for removal of accessible ceiling tiles. Route cable tray around building obstructions as required with prior approval by Architect/Engineer. A minimum of 6" access space shall be maintained above all points in cable tray system to allow accessibility for cabling. Less than 6" access space shall not be allowed without prior permission from engineer.
- C. Remove burrs and sharp edges from cable trays prior to installing cables.
- D. Fasten cable tray supports securely to building structure as specified in Division 26 Section "Basic Electrical Materials and Methods," unless otherwise indicated.
 - 1. Locate and install supports no farther apart than 5'-0" on center.
 - 2. Locate and install factory anti-sway braces no farther apart than 15'-0" on center.
 - 3. Design supports, including fastenings to the structure, to carry the greater of the calculated load multiplied by a safety factor of 4 or the calculated load plus 200 lb.
 - 4. All ceiling-mounted supports must attach at two or more points – Center hung or single point ceiling supports shall not be accepted.
 - 5. A support should be placed within 24" on each side of any connection to a bend, tee, or cross.
- E. Make changes in direction and elevation using field fabricated fittings following manufacturer's instructions.
- F. Cutting: Cut tray in accordance with manufacturer's instructions.
- G. Make cable tray connections using standard fittings.
- H. Firestopping: Firestop penetrations through fire and smoke barriers using factory thru-wall firestopping fittings on each side of each penetration. Install factory identification on each fitting. Follow manufacturer's instructions and maintain rating of penetrated wall.
- I. Workspace: Install cable trays with sufficient space to permit access for installing cables.

3.02 GROUNDING AND BONDING

- A. Ground cable trays according to manufacturer's instructions. Grounding shall conform to ANSI/TIA/EIA 607(A) - Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code®, ANSI/NECA/BICSI-568 and manufacturer's grounding requirements as minimum. Bond cable tray across discontinuous sections.
- B. Bond cable tray to nearest telecommunications room ground bar using #2 AWG conductor.
- C. Bond each section of basket tray to one another with #2 AWG jumper.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

- A. Grounding: Test cable trays to ensure electrical continuity of bonding and grounding connections.
- B. Anchorage: Examine supports and anchors.

3.04 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.05 CLEANING

- A. On completion of cable tray installation, including fittings, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes, including chips, scratches, and abrasions.

3.06 PROTECTION

- A. Provide final protection and maintain conditions that ensure cable tray is without damage or deterioration at the time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

END OF SECTION

**SECTION 26 06 00
GROUNDING AND BONDING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.03 SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For grounding, include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Conductor: No. 6 AWG, stranded conductor were not indicated on electrical riser diagram.
- C. Grounding Bus Bars:
 - 1. Rectangular annealed copper bar
 - 2. .25" nominal thickness
 - 3. Dimensions: See drawings
 - 4. Stainless steel wall brackets with insulators, 5/8" diameter mounting bolts with lock washers

2.02 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
 - 2. Bus Bars: Compression type, two hole.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.03 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, 5/8" diameter by 120 inches.
- B. Ufer Ground (Concrete-Encased Grounding Electrode): #3/0 bare copper in 25' of concrete footing.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors
 - 3. Connections to Ground Rods: Bolted connectors.
 - 4. Connections to Conduits: Insulated grounding bushings
 - 5. Connections to Busbars: Bolted connections.

3.02 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Install **2** parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.
- C. Drive ground rods until tops are 12 inches (300 mm) below finished grade in undisturbed earth.
- D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.
- E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.
- F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.
- G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.03 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. All feeders and branch circuits, including:
 - a. Feeders and branch circuits.
 - b. Lighting circuits.
 - c. Receptacle circuits.
 - d. Single-phase motor and appliance branch circuits.
 - e. Three-phase motor and appliance branch circuits.
 - f. Flexible raceway runs.
- C. **[Metal] [and] [Wood]** Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.04 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Bonding for Metal Enclosed Panelboards: Provide insulated grounding bushings and #4 AWG jumper on conduit that does not terminate in panelboard enclosure bottom plate.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe, Including Fire Service: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Ufer Ground (Concrete-Encased Grounding Electrode): Install according to NFPA 70, using a minimum of 25' of bare copper conductor not smaller than No. 3/0 in concrete footing.
 - 1. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.

3.05 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and

their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect/Engineer promptly and include recommendations to reduce ground resistance.

3.06 ELECTRICAL IDENTIFICATION

- A. Install at ground bars for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for grounding identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Tag and label grounding conductors for simple recognition. Identify source and conductor in each conduit.

END OF SECTION

**SECTION 26 22 00
DRY-TYPE TRANSFORMERS (1000 V AND LESS)**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes dry-type distribution and specialty transformers rated 1000 V and less.

1.03 SUBMITTALS

- A. Product Data: Include data on features, components, ratings, and performance for each type of transformer specified including the following:
 - 1. Outline dimensions
 - 2. Weight
 - 3. Impedance
 - 4. Temperature rating
 - 5. Quantity of voltage taps
 - 6. Noise levels
- B. Maintenance Data: For transformers to include in the maintenance manuals specified in Division 1.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide transformers by one the following:
 - 1. Acme Electric Corp.; Transformer Division.
 - 2. Challenger Electrical Equipment Corp.
 - 3. Cutler-Hammer/Eaton Corp.
 - 4. GE/ABB.
 - 5. MagneTek Inc.
 - 6. Siemens Energy & Automation, Inc.
 - 7. Square D; Groupe Schneider.

2.02 TRANSFORMERS, GENERAL

- A. Description: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.
- B. Cores: Grain-oriented, nonaging silicon steel.
- C. Coils: Continuous windings without splices, except for taps.
- D. Internal Coil Connections: Brazed or pressure type.
- E. Enclosure: Class complies with NEMA 250 for the environment in which installed.
- F. Energy Efficiency: DOE 2016 rated.
- G. Sound levels (measured at 1 foot):
 - 1. 25 to 50 kva, 45 db
 - 2. 51 to 150 kva, 50 db
 - 3. 151 to 300 kva, 55 db
 - 4. 301 to 500 kva, 60 db

2.03 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

- A. Comply with NEMA ST 20 and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Windings: One coil per phase in primary and secondary.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Aluminum
- D. Enclosure: Indoor, ventilated.
- E. Enclosure: Indoor, ventilated, dripproof.
- F. Insulation Class: 185 or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.
 - 1. Rated Temperature Rise: 115 deg C maximum rise above 40 deg C. for transformers 300 kVA and smaller.
 - 2. Rated Temperature Rise: 150 deg C maximum rise above 40 deg C, for transformers larger than 300 kVA.
- G. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:
 - 1. Taps, 3 through 15 kVA: Two 5-percent taps below rated high voltage.
 - 2. Taps, 15 through 300 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.
 - 3. Taps, 301 kVA and Above: Four 2.5-percent taps, 2 above and 2 below rated high voltage.
- H. Electrostatic Shielding: Each winding is independently single shielded with a full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Coil leads and terminal strips are arranged to minimize capacitive coupling between input and output connections.
 - 2. Shield Terminal: Separate; marked "Shield" for grounding connection.
 - 3. Capacitance: Shield limits capacitance between primary and secondary to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - 4. Common-Mode Noise Attenuation: Minus 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
 - 5. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.
- I. Drive isolation transformers shall be designed for use with variable frequency drives.
- J. Wall-Mounting Brackets: Manufacturer's standard brackets for transformers up to 75 kVA.

2.04 CONTROL AND SIGNAL TRANSFORMERS

- A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506.
- B. Ratings: Continuous duty. If rating is not indicated, provide capacity exceeding peak load by 50 percent minimum.
- C. Description: Self-cooled, 2 windings.

2.05 FINISHES

- A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.
- B. Outdoor Units: Comply with ANSI C57.12.28.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All connections to transformers shall be made with flexible metal conduit. Do not connect conduits to the top of transformers.
- B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.
- C. Label transformers in accordance with Basic Materials and Methods.

- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.02 GROUNDING

- A. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer.
- B. Ground core of transformer to enclosure using braided grounding strap sized in accordance with NEC.

3.03 CLEANING

- A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.04 ADJUSTING

- A. After installing and cleaning, touch up scratches and mars on finish to match original finish.
- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.
- C. Adjust buck-boost transformer connections to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in readjusting transformer tap settings to suit actual occupied conditions. Provide up to 2 visits to Project site for this purpose without additional cost.
 - 1. Voltage Recordings: Contractor performed. Provide up to 48 hours of recording on the low-voltage system of each medium-voltage transformer.
 - 2. Point of Measurement: Make voltage recordings at load outlets selected by Owner.

END OF SECTION

**SECTION 26 24 16
PANELBOARDS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices and associated auxiliary equipment rated 600V and less for the following types:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Distribution panelboards.
- B. Related Sections include the following:
 - 1. Division 26 Section "General Electrical Requirements."
 - 2. Division 26 Section "Basic Electrical Materials and Methods."
 - 3. Division 26 Section "Grounding and Bonding."
 - 4. Division 26 Section "Surge Protective Devices (SPDs)."

1.03 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Panel designation (same as on drawings).
 - c. Bus configuration, current, and voltage ratings.
 - d. Short-circuit current rating of panelboards and overcurrent protective devices.
 - e. UL listing for series rating of installed devices.
 - f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices, and auxiliary components.
 - g. SPD devices when integrated into equipment.
 - h. Accessories (ground bar, contactor, door lock, etc.
 - i. Mounting: surface
 - 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Close-out," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.04 COORDINATION

- A. Verify Electrical room sizing and layout. Consider quantity of doors, door swings, panic hardware requirements, etc. Show clear space required on floor plans.
- B. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.05 EXTRA MATERIALS

- A. Keys: Four spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. GE/ABB.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.

2.02 FABRICATION AND FEATURES

- A. Enclosures: Surface mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- E. Bus: Tin-plated aluminum
- F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- H. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- I. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- J. Delete paragraph below if not required. Panel skirt intended for cosmetic purposes to hide conduits, do not use panel skirt as wireway.
- K. Delete paragraph below if owner metering is not desired.
- L. Instrumentation: Digital meter measures and displays volts and amps for 3 phases on selectable LED style display. Meter display mounts through front of panelboard trim.
- M. Select lug option, maintain similar lug style accepted above.
- N. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.03 PANELBOARD SHORT-CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.04 Delete paragraph and subparagraphs below if load centers are not utilized on project. Load centers are common for residential applications.

2.05 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Select one of the options in the paragraph below. Bolt-on breakers are most common. Plug-in breakers are more common in residential load centers.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- C. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

- D. Load center construction shall not be acceptable.

2.06 DISTRIBUTION PANELBOARDS

- A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker.
- C. Branch overcurrent protective devices shall be one of the following:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 - 3. Fused switches.
- D. Lighting and appliance branch-circuit panelboard construction shall not be acceptable.

2.07 SURGE PROTECTIVE DEVICE (SPD)

- A. Panelboard configured to physically accommodate integration of a SPD.
- B. Panelboard phase, neutral, and ground busses configured to accommodate an integral SPD with leads for each mode no longer than 12.
- C. Retain paragraph and subparagraphs below if project includes fused coordination panelboards. Fused coordination panelboards are typically utilized to provide code required coordination on life safety systems.

2.08 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Electronic Trip Unit Circuit Breakers for breaker frame sizes 800 A and larger: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - 3. GFCI Circuit Breakers: Single- and two-pole configurations comply with NEC code sections 210.8 and 230.95 for trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- C. Retain paragraph below for fusible distribution panelboards.
- D. Retain paragraph below for all projects with circuit breakers rated 1200 amps and larger.

2.09 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.

- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- E. Install filler plates in unused spaces.
- F. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods"
- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.04 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.05 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.06 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.
- B. This Section includes floor boxes and poke-thru floor fittings.

1.03 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. DL: Damp location as defined in NFPA 70, Article 100.
- C. WP: Weatherproof for wet locations as defined in NFPA 70, Article 100.

1.04 SUBMITTALS

- A. Product Data: For each product specified.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.06 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wallbox Dimmers
 - a. Leviton
 - b. Lutron
 - 2. Floor Boxes
 - a. Hubbell
 - b. Wiremold
 - 3. Poke-Thru Floor Fittings
 - a. Hubbell
 - 4. Other Wiring Devices
 - a. Bryant Electric, Inc.
 - b. Cooper Wiring Devices.
 - c. Hubbell, Inc.; Wiring Devices Div.
 - d. Leviton Manufacturing Co., Inc.
 - e. Pass & Seymour/Legrand; Wiring Devices Div.

2.02 RECEPTACLES

- A. Description: Impact-resistant nylon face with finder groove, thermoplastic back body, and one-piece triple-wipe power contacts. Side and back wired, back wire terminals use screw pressure plates.
- B. Duplex Straight-Blade Receptacles: Specification grade; 20 ampere, 125 volt rated.
 - 1. Equal to: Pass & Seymour #5362

- C. Simplex Straight-Blade Receptacles: Specification grade; 20 ampere, 125 volt rated.
 - 1. Equal to: Pass & Seymour #5351.
- D. GFCI Receptacles: Design units for installation in a 2-3/4-inch deep outlet box without an adapter.
 - 1. Equal to: Pass & Seymour #2095.
- E. Weather-Resistant Duplex Receptacle: Specification grade, 20 ampere, 125 volt rated.
 - 1. Equal to: Pass & Seymour #WR5362

2.03 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.04 SWITCHES

- A. Snap Switches: Specification grade; 20 ampere, 120/277 volt rated; side and back wired; quiet type.
 - 1. Poles: Provide switches in single-pole, double-pole, three-way, and four-way configurations as indicated on the drawings.
 - 2. Equal to: Pass & Seymour #20AC

2.05 WALL PLATES

- A. Single and combination types match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Select one of five subparagraphs below. Coordinate with Division 9 Section "Painting."
 - 3. Material for Finished Spaces: 0.04-inch thick, Type 302, satin-finished stainless steel.
 - a. Ceiling mounted wall plates to match ceiling color.
 - 4. Material for Unfinished Spaces: Galvanized steel.
 - 5. Weatherproof plates in damp locations (DL): Heavy cast aluminum; hinged, gasketed, equal to Pass & Seymour #4511 for horizontal mount or #4512 for vertical mount. These covers shall be installed outdoors in a location protected from the weather such as roofed open porches, canopies, eaves, and the like or in other damp locations where the receptacle will not be subject to beating rain or water run-off.
 - 6. Heavy Duty Weatherproof Cast Aluminum while-in-use plates in wet locations (WP): Self-closing cast aluminum lockable cover and cast aluminum base, the integrity of the assembly is not affected when the attachment plug cap is inserted. Equal to Intermatic WP1010HMC, WP1010MC, or WP1030MC. Select model coordinated with number of gangs and device orientation of indicated location.

2.06 FINISHES

- A. Color:
 - 1. Gray, unless otherwise indicated for normal circuits.
 - a. Ceiling mounted devices to match ceiling color.

2.07 CIRCUIT LABELS FOR RECEPTACLES

- A. Brother PC clear adhesive with Arial #14 black lettering for normal circuits.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.

- C. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.
- D. Do not share neutral conductor on load side of dimmers.
- E. Protect devices and assemblies during painting.
- F. Provide a GFCI receptacle for each device indicated on the drawings. Do not connect GFCI receptacles to protect downstream devices.
- G. Set floor boxes level and trim after installation to fit flush to finished floor surface.
- H. Provide full-capacity external conduit connections between all compartments of multi-service floor boxes. All compartments shall be capable of installed devices regardless of internal wire tunneling arrangement of floor box.

3.02 IDENTIFICATION

- A. Comply with Division 26 Section "Basic Electrical Materials and Methods."
 - 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 - 2. Receptacles: Identify serving panelboard and circuit number on faceplate of all receptacles.
 - 3. Conductors Serving Receptacles: Identify serving panelboard and circuit number. Use durable wire markers or tags within outlet boxes.

3.03 CONNECTIONS

- A. Connect wiring device grounding terminal to outlet box with bonding jumper.
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values.

3.04 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity.
- B. Test GFCI operation with fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.05 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 26 28 16
DISCONNECT SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes enclosed individually mounted switches and circuit breakers used for the following:
 - 1. Service disconnect switches.
 - 2. Feeder and equipment disconnect switches.
 - 3. Feeder branch-circuit protection.
 - 4. Motor disconnect switches.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 26 Section "Wiring Devices" for attachment plugs and receptacles, and snap switches used for disconnect switches.

1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes. Include data for overcurrent protective device coordination:
 - 1. Descriptive data and time-current curves.
 - 2. Let-through current curves for overcurrent protective devices with current-limiting characteristics.
 - 3. Coordination charts and tables and related data.
- C. Shop Drawings: For each switch, circuit breaker, and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices and accessories, equipment features, and ratings. Include the following:
 - a. Enclosure types and details.
 - b. Bus materials, configuration, current, and voltage ratings.
 - c. Short-circuit current rating of switches and circuit breakers.
 - d. Descriptive documentation of options or accessories such as auxiliary devices, controls, interlocks, etc.
 - e. UL listing for series rating of installed devices.
 - f. Features, characteristics, ratings, and factory settings of overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- D. Field test results indicating and interpreting test results.
- E. Maintenance Data: For switches and circuit breakers to include in operation and maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:
 - 1. Routine maintenance requirements for switches, circuit breakers, and all installed components.

2. Manufacturer's written instructions for testing and adjusting switches and overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain switches and circuit breakers from one source and by a single manufacturer.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide switches and circuit breakers specified in this Section that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide switches and circuit breakers by one of the following:
 1. Enclosed Disconnect Switches, Enclosed Molded Case Switches, and Enclosed Molded Case Circuit Breakers:
 - a. GE/ABB.
 - b. Siemens Energy & Automation, Inc.
 - c. Square D Co.
 - d. Eaton Corp.; Cutler-Hammer Products.

2.02 ENCLOSURES

- A. Enclosure: NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
 1. Outdoor Locations: Type 3R.
 - a. Kitchen Areas: Type 4X, stainless steel.
 - b. Other Wet or Damp Indoor Locations: Type 4.
 - c. Hazardous Areas Indicated on Drawings: Type 7C.

2.03 ENCLOSED DISCONNECT SWITCHES

- A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD Heavy Duty, with lockable handle.
- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD Heavy Duty, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.
- C. Features and Accessories:
 1. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

2.04 ENCLOSED MOLDED CASE SWITCHES

- A. Enclosed, Molded-Case Switch: NEMA AB 1, with lockable handle and without trip units.
- B. Characteristics: Frame size, number of poles, and auxiliary devices as indicated. **Fully rated interrupting rating to meet available fault current.**
- C. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.
- D. Features and Accessories:

1. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
2. Shunt Trip: 120-V trip coil energized from separate circuit.
3. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.05 ENCLOSED CIRCUIT BREAKERS

- A. Enclosed, Molded-Case Thermal-Magnetic Circuit Breaker: NEMA AB 1, with lockable handle. Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated. **Fully rated interrupting rating to meet available fault current.**
- C. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.
- D. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
- E. Circuit Breakers, 400 A and Larger: Field-adjustable, short-time and continuous-current settings.
- F. Features and Accessories:
 1. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All disconnect switches shall be non-fused type unless otherwise indicated on the drawings.
- B. Install switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.
- C. Install switches and circuit breakers level and plumb.
- D. Install wiring between switches and circuit breakers, control, accessories, and indication devices.
- E. Connect switches, circuit breakers, and components to wiring system and to ground as indicated and instructed by manufacturer.
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.02 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods."
- B. Switch and Circuit-Breaker Nameplates: Label each switch and circuit breaker with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 FIELD QUALITY CONTROL

- A. Testing: After installing switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
- B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.04 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.05 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

SECTION 26 43 13
SURGE PROTECTIVE DEVICES (SPD'S)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes permanently installed, factory or field mounted, 1kV or less surge protective device (SPD) equipment.

1.03 DEFINITIONS

- A. Type 1 SPD: Referred to as secondary surge arrestors prior to the 2008 NEC. These devices are designed for installation on the line side of the service entrance disconnect and must have integrated overcurrent protection.
- B. Type 2 SPD: Referred to as hardwired transient voltage surge suppressors (TVSS) prior to the 2008 NEC. These devices are designed for installation at any location on the load side of the service disconnect. External overcurrent protection is allowed.
- C. Type 4 SPD: SPD components intended to be part of a complete SPD.
- D. VPR: Voltage protection rating.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For SPD devices to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- C. Comply with UL 1283 2nd Edition.
- D. Comply with UL 1449 3rd Edition.
- E. Comply with NFPA 70, 2008 Edition.
- F. [Comply with NFPA 780.]

1.07 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed electrical service interruptions.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
- B. Service Conditions: Rate SPDs for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 125 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F.
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet above sea level.

1.08 COORDINATION

- A. Coordinate location of field-mounted SPDs to allow adequate clearances for maintenance.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Designed for integration into selected switchgear/switchboard/panelboard manufacturer's equipment.
 - 1. Panel arrangement allowing maximum lead length to phase, neutral, and ground bus connection points of 8".
- B. Subject to compliance with requirements, provide product by one of the following:
 - 1. Advanced Protection Technologies, Inc. (APT).
 - 2. Cutler-Hammer; Eaton Business Unit.
 - 3. GE/ABB Zenith.
 - 4. Innovative Technology; Eaton Business Unit.
 - 5. LEA International.
 - 6. Liebert; Emerson Network Power Business Unit.
 - 7. Siemens.
 - 8. SurgeLogic/Square D; Schneider Electric Business Unit.
- C. SPD for Service Entrance Equipment Location (Primary Protection)
 - 1. UL listed to UL 1449 3rd Edition
 - 2. Type 1 (installed downstream of main breaker) or Type 2.
 - 3. 20kA nominal discharge (In).
 - 4. Short-circuit current rating (SCCR) complying with UL 1449, and matching or exceeding the connected equipment short-circuit rating.
 - 5. 7 modes of protection (L-N, L-G, N-G).
 - 6. Peak surge current rating: 200kA per phase.
 - 7. VPR: Not to exceed 700V for 208Y/120V systems, 1200V for 480Y/277V systems.
 - 8. System voltage: match service entrance equipment.
 - 9. EMI/RFI noise rejection filter: Noise attenuation of 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.
 - 10. LED indicator lights for power and protection status.
 - 11. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 - 13. Six-digit transient-event counter set to totalize transient surges.
- D. SPDs for Non-Service Entrance Equipment Locations (Secondary Protection)
 - 1. UL listed to UL 1449 3rd Edition
 - 2. Type 1 (installed downstream of main breaker) or Type 2.
 - 3. 20kA nominal discharge (In).
 - 4. Short-circuit current rating (SCCR) complying with UL 1449, and matching or exceeding the connected equipment short-circuit rating and.
 - 5. 7 modes of protection (L-N, L-G, N-G).
 - 6. Peak surge current rating: 100kA per phase.
 - 7. VPR: Not to exceed 700V for 208Y/120V systems, 1200V for 480Y/277V systems.
 - 8. System voltage: match connected equipment.
 - 9. EMI/RFI noise rejection filter: Noise attenuation of 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.

10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. [Six-digit transient-event counter set to totalize transient surges.]

2.02 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install SPD devices at service entrance on load side of main disconnect, with ground lead bonded to service entrance ground.
- B. Install SPD devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 1. Comply with manufacturer's written recommendation for conductor and circuit-breaker size for connecting SPD devices to distribution system.
- C. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
 2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
 3. Complete startup checks according to manufacturer's written instructions.
 4. Coordinate with commissioning agent. Supply requested product documentation.
- D. SPD device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.02 STARTUP SERVICE

- A. Do not energize or connect service entrance equipment to their sources until SPDs are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests and reconnect immediately after the testing is over.

3.03 DEMONSTRATION

- A. Train Owner's maintenance personnel to maintain SPD devices.

END OF SECTION

SECTION 26 51 00
LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. See 26 05 00 "Basic Electrical Materials and Methods" for electrical materials and methods.
- C. See 26 27 26 "Wiring Devices" for manual light switches and device finishes.
- D. See 26 52 00 "Lighting Control" for lighting control devices.

1.02 SUMMARY

- A. This Section includes luminaires, lamps, ballasts, drivers, emergency lighting units, emergency battery packs, emergency lighting inverters, exit signs, luminaire supports, poles, and accessories.

1.03 SUBMITTALS

- A. Product Data: For each luminaire type arranged in order of type designation. Include data on features, accessories, and the following:
 - 1. Physical description including dimensions, construction, and finish.
 - 2. Lamp and ballast data indicating rated life, output, CCT, CRI, and energy use.
 - 3. LED and driver data indicating rated life, output (delivered), CCT, CRI, and energy use.
 - 4. Photometric report including IES files.
 - 5. Emergency lighting units, including batteries and chargers.
- B. Product Data: For each pole type arranged in order of type designation. Include data on features, accessories, and the following:
 - 1. Include data on construction details, profiles, EPA, cable entrances, materials, finishes, dimensions, weight, rated design load, and ultimate strength of individual components.
 - 2. Anchor bolts.
- C. Product Data: For each type and rating of emergency lighting inverter.
 - 1. Include features, performance, electrical ratings, operating characteristics, furnished options, and accessories.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, and components.
 - 3. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.
- D. Shop Drawings: For non-standard or custom luminaires. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- E. Maintenance Data: For luminaires to include in maintenance manuals specified in Division 1.
- F. Samples for Initial Selection: For each luminaire requested by architect or engineer.
 - 1. Include Samples of luminaires and accessories involving color and finish selection.

1.04 QUALITY ASSURANCE

- A. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70 and 101.
- C. Emergency lighting units, inverters, exit signs, and batteries: Comply with UL 924.
- D. Exterior Lighting: Comply with UL 1598 and listed for wet location.

- E. Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.05 COORDINATION

- A. Luminaires, Mounting Hardware, and Trim: Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Coordinate layout and installation of devices with other construction including structural members, underground utilities, above-grade utilities, site design, and building elements.
- C. Coordinate layout and installation of emergency lighting inverters with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels. Label with engraved nameplates.

1.06 WARRANTY

- A. Include labor allowance required for replacement on-site at no extra cost to the Owner within 1-year construction warranty. Transfer remainder of the manufacturer's warranty including ballast manufacturer's labor stipend to owner after 1-year construction warranty.
- B. Ballast and Driver Warranty: 5-year replacement warranty.
- C. Emergency Battery Warranty: 3-year pro-rated warranty.
- D. LED System Warranty: 5-year replacement warranty.
- E. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) and luminaires that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a 5-year warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Luminaires and Poles: Subject to compliance with requirements, provide one of the products indicated for each designation in the Luminaire and Site Lighting Schedules on the drawings.
- B. Emergency Lighting Inverters: Subject to compliance with requirements, provide one of the products indicated for each designation on the drawings.

2.02 LUMINAIRE AND LUMINAIRE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during re-lamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated.
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
 - 2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

- F. Finishes: Manufacturer's standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Metallic Finish: Corrosion resistant.

2.03 LED LIGHT SOURCES

- A. LED Light Source Requirements:
 - 1. Rated life (L70): Minimum 50,000 hours as defined by IES LM80 and TM21.
 - 2. Color Rendering Index (CRI): 80 CRI minimum.
 - 3. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- B. LED Driver Requirements:
 - 1. 0-10V Dimming
 - 2. Total Harmonic Distortion Rating: Less than 20 percent.
 - 3. Ambient temperature rating: -40° to +55° C
 - 4. Power Factor (100% output): >0.95
 - 5. Flickering: LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Submit % flicker in 1% increments for full range of dimming starting at 500 mA for full output reading. Systems that do not meet IEEE P1789 will not be considered.

2.04 EXIT SIGNS

- A. General Requirements:
 - 1. Comply with NFPA 101, UL924, and local AHJ for sign colors, visibility, luminance, and lettering size.
 - 2. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.
- B. Internally Lighted Signs (AC type or Battery type):
 - 1. Light Source: Light-emitting diodes with 70,000 hour minimum rated lamp life.
 - 2. Battery type - Integral automatic charger in a self-contained power pack.

2.05 EMERGENCY LIGHTING UNITS

- A. General Requirements: Self-contained units, wall or ceiling mounted. Comply with UL 924. Units include the following features:
 - 1. Battery: Sealed, maintenance-free, lead-acid type with minimum 5-year nominal life and warranty.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.06 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Twin-Stem Hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single luminaire. Finish same as luminaire.
- C. Rod Hangers: 3/8-inch minimum diameter, cadmium-plated, threaded steel rod.

2.07 POLES

- A. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.
- B. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

- C. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug listed for attaching grounding and bonding conductors of type and size indicated, and accessible through hand hole.
- E. Provide factory-installed internal vibration dampeners in all poles 25 feet and higher.
- F. Provide matching metal base cover.
- G. Mounting Hardware:
 - 1. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi. Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Nuts: ASTM A 563, Grade A, Heavy-Hex. Hot dip galvanized according to ASTM A 153, Class C.
 - 3. Washers: ASTM F 436, Type 1. Hot dip galvanized according to ASTM A 153, Class C.
- H. Finishes: Factory powder-coat finish to match finish of luminaire, unless noted otherwise.

2.08 EMERGENCY LIGHTING INVERTERS

- A. Fast-Transfer Central Battery Equipment: Automatically sense loss of normal ac supply and use a solid-state static switch to transfer load. Transfer in 50ms or less from normal supply to battery-inverter supply.
- B. Inverter and Controls Logic: Microprocessor based, isolated from all power circuits; provides complete self-diagnostics, periodic automatic testing and reporting; with alarms.
- C. Output Voltage Waveform: Pure sine wave with maximum 3 percent TDD throughout battery operating-voltage range, for 100 percent linear load.
- D. Maintenance Bypass Mode: Manual operation only; bypasses central battery equipment power circuits (inverter and static transfer switch); requires local operator selection at central battery equipment. Bypass Overload Capability shall be 1.5 times the base load current.
- E. Integral Output Disconnecting Means and OCPDs: Thermal-magnetic circuit breakers, complying with UL 489; voltage rating matching unit output voltage rating; 20 A, single pole.
- F. Capacity as indicated on the drawings. Manufacturer to verify capacity based on loads served by device and overload capacity of inverter.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1.
- B. Luminaires: Set level, plumb, and square with ceiling and walls. Secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each luminaire.
- C. Align luminaires for optimum directional alignment of light distribution.
- D. Remote Mounting of Ballasts or Drivers: Distance between the ballast/driver and fixture shall not exceed that recommended by manufacturer. Verify wire size and maximum distance between ballast/driver and luminaire with manufacturer.
- E. Support for luminaires in or on Grid-Type Suspended Ceilings: Use grid for support.
 - 1. Install a minimum of four ceiling support system rods or wires for each luminaire. Locate not more than 6 inches (150 mm) from luminaire corners.
 - 2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner.
 - 3. Luminaires of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
- F. Suspended Luminaire Support: As follows:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

2. Continuous Rows: Suspend from cable installed according to luminaire manufacturer's written instructions and details on Drawings.
- G. Burn-In: Continuously illuminate (burn-in) lamps per manufacturer's recommendations. Continuously illuminate LED light sources for 100 hours prior to substantial completion.

3.02 CONNECTIONS

- A. Ground equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
- B. Ground Metal Poles and Support Structures: Comply with requirements in Section 26 06 00 "Grounding and Bonding."
 1. Install grounding electrode for each pole unless otherwise indicated.
 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- C. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 26 06 00 "Grounding and Bonding."
 1. Install grounding electrode for each pole.
 2. Install grounding conductor and conductor protector.
 3. Ground metallic components of pole accessories and foundation.

3.03 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Provide instruments to make and record test results.
- C. Test as follows:
 1. Verify normal operation of each luminaire after installation.
 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
 3. Verify normal transfer to battery source and retransfer to normal.
- D. Malfunctioning Luminaires and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- E. Perform a load-duration test for inverters at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for the minimum time limits required by UL 924. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 CLEANING AND ADJUSTING

- A. Clean luminaires internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Perform startup service for inverters. Engage a factory-authorized service representative if recommended by manufacturer or required for warranty. Train Owner's maintenance personnel to adjust, operate, and maintain emergency lighting inverters, and to use and reprogram microprocessor-based control, monitoring, and display functions.

END OF SECTION

**SECTION 26 52 00
LIGHTING CONTROL**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. See 26 05 00 "Basic Electrical Materials and Methods" for electrical materials and methods.
- C. See 26 27 26 "Wiring Devices" for manual light switches and device finishes.
- D. See 26 51 00 "Lighting" for luminaires, lamps, ballasts, drivers, emergency lighting units, emergency battery packs, emergency lighting inverters, exit signs, luminaire supports, and poles.

1.02 SUMMARY

- A. This Section includes lighting control panels, lighting control devices, and accessories.

1.03 SUBMITTALS

- A. Product Data: For each lighting control panel and device. Include data on features, accessories, and the following:
 - 1. Lighting control panels and devices.
 - 2. Dimensions of control panels and devices.
 - 3. Lighting control system one line diagram.
- B. Occupancy Sensor Layout Drawings: Scaled floor plans with lighting control manufacturer's layout of occupancy sensors. Sensor layout and quantity shall completely cover each area indicated, show coverage patterns for each sensor.
- C. Maintenance Data: For lighting control devices to include in maintenance manuals specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70, NFPA 101, and UL924.

1.05 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace devices that fail in materials or workmanship within two years from date of substantial completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Lighting Control Equipment: Subject to compliance with requirements, provide lighting control equipment from one of the following manufacturers, all equipment should be from one consistent manufacturer:
 - 1. SensorSwitch nLight
 - 2. Wattstopper
 - 3. Encelium

2.02 LIGHTING CONTROL GATEWAY

- A. Mounts to two gang recessed junction box.
- B. Backlit LCD Screen with local control buttons. Integral time clock with remotely upgradeable firmware.
- C. Provide 3 RJ-45 ports for connection to lighting control bridges via Cat 5. Provide with one integral ethernet port.

- D. Gateway shall include SensorView software to be installed to owners existing BAC computer. Provide programming of system to owner's scheduling requirements.
- E. Sensor Switch, nECY MVOLT BAC ENC GFXK.

2.03 LIGHTING CONTROL BRIDGE

- A. Mounts to two gang junction box.
- B. Provide with 8 RJ-45 ports for connection to lighting relay system devices via Cat 5.
- C. Provide commissioning of system. Fill out cards and program zones to owner's schedule specifications.
- D. Sensor Switch, nBRG 8.

2.04 LIGHTING CONTROL SYSTEM ENTRY STATIONS

- A. Provide entry station that connects to lighting control relay system via Cat 5 with J-45 connectors.
- B. See Section 26 27 26 "Wiring Devices" for finish colors.
- C. Sensor Switch Catalog Numbers (See Lighting Control Device Schedule):
 - 1. Lighting Control Network Entry Station: nPODM(2P,4P,DX)
 - 2. Lighting Control Network Scene Entry Station: nPODM(2S,4S,DX)
 - 3. Lighting Control Network Dimming Entry Station: nPODMD
 - 4. Lighting Control Network Graphic Wallpod: nPOD GFX

2.05 POWER PACKS

- A. Connects to lighting control relay system via Cat 5 cabling with RJ-45 connectors.
- B. Provide with an internal latching relay.
- C. Sensor Switch Catalog Numbers (See Lighting Control Device Schedule):
 - 1. Lighting Control Network Relay Pack nPP16
 - 2. Lighting Control Network Dimming / Relay Pack nPP16 D
 - 3. Lighting Control Network UL924 Emergency Relay Pack nPP16 ER
 - 4. Lighting Control Network UL924 Emergency Dimming / Relay Pack nPP16 D ER
 - 5. Lighting Control Network Secondary Two Wire Phase Dimming Pack nSP5 PCD 2W
 - 6. Lighting Control Network Secondary Three Wire Phase Dimming Pack nSP5 PCD 3W
 - 7. Lighting Control Network Secondary MLV Phase Dimming Pack nSP5 PCD MLV
 - 8. Lighting Control Network Secondary ELV Phase Dimming Pack nSP5 PCD ELV 120

2.06 OCCUPANCY SENSORS

- A. Low Voltage Ceiling Sensors:
 - 1. Passive Dual Technology: Infrared and microphonic sensors integrated into one housing.
 - 2. Performance and Coverage: Passive Infrared (PIR) shall engage sensor and PIR or microphonic shall detect continued occupancy. 360 degree field of view. Minimum coverage of 20 foot radius at 9' mounting height, with sensor centered in coverage area. Provide accessory power packs and connect to power sensor.
 - 3. Mounting: Sensor shall flush horizontal mount tight to ceiling surface. Sensors that protrude from ceiling or utilize drop-down mounting brackets shall not be acceptable.
 - 4. Finish: White, unless noted otherwise.
 - 5. Stand Alone Load Rating: Provide accessory power packs with relay; connect to switch load. Relay in power packs shall be rated 20A for ballast loads.
 - 6. Stand Alone: Sensor Switch CM PDT 10 or approved equivalent. Provide associated power packs with sensor power supply and load switching relay.
 - 7. Networked System: Sensor Switch nCM PDT10.
- B. Line Voltage Single Pole Wall Box Sensors:
 - 1. Passive Dual Technology: Infrared and microphonic sensors integrated into one housing.

2. Performance and Coverage: Passive Infrared (PIR) shall engage sensor and PIR or microphonic shall detect continued occupancy. 180 degree field of view. Capable of sensing small motion up to 20' at 4' mounting height.
 3. On Modes
 - a. Automatic on - Sensor turns load on based on sensing occupancy of monitored area.
 - b. Manual on - sensor requires pressing the pushbutton on sensor face to turn load on.
 - c. Reduced turn on - sensor automatically turns load on with detection of large motion, automatically switches minor motion detection on after load is initially powered on.
 4. Switch Off Modes
 - a. Predictive off mode - occupant can turn lights off manually or lights automatically turn off after time out period. If lights are manually turned off, the sensor shall revert to automatic on after sensor sees no motion during time out period.
 - b. Permanent off mode - pressing the switch turns the lights off, lights will not turn on until switch is pressed again.
 - c. Switch disable - prevents user from manually turning lights off.
 5. Mounting: Sensor shall mount in wall box with decorator style faceplate.
 6. Load Rating: Switch integral in sensor housing
 - a. Rated for 800 watt ballast or incandescent load at 120V
 - b. Rated for 1200 watt ballast load at 277V
 - c. Rated for ¼ horsepower motor load at 120V
 7. Operation Mode Settings
 - a. Storage areas - manual on / permanent off
 - b. Private offices / work rooms - reduced turn on / predictive off
 8. Sensor Switch WSX PDT or approved equivalent.
 9. Finish: Coordinate finish of devices with section 26 27 26 "Wiring Devices".
- C. Line Voltage Two Pole Wall Box Sensors:
1. Passive Dual Technology: Infrared and microphonic sensors integrated into one housing.
 2. Performance and Coverage: Passive Infrared (PIR) shall engage sensor and PIR or microphonic shall detect continued occupancy. 180 degree field of view. Capable of sensing small motion up to 20' at 4' mounting height.
 3. On Modes
 - a. Automatic on - Sensor turns load on based on sensing occupancy of monitored area.
 - b. Manual on - sensor requires pressing the pushbutton on sensor face to turn load on.
 - c. Reduced turn on - sensor automatically turns load on with detection of large motion, automatically switches minor motion detection on after load is initially powered on.
 4. Switch Off Modes
 - a. Predictive off mode - occupant can turn lights off manually or lights automatically turn off after time out period. If lights are manually turned off, the sensor shall revert to automatic on after sensor sees no motion during time out period.
 - b. Permanent off mode - pressing the switch turns the lights off, lights will not turn on until switch is pressed again.
 - c. Switch disable - prevents user from manually turning lights off.
 5. Mounting: Sensor shall mount in wall box with decorator style faceplate.
 6. Load Rating: Switches integral in sensor housing, shall be capable of independent operation
 - a. Rated for 800 watt ballast or incandescent load at 120V
 - b. Rated for 1200 watt ballast load at 277V
 - c. Rated for ¼ horsepower motor load at 120V
 7. Operation Mode Settings
 - a. Private offices / work rooms / conference rooms
 - 1) Pole 1 - reduced turn on / predictive off
 - 2) Pole 2 - manual on / permanent off
 8. Sensor Switch WSX PDT 2P or approved equivalent.

9. Finish: Coordinate finish of devices with section 26 27 26 "Wiring Devices".
- D. Line Voltage Single Pole Wall Box Sensors with Dimming:
1. Passive Dual Technology: Infrared and microphonic sensors integrated into one housing.
 2. Performance and Coverage: Passive Infrared (PIR) shall engage sensor and PIR or microphonic shall detect continued occupancy. 180 degree field of view. Capable of sensing small motion up to 20' at 4' mounting height.
 3. Raise and lower buttons dim luminaires via 0-10v output.
 4. On Modes
 - a. Automatic on - Sensor turns load on based on sensing occupancy of monitored area.
 - b. Manual on - sensor requires pressing the pushbutton on sensor face to turn load on.
 - c. Reduced turn on - sensor automatically turns load on with detection of large motion, automatically switches minor motion detection on after load is initially powered on.
 5. Switch Off Modes
 - a. Predictive off mode - occupant can turn lights off manually or lights automatically turn off after time out period. If lights are manually turned off, the sensor shall revert to automatic on after sensor sees no motion during time out period.
 - b. Permanent off mode - pressing the switch turns the lights off, lights will not turn on until switch is pressed again.
 - c. Switch disable - prevents user from manually turning lights off.
 6. Mounting: Sensor shall mount in wall box with decorator style faceplate.
 7. Load Rating: Switch integral in sensor housing
 - a. Rated for 800 watt ballast or incandescent load at 120V
 - b. Rated for 1200 watt ballast load at 277V
 8. Sensor Switch WSX PDT D or approved equivalent.
 9. Finish: Coordinate finish of devices with section 26 27 26 "Wiring Devices".
- E. Low Voltage Wide View Corner Sensors:
1. Passive Dual Technology: Infrared and microphonic sensors integrated into one housing.
 2. Performance and Coverage: Passive Infrared (PIR) shall engage sensor and PIR or microphonic shall detect continued occupancy. 120 degree field of view. Minimum coverage of 40' minor motion detection at 8' mounting height, with sensor at center of field of view. Provide accessory power packs and connect to power sensor.
 3. Mounting: Sensor shall flush horizontal mount tight to ceiling surface. Sensors that protrude from ceiling or utilize drop-down mounting brackets shall not be acceptable.
 4. Finish: White, unless noted otherwise.
 5. Load Rating: Provide accessory power packs with relay; connect to switch load. Relay in power packs shall be rated 20A for ballast loads.
 6. Stand Alone: Sensor Switch WV PDT 16 or approved equivalent. Provide associated power packs with sensor power supply and load switching relay.
 7. Networked System: Sensor Switch nWV PDT 16.

2.07 PHOTOCELLS

- A. Low Voltage Ceiling Photocell:
1. Sensing daylight and electrical lighting levels, the sensor adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed via 0-10v output to luminaires.
 2. Set-point and trim levels shall be field configurable.
 3. Mounting: Sensor shall flush horizontal mount tight to ceiling surface. Sensors that protrude from ceiling or utilize drop-down mounting brackets shall not be acceptable.
 4. Finish: White, unless noted otherwise.
 5. Stand Alone Load Rating: Provide accessory power packs with relay; connect to switch load. Relay in power packs shall be rated 20A for ballast loads.

6. Stand Alone: Sensor Switch CM PC ADC or approved equivalent. Provide associated power packs with sensor power supply and load switching relay.
7. Networked System: Sensor Switch nCM ADCX

2.08 DIMMERS

- A. Wall Box Dimmers:
 1. Slider with preset suitable for operation of connected load.
 2. Capacity as indicated on the drawings. Observe derating restrictions for ganged devices.
 3. Compatibility:
 - a. Match connected loads (forward phase, reverse phase, 3-wire, 0-10v, etc).
 - b. Provides multi-location capability using standard 3-way and 4-way mechanical switches.
 4. Faceplate: Standard decorator faceplate.
 5. Commercial grade Lutron Nova T Series Dimmer or approved equal.
 6. Finish: Coordinate finish of devices with section 26 27 26 "Wiring Devices".

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Stand Alone Controls: Provide required power packs with sensor power supply and load switching relay. Connect power packs per manufacturer's instructions. Adjust settings of occupancy sensors, tailor to configuration and use of room served.
- D. Networked controls:
 1. The Electrical Contractor shall hold a pre-construction meeting with the local representative from the lighting control system manufacturer prior to the start of construction.
 2. Locate all Power Packs above accessible ceilings near fixtures being controlled. In exposed structure areas, locate device in junction box and paint to match surroundings.
 3. Daisy-chain all network lighting control devices to network bridge devices per manufacturer's recommendations. Provide quantity of bridges such that each room/space is a separate lighting control zone that appears in programming software.
 4. After construction, the Electrical Contractor shall provide the Owner a record drawing set detailing the locations of all control devices located above ceilings and the luminaire or groups of luminaires being controlled by each device.
- E. Lighting Control System Cabling:
 1. Provide plenum rated pre-terminated low voltage cabling as manufactured by lighting control manufacturer for all cables shorter than 150 feet. Provide lengths necessary for installation, cables shall be as short as practical with a minimum 10' cable length. Cables longer than 150 feet shall be terminated by a low voltage technician or qualified contractor.
 2. 0-10v Dimming Devices: Provide #14 control wiring to luminaires controlled by device.
 3. Provide J-Hook style supports for low voltage cabling above accessible ceilings. Where exposed structure occurs run low voltage cabling concealed in conduit.
- F. After Substantial Completion, but not more than 60 days after Final Acceptance, re-adjust occupancy sensors for Owner's actual pattern of use.

3.02 FIELD QUALITY CONTROL

- A. Tests: As follows:
 1. Verify normal operation of each lighting control per lighting control sequence of operations.
- B. Malfunctioning Lighting Controls: Replace or repair, then retest. Repeat procedure until units operate properly.

- C. Prepare test and inspection reports.

3.03 SYSTEM PROGRAMMING AND SEQUENCE OF OPERATION

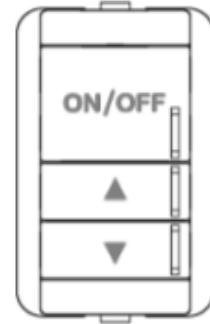
- A. Head End Software

- 1. Install software on computer furnished by Owner.

- B. Program spaces per sequence of operation below. Design light level shall be used to set high end trim as well as daylight harvesting photocell set points. Assist commissioning agent in system testing and verification.

- C. Building Time Schedule:

- 1. Business Hours: 6am until 6pm
- 2. After Hours: 11pm until 6am

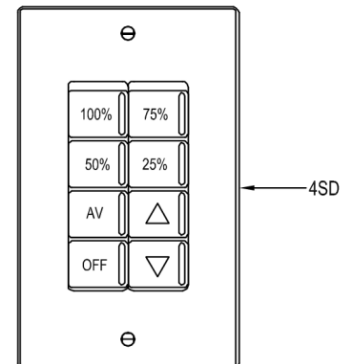


- D. Typical Enclosed Office

- 1. Design Light Level: 40fc
- 2. Time Out Periods:
 - a. Business Hours: 15 minutes
 - b. After Hours: 5 minutes
- 3. Wall switch occupancy sensor or Entry Station 1PD:
 - a. Button 1: On/Off
 - b. Button 2: All lights up
 - c. Button 3: All lights down
- 4. Room Function Description:
 - a. Occupancy presses button 1 and lights illuminate to 30fc. Button 2 increases light levels to a maximum of 40fc. Button 3 dims lighting to minimum. Pressing button 1 a second time turns lights off. If no movement is sensed for time out period lights turn off. Sensor shall operate as a vacancy sensor.

- E. Typical Room

- 1. Time Out Periods:
 - a. Business Hours: Retain current state from entry station
 - b. After Hours: 5 minutes
- 2. Entry Station 4SD at classroom/simulator locations:
 - a. Button 1: 100% - 100% output
 - b. Button 2: 50% - Adjusts lighting to 20fc at work plane 30fc at marker board
 - c. Button 3: A/V - Turns off marker board light Dims all other lights to 5fc
 - d. Button 4: Off - Turns all lights off
 - e. Button 5: 75% - Adjusts lighting to 30fc at work plane 30fc at marker board
 - f. Button 6: 25% - Adjusts lighting to 10fc at work plane 20fc at marker board
 - g. Button 7: Up - Uniformly raises all lights.
 - h. Button 8: Down - Uniformly lowers all lights
- 3. Entry Station 4SD at lab locations:
 - a. Button 1: 100% - 100% output
 - b. Button 2: 50% - Adjusts lighting to 20fc at work plane 30fc at marker board
 - c. Button 3: On - 100% output
 - d. Button 4: Off - Turns all lights off
 - e. Button 5: 75% - Adjusts lighting to 30fc at work plane 30fc at marker board



- f. Button 6: 25% - Adjusts lighting to
10fc at work plane
20fc at marker board
 - g. Button 7: Up - Uniformly raises all lights.
 - h. Button 8: Down - Uniformly lowers all lights.
 - 4. Entry Station 4SD at Halls and Breakroom locations:
 - a. Button 1: On - 100% output, all fixtures in area.
 - b. Button 2: Office 1 - 100% Hall lights only.
 - c. Button 3: Break - 100% output, break room only
 - d. Button 4: Master Off - Turns all lighting off in entire building. Runs after hour control sequence.
 - e. Button 5: Off - Turns all lights off
 - f. Button 6: blank- Spare
 - g. Button 7: Up - Uniformly raises lights. Devices located in the Halls shall only raise hall fixtures. Device located in Break Room shall only raise Break Room fixtures.
 - h. Button 8: Down - Uniformly lowers all lights. Devices located in the Halls shall only lower Hall fixtures. Device located in Break Room shall only lower Break Room fixtures.
 - 5. Room Function Description:
 - a. Sensor shall function as a vacancy sensor. Vacancy sensor shall turn off all lights after timeout period. Where daylight zones are indicated on plan photocell shall automatically maintain specified light level by dimming lights within daylight zone when daylight is available.
- F. Typical Public Restroom
- 1. Time Out Periods:
 - a. Business Hours: 15 minutes
 - b. After Hours: 5 minutes
 - 2. Room Function Description:
 - a. During business hours lights shall not turn off, lights shall dim to minimum after time out period. All other hours lights shall illuminate upon detection of occupancy. If no movement is detected for time out period the lights shall turn off.
 - 3. Room Function Description:
 - a. Sensor shall function as a vacancy sensor. Vacancy sensor shall turn off all lights after timeout period. Where daylight zones are indicated on plan photocell shall automatically maintain specified light level by dimming lights within daylight zone when daylight is available.

3.04 ADJUSTING

- A. Occupancy Adjustments: When requested within twelve (12) months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two (2) visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and dead band controls to suit Owner's operations.

3.05 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.
- B. Six (6) months after project completion provide one (1) two (2) hour owner re-training session.

END OF SECTION

SECTION 26 81 00

FIRE ALARM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes fire alarm systems with control panel, manual stations, detectors, signal equipment, controls, and devices.
- B. All control panels, initiating devices, wiring, backbone cabling, etc. shall be compatible with Alison Controls. Provide accessories and programming required to connect new building system into Owner's existing Alison Controls System. Provide deduct alternate for programming if programming can be completed along with concurrent Owner project involving additional fire alarm system programming – coordinate with OPPD. Existing headend equipment is located in Unit No. 1 labeled "AI-10". Coordinate routing of backbone cabling with existing underground and overhead cable tray pathways.

1.03 DEFINITIONS

- A. FACP: Fire alarm control panel.
- B. LED: Light-emitting diode.
- C. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.04 SYSTEM DESCRIPTION

- A. General: Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.
 - 1. Interface with existing fire alarm system for monitoring.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Drawings: Prepare project specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed media.
 - 2. Wiring Diagrams: Detail wiring and differentiate between manufacturer-installed and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified.
- C. Operating Instructions: For mounting at the FACP.
- D. Submissions to Authorities Having Jurisdiction: Submit to authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Engineer for review.
- E. Certificate of Completion: Comply with NFPA 72.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative of the FACP manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Source Limitations: Obtain fire alarm system components through one source from a single manufacturer.

- D. Compliance with Local Requirements: Comply with applicable building code, local ordinances and regulations, and requirements of authorities having jurisdiction.
- E. Comply with NFPA 72.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
 - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
 - 3. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
 - 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
 - 5. Keys and Tools: One extra set for access to locked and tamperproofed components.
 - 6. Audible and Visual Notification Appliances: One of each type installed.
 - 7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alison Control, Inc (Match Existing buildings) Contact: Joe Del Nobile, Service Manager, Alison Control Inc #973-575-7100.
 - 2.

2.02 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.
 - 1. Interface with existing fire alarm system in main building via fiber optic cable.

2.03 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72.
- B. Premises protection includes II-B and Occupancy B.
- C. Fire alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors
 - 4. Automatic sprinkler system water flow.
- D. Fire alarm signal shall initiate the following actions:
 - 1. Alarm notification appliances shall operate continuously.
 - 2. Identify alarm at the FACP
 - 3. De-energize electromagnetic door holders.
 - 4. Transmit an alarm signal to the remote alarm receiving station.
 - 5. Unlocking of electric door locks in designated egress paths.
 - 6. Shutdown of individual fans and other air handling equipment if alarm was initiated by duct detector(s) installed at unit(s).
 - 7. Shutdown of terminal unit fans serving zone where alarm was initiated.
 - 8. Closing of smoke dampers in air ducts of system serving zone where alarm was initiated by opening a fire alarm relay to interrupt power to smoke dampers located in air supply ducts across smoke partitions in the area of the alarm.
 - 9. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
 - 10. Record events in the system memory.
- E. Supervisory signal initiation shall be by one or more of the following devices or actions:

1. Operation of a fire-protection system valve tamper.
- F. System trouble signal initiation shall be by one or more of the following devices or actions:
1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
 2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at the FACP.
 4. Ground or a single break in FACP internal circuits.
 5. Abnormal ac voltage at the FACP.
 6. A break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at the FACP.
- G. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACP Record the event on system printer.

2.04 MANUAL PULL STATIONS

- A. Description: Fabricated of metal or plastic and finished in red or brushed aluminum with molded operating instructions of contrasting color.
1. Single-action mechanism initiates an alarm. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
 2. Station Reset: Key or wrench operated.

2.05 SMOKE DETECTORS

- A. General Description:
1. UL 268 listed, operating at 24-V dc, nominal.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
 4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 5. Integral Visual-Indicating Light: LED type. Indicating detector has operated status.
 6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
 - a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg F per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 155 deg F.
 - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
1. Detector style: Low Profile.
 2. Sensor: LED or infrared light source with matching silicon-cell receiver.
 3. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
- C. Duct Smoke Detectors:
1. Photoelectric Smoke Detectors:
 - a. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
 2. UL 268A listed, operating at 24-V dc, nominal.
 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated status. Provide remote status and alarm indicator and test station where indicated.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
8. Each sensor shall have multiple levels of detection sensitivity.
9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
10. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.06 NOTIFICATION APPLIANCES

- A. Description: Equip for mounting as indicated and have screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
 2. All alarm devices shall be semi-flush mounted unless otherwise indicated.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns produce a sound-pressure level of 90 dB, measured 10 feet from the horn.
- C. Visible Alarm Devices: Synchronized Xenon strobe lights listed under UL 1971 with clear or nominal white polycarbonate lens. Mount lens on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
 1. Rated Light Output: Per NFPA.

2.07 CENTRAL FACP

- A. General Description:
 1. Modular, power-limited design with electronic modules, UL 864 listed.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Annunciator and Display: Liquid-crystal type.
 2. Keypad: Arranged to permit entry and execution of programming, display and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
 1. Signaling Line Circuits: NFPA 72, Class B.
 - a. System Layout: Install no more than 50 addressable devices on each signaling line circuit.
 - b. Furnish system with a minimum of 25% spare device capacity.
 2. Notification-Appliance Circuits: NFPA 72, Class B.
 3. Actuation of alarm notification appliances, annunciation, and actuation of suppression systems shall occur within 10 seconds after the activation of an initiating device.

- D. Smoke-Alarm Verification:
 - 1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
 - 2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
 - 3. Record events by the system printer.
 - 4. Sound general alarm if the alarm is verified.
 - 5. Cancel FACP indication and system reset if the alarm is not verified.
- E. Elevator Controls: Heat detector operation shuts down elevator power by operating a shunt trip in a circuit breaker feeding the elevator.
 - 1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.
- F. Fire-pump power failure, including a dead-phase or phase-reversal condition, initiates the following:
 - 1. A supervisory, audible, and visible "fire-pump power failure" signal indication at the FACP and the annunciator(s).
 - 2. Transmission of trouble signal to remote alarm receiving station.
- G. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.
- H. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP after initiating devices are restored to normal.
 - 1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
 - 2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
 - 3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- I. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.
- J. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.
- K. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.
- L. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, shall be powered by the 24-V dc source.
 - 1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
 - 2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."
- M. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
 - 1. Batteries: Sealed lead calcium.
 - 2. Battery and Charger Capacity: Comply with NFPA 72.

- N. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.
- O. Provide alterations to existing Control Panel for intended modifications.

2.08 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

2.09 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Listed and labeled under UL 864 and NFPA 72.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP panel, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising two lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.
- C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
- D. Self Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Connect the FACP with a disconnect switch or breaker with breaker lock.
- B. Mount FACP with top of cabinets not more than 72" above the finished floor.
- C. Manual Pull Stations: Mount semi-flush in recessed back boxes.
- D. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.
- E. Ceiling Mounted Fire Alarm Devices in Accessible Ceilings: Use flexible metal conduit whip from EMT conduit to ceiling tile to facilitate device relocation in the future and allow device to mount flush to ceiling tile.
- F. Ceiling-Mounted Smoke Detectors: Not less than 4 inches from a sidewall to the near edge.
- G. Smoke Detectors near Air Registers: Install no closer than 60 inches.
- H. Provide an exterior horn.
- I. Provide connection to fire sprinkler PIV valve.
- J. Provide 120 volt circuit for fire sprinkler bell.
- K. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Combine audible and visible alarms at the same location into a single unit.

3.02 INTERCONNECTION TO OTHER SYSTEMS

- A. Alarm Indicating: Provide 18/2 cables in 3/4" conduit as required for alarm and trouble contacts in fire alarm control panel to security panel. Coordinate with Security Contractor.
- B. Alarm Transmitting: Provide CAT 3 telephone cables in 3/4" conduit as required from Digital Alarm Transmitter in fire alarm control panel to telephone board.
- C. Damper control: Provide all necessary wiring to smoke dampers.

- D. Access/Security Control: Provide a relay for each electrically locked exit door. Connect so relay will interrupt power to the locking device under alarm condition.

3.03 WIRING INSTALLATION

- A. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- B. Cable Taps: Use numbered terminal strips in junction, pull and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- C. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- D. Install in conduit in exposed ceiling areas, cabling can be run-free air above accessible ceiling installations.

3.04 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Basic Electrical Materials and Methods."
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply breaker red and lock. Label "FIRE ALARM."

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and connections and to supervise pretesting, testing, and adjustment of the system. Report results in writing.
- B. Final Test Notice: Provide a minimum of 10 days' notice in writing when the system is ready for final acceptance testing.
- C. Minimum System Tests: Test the system according to procedures outlined in NFPA 72. Minimum required tests are as follows:
 - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
 - 2. Test all conductors for short circuits using an insulation-testing device.
 - 3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on record drawings.
 - 4. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
 - 5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
 - 6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
 - 7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones.

8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.
- D. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets Specifications and complies with applicable standards.

3.06 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, adjusting, and maintaining equipment and schedules. Provide a minimum of 4 hours' training.
 2. Schedule training with Owner with at least seven days' advance notice.

3.08 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to two requested visits to Project site for this purpose.

END OF SECTION

DIVISION 27 – COMMUNICATIONS

SECTION 27 15 00
COMMUNICATION CABLING SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes: Equipment, materials, labor, and services to provide telephone, data, and video distribution system including, but not limited to:
 - 1. Communication Pathways
 - 2. Equipment racks, cabinets, and cable management
 - 3. Backboards
 - 4. Structured cable solution
 - 5. Fiber Optic cabling
 - 6. Cabling system identification and administration
 - 7. Communications grounding and bonding
 - 8. System testing certification
- B. Provide all equipment, materials, labor, and services, not specifically mentioned or shown, which may be necessary to complete or perfect all parts of the installation. Ensure that they are in compliance with requirements stated or reasonably inferred by the contract documents.

1.03 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International
- B. EF: Entrance Facility
- C. EMI: Electromagnetic interference
- D. ER: Equipment Room
- E. IDC: Insulation displacement connector
- F. LAN: Local area network
- G. TBB: Telecommunications Bonding Backbone
- H. TR: Telecommunications Room
- I. TGB: Telecommunications Grounding Bar
- J. TMGB: Telecommunications Main Grounding Bar
- K. UTP: Unshielded twisted pair

1.04 WARRANTY

- A. Unless otherwise specified, unconditionally guarantee in writing the materials, equipment, and workmanship for a period of not less than twenty five (25) years from date of acceptance by the owner. The owner shall deem acceptance as beneficial use. Warranty shall be written through the connectivity manufacturer.
- B. Transfer manufacturer's warranties to the owner in addition to the General System Guarantee. Submit these warranties on each item in list form with shop drawings. Detail specific parts within equipment that are subject to separate conditional warranty. Warranty proprietary equipment and systems involved in this contract during the guarantee period.

1.05 SUBMITTALS

- A. Product Data: Include data on features, ratings, and performance for each component specified.
- B. Warranty documents for equipment.
- C. Qualification Data: For installer/ technician, installation supervisor, and field inspector.

- D. Operation and Maintenance Data:
 - 1. Provide three (3) copies of operations and maintenance manuals. As a minimum, manuals should include:
 - a. Complete schematics of each system component
 - b. Troubleshooting procedures
 - c. Factory-authorized support information
 - d. Test results
 - e. Record Drawings
 - f. Cable Administration Drawings

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Contractor shall have at least 5 years experience in the field. Contractor shall be a certified partner of the structured cable system manufacturer. Each installer/technician, installation supervisor, and field inspector shall be a certified installer of the structured cable system manufacturer. The contractor shall provide at least five references for projects of similar scope and specifications.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Grounding: Comply with ANSI-J-STD-607-A/B.
- D. Comply with all applicable ANSI/TIA/EIA 568-C and BICSI standards / guidelines for telecommunications cabling, pathways, performance testing, and administration.

1.07 COORDINATION

- A. Coordinate work of this section with Owner's Representative:
 - 1. Meet with Owner's Representatives to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute record to other participants.
 - 3. Adjust arrangements and locations of distribution frames, patch panels, and cross connects in equipment rooms, wiring closets, and racks to accommodate and optimize arrangement and space requirements of LAN equipment.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. Telecommunications Pathways and Spaces: Comply with most current version of TIA/EIA-569.
- B. Ladder Cable Management Tray (Communications Rooms)
 - 1. Manufacturers: Equipment listed in this specification shall be the standard product of Eaton. whose catalog and model numbers are used to identify the type and quality of design, materials used, and features required.
 - 2. Ladder Cable Management Tray:
 - a. Sizes and Layout: Widths and layouts indicated on drawings.
 - 3. Material: Welded steel
 - a. Straight Section: B-Line series FT4X12**
 - b. Corner Bend: B-Line part no. FTA4RS
 - c. Wall Angle Support Kit: B-Line series FTA9WTK**
 - d. Triangular Support Bracket: B-Line series FTB12CS**
 - e. Cable Radius Drop Outs: B-Line part no. FTA2DO
 - f. Runway Dividers: 4 IN DIVIDER**
 - g. Splice Kits: B-Line series WASHER SPL KIT**
 - 4. Support system: Provide additional support devices as required per manufacturer's recommendations. Supports shall consist of threaded rods with associated fittings and/or wall brackets. Wall brackets shall be factory assemblies by cable tray manufacturer.
 - 5. Grounding: Provide grounding lugs for attachment of ground conductor to tray.
 - 6. Horizontal transition pieces (90s, 45s, etc.) shall be factory manufactured assemblies and shall not be cut and bent from straight runs.

- C. Non-Continuous Cable Support:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Erico/Caddy
 - 2) Cooper/B-line
 - 3) Panduit Corp.
 - 4) Arlington Industries
 - b. J-Hooks or straps: 4" size (or larger), rated for Category cables being supported, with wire spring cable retaining clips or slots for Velcro cable ties.
 - c. Loop Cable Supports: 2" minimum diameter. Arlington Industries TL series LOOP supports.
 - d. Distribution Rings: Wall Mounted 6" D-rings suitable for Category cables being supported.

2.02 EQUIPMENT RACKS, CABINETS, CABLE MANAGEMENT

- A. Subject to compliance with requirements, additional manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1. Panduit
 - 2. Chatsworth/CPI
 - 3. Middle Atlantic
 - 4. Commscope
- B. Equipment Enclosures/Racks
 - 1. See plan details and schedules.
- C. Cable Management
 - 1. See plan details and schedules.

2.03 BACKBOARDS

- A. Backboards: Provide A/C grade plywood, ¾" by 48" by 96", painted with 3 coats of white fire resistant paint on all six sides. Mount plywood "A" side out. Coordinate work with General Contractor.

2.04 STRUCTURED CABLE SOLUTION

- A. Manufacturers:
 - 1. Subject to compliance with requirements, available manufacturers offering products/solutions that may be incorporated into the work include the following:
 - a. Systimax (2071E series cable)
- B. UTP Cable
 - 1. All UTP cable shall be considered "data" cable. This solution shall provide connectivity for current analog telephone switching systems as well as provide future capability for VoIP telephone systems.
 - 2. Data Cable Description: Category 5E/Class D Channel Specifications to 100 MHz, 100-ohm, 4-pair UTP, covered with RED a thermoplastic jacket. All cabling shall be plenum rated.
 - a. Comply with IEEE 802.3 1000BASE-T.
 - b. Comply with TIA/EIA-568-B.2.
 - 3. Data Cable Description: Category 6/Class E Channel Specifications to 250 MHz, 100-ohm, 4-pair UTP, covered with a thermoplastic jacket. All cabling shall be plenum rated.
 - a. Comply with IEEE 802.3 1000BASE-T.
 - b. Comply with TIA-854-A 1000BASE-TX.
 - c. Comply with TIA/EIA-568-B.2.
 - d. Color of cabling as follows:
 - 1) Corporate Network – yellow
 - 2) DCS Network - red
- C. UTP Cable Hardware

1. General Requirements: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
 2. Jacks and Jack Assemblies:
 - a. Modular, matching cable category specifications, eight-position modular receptacle units with integral IDC-type terminals. Comply with TIA/EIA-568-C.1.
 - b. Color of jacks as follows:
 - 1) Corporate Network – yellow
 - 2) DCS Network - red
 3. Copper Patch Cords:
 - a. Patch cords shall be contractor furnished, owner-installed unless otherwise noted.
 - b. Factory-made, four-pair, stranded cables, matching horizontal cable category for rating.
 - c. Quantities: Equal to total number of data outlets = 33% 5 foot, 133% 7 foot, 34% 10 foot (e.g., 100 data outlets = 33 five foot, 133 seven foot, 34 ten foot)
 - d. Color: half - yellow, half – black
 - e. Provide bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
 4. Workstation Outlets: Two-port or four-port connector assemblies mounted in single gang faceplate, unless otherwise noted.
 - a. Faceplate:
 - 1) Faceplate shall have integrated recessed label field with clear plastic window.
 - 2) Color of faceplate shall be white, coordinate faceplate material with adjacent electrical wiring devices at all locations. Refer to "Wiring Devices" specification section.
 - b. Use blanking insert(s) for any unused port(s).
- D. Distribution (backbone) Cabling
1. Optical Fiber Cable.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products/solutions that may be incorporated into the work include the following:
 - 1) Corning ALTOS
 - b. Description: Single-mode 8.3-10/125-micron, nonconductive, loose buffer, optical fiber cable. All fiber cable shall be outdoor rated. See plans for fiber strand counts.
 - 1) Comply with ICEA S-83-596 for mechanical properties.
 - 2) Comply with TIA/EIA-568-C.3 for performance specifications.
 - 3) All optical fiber cable shall be Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70.
 - c. Jacket:
 - 1) Jacket Color: Yellow for 8.3-10/125-micron cable.
 - 2) Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 - 3) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
 2. Optical Fiber Cable Hardware.
 - a. Rack mounted optical fiber termination panel.
 - 1) See schedules.
 - b. Number of connectors per field: One for each fiber assigned to field, plus spares and blank positions adequate to suit specified 20 percent expansion criteria.
 - c. Optical fiber cable connecting hardware:
 - 1) Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-C.3.
 - 2) LC style connectors shall be used. Insertion loss not more than 0.75 dB.

3. Optical Fiber Patch Cords:
 - a. Patch cords shall be contractor furnished, owner-installed unless otherwise noted.
 - b. Factory-made, dual fiber cables matching rating of fiber backbone.
 - c. Quantity: Equal to the total number of fiber strands at each cross connect.
 - d. Lengths: 20% shall be 4 foot, 80% shall be 7 foot.

2.05 CABLING SYSTEM IDENTIFICATION AND ADMINISTRATION

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate work in this section with owner's telephone switch provider, workstation and LAN equipment provider, and local exchange carrier.
 1. Meet jointly with representatives of above organizations, engineering firm and owners to exchange information and agree on details of equipment arrangements and installation of system interfaces prior to start of installation.
 2. Coordinate locations of distribution frames, patch panels, and cross connects in ERs and TRs to accommodate and optimize arrangement and space requirements of telephone, LAN, demarcation, and miscellaneous equipment
- B. Coordinate work of this section with other trades. Coordinate installation of racks, enclosures, and other equipment to avoid overhead sprinkler piping or similar obstructions over communications equipment.

3.02 WIRING METHODS

- A. Comply with TIA/EIA-568-C.
- B. Only Main conduit sleeves are indicated on drawings. Additional sleeves will be required. Communications contractor shall provide additional sleeves through walls / areas as required to protect cabling at all locations.
- C. Provide bushings at both ends of all raceways / sleeves prior to installing cable.
- D. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except above accessible ceiling spaces where unenclosed wiring method may be used.
- E. Conceal conductors and cables in accessible ceilings, walls, and floors where possible. In exposed structure areas, route conduit tight to structure. Conduit shall be routed parallel and perpendicular to structure in a neat manner. Exposed cabling of any type shall not be allowed.
- F. Install cables parallel to structural members.
- G. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- H. Install all ladder tray in telecommunications rooms. Provide all components and accessories included for a complete installation including splices, end closing kits, grounding and bonding, etc.
- I. Provide vertically mounted ladder tray for vertical cable pathways in TRs or ERs. Mount according to manufacturer's specifications, sized appropriately.
- J. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- K. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- L. Separation from EMI Sources:

1. Comply with TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.
 7. Separation from communication, speaker-microphone, line-level, speaker-level, and power wiring: A minimum of 4 inches.
- M. Open-Cable Installation:
1. Communications cables shall be installed in cable tray where cable tray is available. Secure cable within cable tray system a minimum of every 15 feet. Within telecommunications closets, secure cables to ladder system 12" on center. All securing of cables shall be with removable Velcro type fasteners.
 2. J-hooks or adjustable cable supports (slings) shall be used in any ceiling space where cable tray is not specified. Maximum distance between supports shall be 5'. J-hooks shall be fastened to permanent building elements (i.e., steel, walls, etc.).
 3. Where j-hooks are fastened using support wires, the support wires shall be independent from the other building support wires and shall be secured at both ends. Cables and raceways shall not be supported by ceiling grids.
 4. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 5. Suspend UTP cable not in a raceway or cable tray a minimum of 8 inches above ceilings by cable
 6. Penetrations through floor and fire-rated walls shall utilize intermediate metallic conduit (IMC) or galvanized rigid conduit (GRC) sleeves and shall be firestopped after installation and testing, utilizing a firestopping assembly approved for that application.
 7. Cable shall not be run through structural members or in contact with pipes, ducts, building structure, or other potentially damaging items.
- N. Horizontal Cabling
1. Bridged taps or splices shall not be permitted in the horizontal cabling.
 2. The maximum allowable horizontal cable length is 295 feet (90 m).
 3. The maximum combined cross-connect cable length is 33 feet (10 m).
 4. Terminate conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 5. In the communications equipment room, provide a 10 foot service loop for each cable.
 6. At the workstation outlet, provide a 3 foot service loop for each cable. Bundle cable above accessible ceiling location with Velcro straps.
- O. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-C.

3.03 COMMUNICATIONS GROUNDING

- A. Grounding shall conform to ANSI/TIA-607-A - Commercial Building Grounding and Bonding Requirements for Telecommunications, ANSI/TIA-607-B - Generic Telecommunications Bonding and Grounding for Customer Premises, National Electrical Code®, ANSI/NECA/BICSI-568 and manufacturer's grounding requirements as minimum.
- B. Bond and ground equipment racks, housings, messenger cables, ground bars, and communication raceways.

3.04 FIRESTOPPING

- A. Comply with TIA/EIA-569-A; Annex A, "Firestopping."
- B. Use firestop devices for all wall, floor, and roof penetrations.
- C. Penetrations through floor and fire-rated walls shall utilize intermediate metallic conduit (IMC) or galvanized rigid conduit (GRC) sleeves and shall be firestopped after installation and testing, utilizing a firestopping assembly approved for that application.
- D. Selected systems shall not be less than the hourly time delay ratings indicated in the Contract Documents for each respective fire-rated floor, wall, or other partition of building construction. Firestop for each type of communications penetration shall conform to requirements of an independent testing laboratory design drawing or manufacturer's approved modification when used in conjunction with details shown on the Drawings.
- E. Perform all necessary coordination with trades constructing floors, walls, or other partitions of building construction with respect to size and shape of each opening to be constructed and device or system approved for use in each instance.

3.05 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 1. Administration Class: 3
 2. Color-code cross-connect fields. Apply colors to voice and data service covers and labels.
- B. Comply with requirements in "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner. Also furnish printed drawing no smaller than 36" by 24" and laminated for each TR. At completion, drawing shall reflect as-built conditions.
- D. Cable and Wire Identification:
 1. Comply with TIA/EIA standards.
 2. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
 3. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in ER and TRs: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

3.06 SOURCE QUALITY CONTROL

- A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-C.
- B. Factory test UTP cables according to TIA/EIA-568-C.
- C. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-C. See Division 01 Section "Quality Requirements" for retesting and re-inspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

3.07 FIELD QUALITY CONTROL

- A. Perform tests and inspections. Test each signal path for end-to-end performance from each end of all pairs installed.
- B. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C, when tested according to test procedures of this standard.
- C. Tests and Inspections:
 1. Visually inspect UTP and or optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B/C.
 2. Visually confirm marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 5. Correct non-passing cables including removing excess cabling from cables that test over specified distance limits. Retest to demonstrate compliance.
 6. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.3. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-C.3.
 7. UTP Performance Tests:
 - a. Test for each outlet. Perform the following tests according to TIA/EIA-568-C.1 and TIA/EIA-568-C.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.

- 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
8. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-C.

3.08 CLEANING

- A. After completing system installation including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes including chips, scratches, and abrasions.

3.09 RECORD DRAWINGS

- A. Maintain current documents at the construction site. Submit with Operations and Maintenance Manuals.
- B. Record drawings shall include all information required for shop drawings and in addition shall indicate the following:
 1. Identification of each cable outlet uniquely identified.
 2. Routing of cables from communications closets to jacks.
 3. Revisions to construction documents (addenda and field changes).
- C. Provide warranty certificate for voice data system.

END OF SECTION

SECTION 27 41 34
AUDIO VISUAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. All work in this section can be completed by the following contractors:
 - 1. AVI-SPL: 10351 Portal Road, Omaha, NE 68128. (402) 509-3989
 - 2. AVI Systems: 5055 S 111th Street, Omaha, NE 68137. (402) 593-6500
 - 3. CCS Presentation Systems: 11041 O Street, Omaha, NE 68137. (402) 331-2320
 - 4. CTi Technologies: 14990 Shepard Street, Suite 600, Omaha, NE 68138. (402) 593-6750
- B. This Section includes audio visual systems indicated on the construction drawings including but not limited to:
 - 1. Televisions
 - 2. Projectors
 - 3. Projector Screens
 - 4. Audio Visual Cabling, Faceplates, Connectors
 - 5. Speakers (excluding sound masking system speakers) and speaker cabling
 - 6. AV Racks
 - 7. AV Components including amplifiers, A/V Controller, touch screens
 - 8. Microphones
 - 9. Video Conferencing Cameras

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For audio visual equipment and components to include in maintenance manuals specified in Division 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:
 - 1. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
 - 2. System installation and setup guides, with data forms to plan and record options and setup decisions.
- E. Warranty documents for equipment.
- F. As-Built Drawings upon completion of project.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70, "National Electrical Code."
- D. Compliance with Local Requirements: Comply with applicable building code, local ordinances and regulations, and requirements of authorities having jurisdiction.

1.05 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of audio/visual systems and equipment that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A/B.
- B. Types of pathways:
 - 1. Non-Continuous Cable Support:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Erico/Caddy
 - 2) Cooper/B-line
 - 3) Panduit Corp.
 - b. NRTL labeled for support of UTP cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - c. J-hooks and or adjustable cable supports (also called slings) shall be used.

2.02 MANUFACTURERS / PRODUCTS

- A. Refer to plans for acceptable manufacturers and product data. All part numbers shown represent current equipment available at time of bid. Should any piece of equipment become unavailable or be replaced by a different model number, the contractor shall provide the current model at time of order or an equal replacement at no additional cost to the project.
- B. All cabling shall be plenum rated unless otherwise indicated.
- C. Drawings indicate major AV system components. Provide products complete with all accessories, misc. devices, connectors, etc. as needed for a complete and operational system for the intended use and effect.
- D. Provide faceplates for AV input devices where exposed. Faceplates shall match adjacent electrical wiring devices for material and finish at all locations.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

3.02 SYSTEM SETUP

- A. Obtain detailed Project planning forms from manufacturer of audio/visual control systems.
 - 1. Program room touch screen(s) to control projectors, displays, volume controls, source inputs, motorized shades, room lighting, video conferencing equipment, and other devices as indicated on drawings.
 - 2. Set maximum volume level for all AV displays and audio sound systems. Coordinate maximum levels with owner and engineer. Program touch screen to select and control designated speaker zones.
 - 3. Set up wired and wireless microphone systems including setting frequencies and checking coverage patterns. Aim microphones per manufacturer's recommendations. Adjust pick-up levels to minimize echo and ambient room noises.
 - 4. Program touch-screen screen saver and background to display owner selected logo. Match owner-provided templates if available. Coordinate templates with owner and Engineer prior to final programming.

5. Provide network connection to all projectors, televisions, encoders, decoders, wireless collaboration devices, and AV head-end equipment. Coordinate obtaining IP addresses with owner's IT representative.
6. Program touch screen to select and control room sources such as HDMI inputs, wireless display devices, owner-furnished cable TV boxes, owner-furnished PCs, etc.
7. Interface AV system with room lighting control system where indicated. Program AV touch screen to mimic room lighting control pushbuttons. Refer to lighting plans for additional information.
8. Provide interface between all audio systems / amplifiers to building fire alarm control panel to silence all AV system audio when fire alarm system is in an alarm condition in accordance with NFPA requirements. Test interface for compliance.
9. Program touch screens to present multiple pages for control of dividable and open spaces.
10. Program touch screens to mirror Cisco Webex interface.
11. Connect all devices, accessories, equipment, cabling, etc. for a complete and operational system.
12. Install video conferencing cameras flush and level. Aim cameras for proper room coverage. Adjust aiming and installation location if needed to avoid view obstructions.

3.03 CABLING

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces. In exposed structure areas, route conduit tight to structure. Conduit shall be routed parallel and perpendicular to structure in a neat manner. Exposed cabling of any type shall not be allowed.
- B. General Cable Installation Requirements:
 1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
 2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
 3. Secure and support cables at intervals not exceeding 48 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

3.04 GROUNDING

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Bond shields and drain conductors to ground at only one point in each circuit.

3.05 IDENTIFICATION

- A. In addition to requirements in this Article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and with TIA/EIA-606.
- B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.

2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

C. At completion, cable and asset management software shall reflect as-built conditions.

3.06 SYSTEM SOFTWARE

- A. Develop, install, and test software and databases for the complete and proper operation of systems involved. Install software on owner-designated workstations. Assign software license to Owner.
- B. All programming code for AV system components (controllers, touch screens, audio DSPs, etc.) shall be turned over to owner after programming, commissioning, and setup of system is complete.

3.07 FIRESTOPPING

- A. Comply with TIA/EIA-569-A; Annex A, "Firestopping."
- B. Select appropriate type or types of through penetration firestop devices or systems appropriate for each type of communications penetration and base each selection on criteria specified herein.
 1. Use firestop devices for all wall, floor, and roof penetrations.
 2. Putty or caulk is only to be used on small penetrations.
- C. Selected systems shall not be less than the hourly time delay ratings indicated in the Contract Documents for each respective fire-rated floor, wall, or other partition of building construction. Firestop for each type of communications penetration shall conform to requirements of an independent testing laboratory design drawing or manufacturer's approved modification when used in conjunction with details shown on the Drawings.
- D. Perform all necessary coordination with trades constructing floors, walls, or other partitions of building construction with respect to size and shape of each opening to be constructed and device or system approved for use in each instance.

3.08 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports:
- C. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.09 STARTUP SERVICE

- A. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain audio visual systems.
 1. Conduct a minimum of four hours' training as specified in instructions to Owner's employees in Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 27 51 23

COMMERCIAL MULTI-PARTY COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. All work in this section shall be by GAI-TRONICS, A Hubbell Company, 3030 Kutztown Road, Reading, PA 19605.
- B. This Section includes communications systems indicated on the construction drawings including but not limited to:
 - 1. Wall Stations
 - 2. Cabling, Faceplates, Connectors
 - 3. Speakers
 - 4. Volume Controls

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For audio visual equipment and components to include in maintenance manuals specified in Division 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:
 - 1. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
 - 2. System installation and setup guides, with data forms to plan and record options and setup decisions.
- E. Warranty documents for equipment.
- F. As-Built Drawings upon completion of project.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70, "National Electrical Code."
- D. Compliance with Local Requirements: Comply with applicable building code, local ordinances and regulations, and requirements of authorities having jurisdiction.

1.05 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of audio/visual systems and equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A/B.
- B. Types of pathways:
 - 1. Non-Continuous Cable Support:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Erico/Caddy
 - 2) Cooper/B-line
 - 3) Panduit Corp.
 - b. NRTL labeled for support of UTP cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - c. J-hooks and or adjustable cable supports (also called slings) shall be used.

2.02 MANUFACTURERS / PRODUCTS

- A. Refer to plans for acceptable manufacturers and product data. All part numbers shown represent current equipment available at time of bid. Should any piece of equipment become unavailable or be replaced by a different model number, the contractor shall provide the current model at time of order or an equal replacement at no additional cost to the project.
- B. Drawings indicate major system components. Provide products complete with all accessories, misc. devices, connectors, etc. as needed for a complete and operational system for the intended use and effect.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

3.02 SYSTEM SETUP

- A. The system shall provide facilities for both page and common-talking party line operation at various locations throughout the system. Two-way conversations shall take place between stations using telephone type handsets. Handsets shall perform in areas as high as 115 dB (Sound Pressure Level) ambient noise without the use of acoustical enclosures or booths (not to exceed 115 dB SPL).
- B. Each station shall be capable of switching between the page line and (five) common-talking party line(s).
 - 1. Page channel shall broadcast speech over all system speakers. Where necessary, to prevent acoustic coupling, the speaker adjacent to the handset station shall be automatically muted (when wired accordingly in enclosure during installation) when the handset is removed from its cradle and the page channel is selected.
 - 2. Party line channel(s) shall provide two-way conversation capability without interference or crosstalk between channels; conversation will not be heard over the speaker system.
- C. Install all components per manufacturer's recommendations.

3.03 CABLING

- A. Wiring Method: Install cables in conduit, raceways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces. In exposed structure areas, route conduit tight to structure. Conduit shall be routed parallel and perpendicular to structure in a neat manner. Exposed cabling of any type shall not be allowed.

- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible. In exposed structure areas, route conduit tight to structure. Conduit shall be routed parallel and perpendicular to structure in a neat manner. Exposed cabling of any type shall not be allowed.
- C. Install cables without damaging conductors, shield, or jacket.
- D. J-hooks or adjustable cable supports (slings) shall be used in any ceiling space where cable tray is not specified. Maximum distance between supports shall be 5'. J-hooks shall be fastened to permanent building elements (i.e., steel, walls, etc.).
- E. Where j-hooks are fastened using support wires, the support wires shall be independent from the other building support wires and shall be secured at both ends. Cables and raceways shall not be supported by ceiling grids.
- F. Suspend cable not in a raceway or cable tray a minimum of 8 inches above ceilings.
- G. General Cable Installation Requirements:
 - 1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
 - 2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
 - 3. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
 - 4. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
- H. Seller must guarantee that no crosstalk, interference or oscillation will occur due to induced coupling under wiring conditions indicated above, when installed in accordance with field wiring recommendations.
- I. One twisted pair of conductors shall be required for the page line and one twisted pair for each party line.
 - 1. Multi-party system cable with ground conductor and spare conductor shall contain sixteen (16) conductors.
 - 2. Speaker cable shall contain two (2) conductors.

3.04 GROUNDING

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Bond shields and drain conductors to ground at only one point in each circuit.

3.05 IDENTIFICATION

- A. In addition to requirements in this Article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and with TIA/EIA-606.
- B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - 1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.
- C. At completion, cable and asset management software shall reflect as-built conditions.

3.06 FIRESTOPPING

- A. Comply with TIA/EIA-569-A; Annex A, "Firestopping."
- B. Select appropriate type or types of through penetration firestop devices or systems appropriate for each type of communications penetration and base each selection on criteria specified herein.
 - 1. Use firestop devices for all wall, floor, and roof penetrations.
 - 2. Putty or caulk is only to be used on small penetrations.
- C. Selected systems shall not be less than the hourly time delay ratings indicated in the Contract Documents for each respective fire-rated floor, wall, or other partition of building construction. Firestop for each type of communications penetration shall conform to requirements of an independent testing laboratory design drawing or manufacturer's approved modification when used in conjunction with details shown on the Drawings.
- D. Perform all necessary coordination with trades constructing floors, walls, or other partitions of building construction with respect to size and shape of each opening to be constructed and device or system approved for use in each instance.

3.07 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports:
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. Provide special equipment and software if testing requires special or dedicated equipment.
 - 2. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
- D. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.08 STARTUP SERVICE

- A. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks.

END OF SECTION

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

**SECTION 28 13 00
ACCESS 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.
- B. Access control system shall be integrated with Owner's existing control system.

1.02 SUMMARY

- A. All work in this section shall be by Paladin Technologies (formerly VTI Security). 11011 Q Street Building A Suite 101, Omaha, NE 68137. (402) 210-2839
- B. This Section includes pathways and devices for an access control system as indicated on the drawings including but not limited to:
 - 1. Card readers, door contacts, request-to-exit motion sensors, door controllers, power supplies, and network interface devices.
 - 2. Select Pathways for cabling
 - 3. Conductors and cabling
 - 4. Access Control System Licenses
- C. Provide all equipment, materials, labor, and services, not specifically mentioned or shown, which may be necessary to complete or perfect all parts of the installation. Ensure that they are in compliance with requirements stated or reasonably inferred by the contract documents.
- D. Related Sections include the following:
 - 1. Division 08 Section "Door Hardware" for door hardware and access control device information.
 - 2. Division 26 Section "Basic Electrical Materials and Methods" for raceway information.
 - 3. Division 27 Section "Structured Cable Systems" for interface devices and communications cabling to integrate security functions of that Section into security access system.

1.03 DEFINITIONS

- A. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- B. Credential: A physical medium used to associate a person with an access level.
- C. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated. Include operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. System components including devices and cabling.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Floor plans showing device locations, quantities, and cabling diagrams.
- C. Qualifications Data: For installer / technician, installation supervisor and field inspector.
- D. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:
 - 1. Software documentation.

2. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
 3. System installation and setup guides, with data forms to plan and record options and setup decisions.
- E. As-Built Drawings upon completion of project.
- F. Test results
- G. Warranty Information

1.05 QUALITY INSURANCE

- A. Installer Qualifications: Contractor shall have at least 5 years' experience in the field. Each installer/technician, installation supervisor, and field inspector shall be a certified installer of the system manufacturer. The contractor shall provide at least five references for projects of similar scope and specifications.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Grounding: Comply with ANSI-J-STD-607-A/B.
- D. Comply with all applicable ANSI/TIA/EIA 568-C and BICSI standards / guidelines for telecommunications cabling, pathways, performance testing, and administration.

1.06 WARRANTY

- A. Equipment shall be warranted against any defects in material and from the date of acceptance by the owner. The owner shall deem acceptance as beneficial use. In the event any part of the system is found by manufacturer to be defective within the warranty period, the manufacturer shall repair and/or replace any defective parts.
1. Warranty Period: One year from the date of owner acceptance.

1.07 SYSTEM DESCRIPTION

- A. The access Control System shall consist of the following:
1. TCP/IP network interface capability
 2. Gateways
 3. Door Controllers
 4. Card Readers
 5. Door position switches
 6. Request-to-exit sensors
 7. Interface to Door locking devices (electric strikes, electronic lock sets, etc.)

1.08 PERFORMANCE REQUIREMENTS

- A. Security access system shall seamlessly integrate with existing Owner security access system – Software House C-Cure 9000 (example iStar).
- B. Door Hardware Interface: Coordinate with Division 08 Sections that specify door hardware required to be monitored or controlled by the security access system. The Controllers in this Section shall have electrical characteristics that match the signal and power requirements of door hardware. Integrate door hardware specified in Division 08 Sections to function with the door controllers and power supplies furnished and installed as part of this section.
1. Scope of work distribution is as follows:
 - a. Division 8 to prepare doors and mount all access control hardware furnished with division 8 equipment.
 - b. Security contractor to install all division 28 hardware as required.
 - c. Security contractor to test all door hardware and coordinate troubleshooting with Division 8 as required.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A/B.

B. Types of pathways:

1. Non-Continuous Cable Support:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Erico/Caddy
 - 2) Cooper/B-line
 - 3) Panduit Corp.
 - b. NRTL labeled for support of UTP cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - c. Lacing bars, spools, and D-rings should only be used in the EFs, TRs and ERs.
 - d. J-hooks and or adjustable cable supports (also called slings) shall be used in any ceiling space where cable tray is not specified.

2.02 MANUFACTURERS

- A. Access control equipment furnished under this section shall be the standard product utilizing HID, iStar, Alarm SAF, Sentrol, Securitron, and Bosch.

2.03 CONTROLLERS

- A. Controllers must be compatible with Software house C-Cure 9000 (example – iStar). Each new door controller shall be interconnected to the facility network via manufactured CAT6 plenum rated cable. Basis of design:
 1. iSTAR Ultra

2.04 READER MODULE

- A. RM-4 Reader Module (as required)

2.05 CARD READERS

- A. HID iClass Reader
 1. Black in color
 2. HID R40
 3. HID RK40 (keypad locations only)
 4. HID R15 (mullion mount locations only)

2.06 REQUEST TO EXIT MOTION SENSORS

- A. PIR motion sensor
 1. Light Gray
 2. Bosch DS160

2.07 DOOR POSITION SWITCHES

- A. Steel Door Type:
 1. 1" diameter
 2. Dual Pole, Dual Throw (DPDT)
 3. Sentrol 1076 series
- B. Overhead Door Type:
 1. Securitron Series MSS

2.08 POWER SUPPLIES

- A. Power supplies for power to doors shall be furnished by security contractor. Provide Alarm SAF PS 1240 series power supplies as required to accommodate door controller power in each communications room. Coordinate power supply compatibility with door hardware components prior to ordering.

2.09 CABLES

- A. All access control cabling shall be plenum rated. Provide cable size/quantity configurations for each device as required to perform functions specified.
 1. Coleman Cable # 73100
 2. Belden Cable # 658AFS0001000

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

3.02 COORDINATION

- A. Coordinate work with other trades. Coordinate equipment mounting locations with available wall space.

3.03 SYSTEM SOFTWARE, PROGRAMMING, AND COMMISSIONING

- A. OPPD is responsible for all programming of controllers, card readers, door position switches, etc. on the C-Cure 9000 access control software.
- B. OPPD will provide the IP Addresses, Sub Net Addresses, Gateway, Port/Port Number, and Location description of each door/card reader.
- C. OPPD will assist with all door testing and commissioning of system.
- D. Sequence of Operations
 - 1. Condition: Door with card reader, door switch, electrified lockset and presence switch: Entrance into the secure area is obtained by valid card use at the reader which activates a ten second override of the door switch and release of the electrified lockset. Exit from the secure area is obtained when the presence sensor is activated initiating a ten second override of the door switch during which time the person uses the manual door hardware to exit the door.
 - 2. Condition: Door with door switch: Entrance into the secure area is not allowed. Exit from the secure area is obtained when the person uses the manual door hardware to exit the door.
- E. Security vendor shall connect fire alarm output, provided by others, to control panel.

3.04 CABLING

- A. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible. In exposed structure areas, route conduit tight to structure. Conduit shall be routed parallel and perpendicular to structure in a neat manner. Exposed cabling of any type shall not be allowed.
- C. Install cables without damaging conductors, shield, or jacket.
- D. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- E. J-hooks or adjustable cable supports (slings) shall be used in any ceiling space where cable tray is not specified. Maximum distance between supports shall be 5'. J-hooks shall be fastened to permanent building elements (i.e., steel, walls, etc.).
- F. Where j-hooks are fastened using support wires, the support wires shall be independent from the other building support wires and shall be secured at both ends. Cables and raceways shall not be supported by ceiling grids.
- G. Suspend cable not in a raceway or cable tray a minimum of 8 inches above ceilings.

3.05 GROUNDING

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Bond shields and drain conductors to ground at only one point in each circuit.

3.06 INSTALLATION AND PRE-PROGRAMMING

- A. Install access control devices including card readers, request-to-exit devices, and other pertinent equipment.
- B. Install door controllers, power supplies, and other equipment in designated rooms. Provide enclosures for equipment. Connect 120V power to power supplies as required.
- C. Install Network Interface Device. Connect network interface device to door controllers. Connect network data cable to network interface device and prepare for integration by owner's security integration contractor.

3.07 IDENTIFICATION

- A. In addition to requirements in this Article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and with TIA/EIA-606.
- B. Using cable and asset management software, develop Cable Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement.
- C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - 1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.
- D. At completion, cable and asset management software shall reflect as-built conditions.

3.08 FIRESTOPPING

- A. Comply with TIA/EIA-569-A; Annex A, "Firestopping."
- B. Select appropriate type or types of through penetration firestop devices or systems appropriate for each type of communications penetration and base each selection on criteria specified herein.
 - 1. Use firestop devices for all wall, floor, and roof penetrations.
 - 2. Putty or caulk is only to be used on small penetrations.
- C. Selected systems shall not be less than the hourly time delay ratings indicated in the Contract Documents for each respective fire-rated floor, wall, or other partition of building construction. Firestop for each type of communications penetration shall conform to requirements of an independent testing laboratory design drawing or manufacturer's approved modification when used in conjunction with details shown on the Drawings.
- D. Perform all necessary coordination with trades constructing floors, walls, or other partitions of building construction with respect to size and shape of each opening to be constructed and device or system approved for use in each instance.

3.09 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports:
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
 - 2. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
- D. Remove and replace malfunctioning devices and circuits and retest as specified above.

END OF SECTION

SECTION 28 23 00
VIDEO SURVEILLANCE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. All work in this section shall be by Inteconnex. 4531 South 88th Street, Suite B, Omaha, NE 68127. Contact: Matt Hoeke 402-670-8515
- B. This Section includes devices for a video surveillance system as indicated on the drawings including but not limited to:
 - 1. Video Surveillance Cameras
 - 2. Camera mounting hardware
 - 3. Network video recorders (archivers)
 - 4. Video Surveillance System Software and Licenses
 - 5. Video Intercom
- C. Provide all equipment, materials, labor, and services, not specifically mentioned or shown, which may be necessary to complete or perfect all parts of the installation. Ensure that they are in compliance with requirements stated or reasonably inferred by the contract documents.

1.03 DEFINITIONS

- A. AGC: Automatic gain control.
- B. FPS: Frames per second.
- C. MPEG: Moving picture experts group.
- D. Motion JPEG: Motion joint photographic experts group standard.
- E. NVR: Network Video Recorder
- F. ONVIF: Open network video interface forum.
- G. UPS: Uninterruptible power supply.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
 - 1. Wiring Diagrams: Power, signal, and control wiring, and grounding.
 - 2. Equipment List: Include every piece of equipment by model number, manufacturer.
 - 3. Floor plans showing device locations, quantities, and cabling diagrams
- C. Qualification Data: For installer / technician, installation supervisor, and field inspector.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data:
 - 1. Provide three (3) copies of operations and maintenance manuals. As a minimum, manuals should include:
 - a. Complete schematics of each system component
 - b. Troubleshooting procedures
 - c. Factory-authorized support information
- F. As-Built Drawings upon completion of project.
- G. Warranty Information

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Compliance with Local Requirements: Comply with applicable building code, local ordinances and regulations, and requirements of authorities having jurisdiction.

1.06 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.

1.07 SYSTEM REQUIREMENTS

- A. Video signal format shall comply with ONVIF.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
- C. Video surveillance system shall seamlessly integrate with Owner's Avigilon monitoring and control system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Software furnished under this section shall be the standard product of Avigilon whose catalog and model numbers are used to indicate the functions and quality of the software.
- B. Network Video Recorders (Archivers) furnished under this section shall be the standard product of Avigilon whose catalog and model numbers are used to indicate the type and quality of design, material type, and required features.
 - 1. Storage NVR shall be dedicated NVR with the following requirements:
 - a. 30 days Storage
 - b. Classified Object Detection
- C. Camera equipment furnished under this section shall be the standard product of Avigilon whose catalog and model numbers are used to indicate the type and quality of design, material type, and required features.

2.02 CAMERAS

- A. Megapixel Indoor Dome Color Camera with the following features:
 - 1. Fixed IP Day/Night
 - 2. 3-9mm
 - 3. 1080P
 - 4. Remote zoom and focus
 - 5. Recessed Ceiling
 - 6. Avigilon 2.0C-H5SL-D1
- B. Megapixel Outdoor Multi-Sensor Color Camera with the following features:
 - 1. Fixed IP Day/Night
 - 2. Remote zoom and focus
 - 3. Corner mount bracket
 - 4. Outdoor Rated
 - 5. Avigilon H4A-3MH-270 (or equal)

2.03 CAMERA LICENSES

- 1. Provide cameras with individual camera connection license to integrate with Avigilon archiver.

2.04 VIDEO INTERCOM DOOR STATION

- A. Physical Features:
 - 1. Brushed stainless steel front plate with aluminum body
 - a. IP66/67 rated
 - b. IK10 impact-resistant
- B. Model Avigilon H4

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate work with other trades. Coordinate equipment mounting locations with available wall space.

3.02 WIRING

- A. Wiring for cameras shall be furnished / installed by division 271500 contractor.

3.03 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras and infrared illuminators level and plumb.
- B. Install cameras at heights indicated on drawings. Coordinate exact locations in field to avoid obstructions of intended view.
- C. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system component enclosures, and mounted in self-protected, inconspicuous positions.
- D. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification of Electrical Systems."

3.04 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video surveillance system components, including camera-housing windows, lenses, and monitor screens.

END OF SECTION

DIVISION 31 - EARTHWORK

**SECTION 31 10 00
SITE CLEARING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
 - 1. Vegetation removal limits.
 - 2. Areas for temporary construction and field offices.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 GENERAL SITE PREPARATION

- A. Review and implement recommendations noted within the geotechnical exploration report included within Section 00 31 32 - Geotechnical Data . Site clearing, grubbing and stripping will need to be performed only during dry weather conditions. Operation of heavy equipment on the site during wet conditions could result in excessive rutting and mixing of organic debris with the underlying soils.
- B. Keep project site free from drainage ponding due to construction operations during progress of work. Make arrangements for disposal of all water and sewage received on the site from temporary connection or stoppages. Do not discharge any water or sewage onto private property outside of the construction right-of-way.
- C. Remove and store obstructions such as signs and fences for replacement upon completion of construction. Provide temporary fencing if necessary to prevent accidents until permanent fencing is restored.

3.02 SITE CLEARING

- A. Comply with other requirements specified in Section 01 70 00.
- 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.

3.03 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.

3.04 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. Do not remove or damage vegetation beyond the limits indicated on drawings.

- C. Install substantial, highly visible fences at least 4 feet high to prevent inadvertent damage to vegetation to remain:
 - 1. At vegetation removal limits, as indicated on the drawings.
 - 2. The contractor shall exercise all possible care to avoid damage to existing trees and their roots which are scheduled to remain.
- D. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- E. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
 - 1. Clearing shall consist of the felling and cutting up of trees and landscaping and their satisfactory disposal. Trees and other vegetation designated for removal, together with down timber, vegetation, stumps, roots, and brush in areas to be cleared, shall be removed in their entirety.
 - 2. Remove and dispose of stumps, matted roots and roots larger than 2-inches in diameter under paved areas and cut areas, and areas having 2-feet or less of fill. Exercise special care to avoid damage to trees and their roots which are scheduled to remain.
- F. 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.

3.05 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 20 00
EARTHWORK**

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section covers excavation, trenching, cutting, filling, backfilling, overexcavation & recompaction and related work for construction. Refer to the full Geotechnical Engineering Report prepared for this project included under Specification Section 00 31 32 - Geotechnical Data for additional information.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 00 31 32 - Geotechnical Data.
- B. Section 01 40 00 - Quality Requirements.
- C. Section 31 10 00 - Site Clearing.

1.03 PROTECTION

- A. Utility Removal: Before the Prime (General) Contractor begins his/her grading operations, he/she shall confer with the Mechanical and Electrical Subcontractors to assure that they have contacted the owners of any underground and overhead utilities which may be on or in close proximity to the grading areas, and have arranged for the necessary disconnection of these utilities in accord with the regulations of the utility company concerned. Such utility disconnections, if performed by the owning utility company, shall be paid for by the Mechanical or Electrical Subcontractors, respectively, and such costs shall be included within their bid. Where such disconnection is not customarily performed by the owning utility, the respective Mechanical or Electrical Subcontractors shall perform the disconnection and the costs shall be included in their bid. The Prime Contractor shall take such measures as the Architect/Engineer may direct in properly protecting utilities which are scheduled to remain throughout the period when his/her grading operations are in progress. Whenever and wherever disconnection and removal operations are undertaken by the Mechanical or Electrical Subcontractors, or the owners of the utilities, the Prime Contractor shall cooperate to the extent that ample protection of their work will be provided, so that the entire work as contemplated be expedited to the best interests of all concerned, as judged by the Architect/Engineer. Known existing abandoned utility lines shall not be allowed to remain under the building or under areas less than 5-feet outside the building line regardless of the depth of the lines. They shall not be allowed to remain under paving and walk areas and nonpaved areas where the utility will be less than 3-feet below finish grade. Where abandoned utilities are required to be removed, they shall be totally removed, and the excavations backfilled and compacted as specified elsewhere in this Section.
- B. Protection of Existing Service Lines and Utility Structures: The existing service lines and utility structures which are scheduled to remain and which are shown or indicated on the Drawings, the location of which is known to the Contractor prior to excavation or construction of fills and embankments, shall be protected and safeguarded from damage during grading operations, and, if damaged, shall be repaired by the Contractor at his/her expense. The above provisions are applicable to all service lines and utility structures, all or any portion of which protrudes above the original ground surface or lies beneath the ground surface within the grading area.
- C. Protection of Existing Site Features: The Contractor shall guard against, and be responsible for, movement, settlement, and collapse of existing site features including but not limited to sidewalks, monument signs, street passages, and aboveground and underground utilities. The Contractor shall repair damage done to the Owner's property and other property, on or off premises, by reason of required work.
- D. Provide for surface drainage during the period of construction in a manner that will protect newly graded and adjacent areas. At all times, maintain positive drainage away from the building area.

- E. Protect all excavations within the area of construction from the action of the elements. Keep all excavations free of water at all times during the entire progress of construction, regardless of the cause, source, or nature of the water. Temporarily grade away from excavated areas to prevent excessive moisture from penetrating at those areas.
- F. All areas of the site which are regraded as shown on the Drawings shall be finished graded to the profile shown on the Drawings.
- G. Erosion Control: Every precaution and temporary measure shall be taken, such as temporary seeding or temporary grading to prevent damage from erosion of freshly graded areas. This shall apply to damage to newly graded areas within the site and damage to adjacent properties by eroded materials. Comply with all codes and ordinances regarding erosion control requirements.
- H. Adjoining Streets and Roads: The Contractor shall prevent excessive dirt from depositing on adjacent roads and streets. In the event that dirt gathers on adjacent roads and streets contractor shall clean streets, removing dirt and soil.
- I. Care of Trees to Remain: The Contractor shall exercise all possible care to prevent damage to roots and other members of trees scheduled to remain. Do not grade or strip vegetation off of the ground surface at areas inside tree protection fencing shown on the plans until the time of finish grading. Grading within those areas shall be accomplished with small equipment or by hand rather than large equipment.
- J. Contractor shall install barricades and/or temporary fencing during excavation and earthwork as required for public safety.
- K. Subsurface Investigations: A Geotechnical Engineering Report has been created for this project. Refer to Section 00 31 32 - Geotechnical Data for a full copy of this report. The Prime (General) Contractor shall thoroughly familiarize himself/herself with this report and adhere to its recommendations.

PART 2 PRODUCTS

2.01 GENERAL STRUCTURAL FILL COMPOSITION REQUIREMENTS

- A. All fill and backfill material under new building and paving areas, and within 5-feet of the edge of building and 2 feet of the edge of paving, shall be USCS Classification CL, clean, inorganic low plasticity cohesive materials with a liquid limit less than 45 and a plasticity index between 10 and 20 and approved by the Testing Laboratory. The excavated site soils will generally be suitable for reuse as structural fill, although some moisture conditioning may be required. Refer to the geotechnical report in Section 00 31 32 - Geotechnical Data for information regarding fill material, compaction and placement requirements.
- B. Granular Fill: The top 4-inches minimum of fill under slabs-on-grade, unless otherwise noted, and at other locations noted on the Drawings, shall be a granular material which is pervious, which will prevent capillary action, and which conforms to the following requirements:
 - 1. USGS Classification SP, SW, GW
 - 2. Well graded, crushed stone or crushed concrete, containing 100 percent passing the 1-inch sieve, less than about 40 percent passing the No. 40 sieve, and less than 5 percent passing the No. 200 sieve.
 - 3. The Testing Agency shall review gradations of proposed materials and perform necessary tests as may be required.
- C. Extensive additional depths of granular fill use in lieu of compacted earth will not be permitted. Granular fill may not be used as backfill around underground and underslab utilities.
- D. Granular Working Layer and Drainage Fill: See geotechnical report for all requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Completely remove stumps, roots, brush, etc., as noted in the geotechnical report and as specified in Section 31 10 00 - Site Clearing.

- B. Coordinate with the mechanical and electrical subcontractors to assure that they have notified the utility companies which have utilities that interfere with construction, and have arranged for their disconnection.

3.02 GENERAL EXCAVATION AND FILLING REQUIREMENTS

- A. General: Excavate to the lines and grades indicated on the Drawings and specified hereinafter. During construction, excavation shall be performed in a manner and sequence that will provide drainage at all times. All areas under and within 5-feet of building and 2-feet of paving areas which are disturbed shall also be inspected by the Testing Laboratory before the fill is placed.
- B. Fills and embankments shall be constructed at locations and to lines and grades indicated on the Drawings. Completed surfaces shall correspond to the shape of the typical sections shown on the Drawings, or shall meet the requirements of the particular case.
- C. Finished Excavations and Embankments: Uniformly smooth grading of all areas covered by the Project, including excavations, embankments and adjacent transition areas shall be accomplished. Finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. All swales shall be finished so as to drain readily. Construction debris shall not be present to any significant extent in the final finish grade. This latter requirement will be strictly enforced.
- D. Soils in the building areas, and within 20-feet of the building perimeter, shall be protected against moisture content increase throughout the construction period. Footing and utility excavations shall be exposed for as short a time as practical, and, if water enters the excavations, the softened soils shall be removed completely before footings and utilities are placed. All swales shall be kept a minimum of 20-feet away from exterior walls.
- E. All excavation work shall be completed in accord with OSHA Standards. All excavations shall have safe back-slopes or bracing. Where safe back-slopes cannot be provided, properly designed bracing shall be installed.

3.03 TRENCH EXCAVATION

- A. Trenches included in the building shall be carefully excavated, maintaining a minimum width and in no way impairing the bearing value of footings and foundations.

3.04 FOOTING EXCAVATION

- A. Cut excavations for footings vertically from the widest part of the footing. Undercutting for footing projections will not be permitted.
- B. Surface water shall not be allowed to stand in footing excavations, and all water shall be removed immediately. Soil that inadvertently becomes wet must be removed prior to the placement of footing construction. This is important because the existing on-site soils are of a type which tend to lose their bearing capacity if wetted.
- C. Pour footings immediately after excavation for footings is completed and inspected. The last 4-inches to 6-inches of subsoil shall not be removed until preparations are complete for pouring footings. Concrete for footings which bear on earth shall be placed on undisturbed soil and/or compacted fill. When footings are inadvertently over-excavated below elevations shown on the Drawings, the footings shall be filled to the proper level with concrete.

3.05 SLAB-ON-GRADE

- A. Granular fill for slab-on-grade shall be placed in uniform depths and compacted by vibratory hand-held compaction equipment or other approved means until complying with the compaction requirements for granular fill.

3.06 BACKFILLING

- A. Support walls laterally while the fill and backfill is placed and compacted against walls and until all permanent lateral support is in place.
- B. Place backfill for structures in horizontal uniform layers not to exceed 8-inches loose lifts. Bring each layer up uniformly on all sides of the structure and thoroughly compact using pneumatic

compaction or other methods as approved by the Geotechnical Engineer.

3.07 STRUCTURAL FILL COMPACTION REQUIREMENTS

- A. All fill and backfill shall be wetted or dried by aeration, and then compacted to the following percentage of maximum density, at a moisture content within the limits specified above or below optimum moisture content, as determined by testing Procedure ASTM D-698 (Standard Proctor), unless otherwise specified. These compaction requirements shall also apply to all utility trenches in the respective areas.

B.	Percent Above or Below	Percent of Optimum	
	Material	Maximum Density	Moisture Content
	(See detailed information in Geotechnical Engineering Report Section 00 31 32)		
1.	Structural Fill - Upper 8 inches below Pavements Structural Fill - All	98 percent minimum	-1 to +3 percent
2.	Other Locations	95 percent minimum	-1 to +3 percent

(All fill shall be placed and compacted as structural fill.)

3.08 GEOTECHNICAL OVERVIEW

- A. Construction Considerations: The floor slab Subgrade shall be rough graded and then proofrolled prior to fine grading and placement of base rock. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to backfilled trenches. Areas where unsuitable conditions are located shall be repaired by removing and replacing the affected material with properly compacted fill. All floor slab subgrades should be moisture conditioned and properly compacted to the recommendations in the Geotechnical Report immediately prior to placement of the aggregate base course and concrete. See Geotechnical Engineering Report in Section 00 31 32 - Geotechnical Data and follow all recommendations outlined therein.

3.09 QUALITY CONTROL

- A. Testing Laboratory: See Section 01 40 00 - Quality Requirements.
- B. Testing: Testing Laboratory will take the number of tests required to determine the specified compaction. Fill and backfill not meeting the required compaction, as determined by the Testing Laboratory, shall be removed, replaced, recompacted, and retested at the expense of the Contractor. All footing excavations shall be inspected before concrete is placed.
- C. Inspection: See references earlier in this Section and within the Geotechnical Engineering Report for specific inspections that the Geotechnical Engineer shall make.
- D. Unexpected Conditions: Notify the Testing Laboratory if conditions are uncovered which appear to be questionable as far as soil bearing capacity is concerned.

END OF SECTION

**SECTION 31 22 00
GRADING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rough grading the site for site structures.
- B. Topsoil and finish grading.

PART 2 PRODUCTS

- A. Topsoil: Hauled in or onsite excavated material.
 - 1. Graded.
 - 2. Free of roots, rocks larger than 1 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.
- B. Verify the absence of standing or ponding water.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.
- D. Protect plants and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

- A. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- B. Do not remove wet subsoil , unless it is subsequently processed to obtain optimum moisture content.
- C. When excavating through roots, perform work by hand and cut roots with sharp axe.
- D. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
- E. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

3.04 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 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 in areas indicated.
- F. Place topsoil where required to level finish grade.
- G. Place topsoil during dry weather.
- H. Remove roots, weeds, rocks, and foreign material while spreading.
- I. Near plants spread topsoil manually to prevent damage.

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- J. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- K. Lightly compact placed topsoil.
- L. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.05 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).

3.06 REPAIR AND RESTORATION

- A. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.07 CLEANING

- A. Remove unused stockpiled topsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

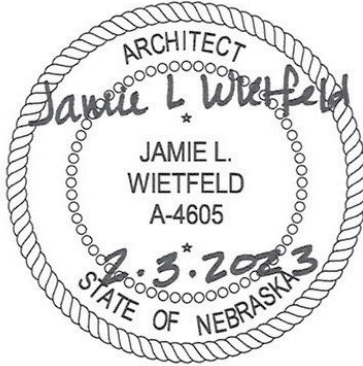
END OF SECTION

DIVISIONS 32 AND 33 – NOT USED



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landscape architecture
interior design
construction management



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End of Specifications

Omaha Public Power District Training Facility Phase 2

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Project Manual Combined Contract

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